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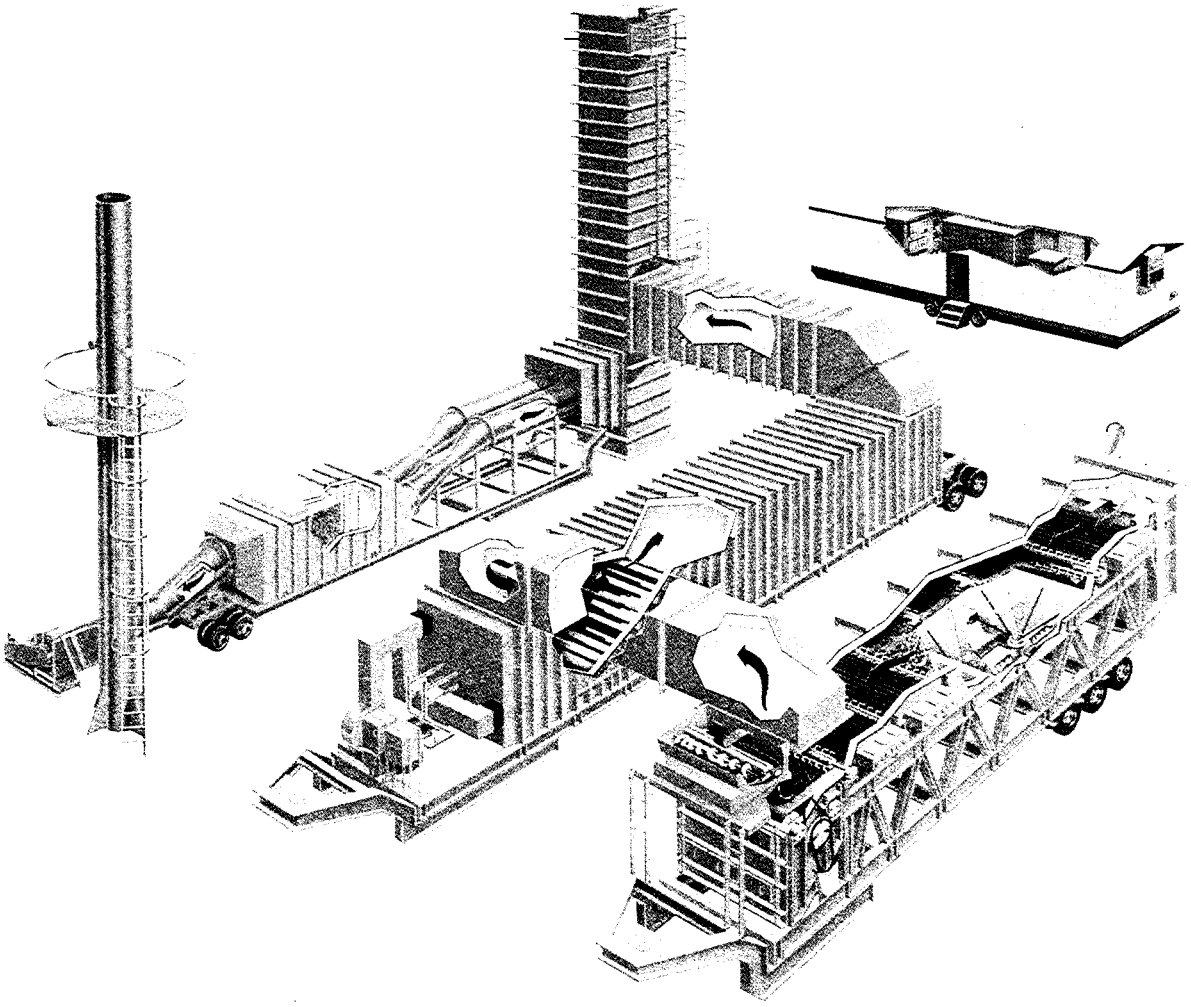
Canadian Council of Ministers of the Environment

Le Conseil canadien des ministres de l'environnement

Guidelines for Mobile Polychlorinated Biphenyl Destruction Systems

CCME-TS/WM-TRE011E
March 1990



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GUIDELINES FOR MOBILE POLYCHLORINATED BIPHENYL DESTRUCTION SYSTEMS

Canadian Council of Ministers of the Environment

CCME-TS/WM-TRE011
March 1990

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ABSTRACT

This report presents the Canadian Council of Ministers of the Environment (CCME) recommendations for the assessment, approval and operation of mobile system for the destruction of PCB wastes in Canada. These recommendations are procedures and controls that regulatory agencies and technology proponents should consider for the licensing and operation of mobile thermal destruction technologies for PCB wastes.

The recommendations contained herein are not enforceable by law as federal and provincial regulatory agencies have the legal authority and responsibility to develop regulations in their jurisdictions. However, it is important that there are consistent Canadian requirements. Accordingly, it is intended that the recommendations in this document should serve as a guide in attaining a consistent national policy for PCB disposal.

This document is intended to assist in the development of a uniform system of federal and provincial regulatory programs. Although provinces and municipalities may wish to adopt additional or more stringent requirements, these recommendations provide an adequate level of regulatory control for the well-managed destruction of PCBs in mobile systems.

RÉSUMÉ

Le présent rapport expose les recommandations du Conseil canadien des ministres de l'Environnement concernant l'évaluation, l'approbation et l'exploitation de systèmes mobiles de destruction des déchets contenant des BPC au Canada. Ces recommandations portent sur des méthodes et des contrôles dont les organismes de réglementation et les promoteurs des diverses techniques devraient tenir compte pour l'approbation et l'exploitation d'installations mobiles de destruction thermique des déchets contenant des BPC.

Les recommandations formulées ci-après ne sont pas exécutoires en droit étant donné que les organismes de réglementation fédéraux et provinciaux ont le pouvoir et la responsabilité d'établir des règlements dans leurs champs de compétence respectifs. Cependant, il importe que des exigences cohérentes s'appliquent dans tout le Canada. Les recommandations contenues dans le présent document devraient donc servir de guide en vue de l'établissement d'une politique nationale cohérente en matière d'élimination des BPC.

Le présent rapport est destiné à faciliter l'élaboration d'un système uniforme de programmes fédéraux et provinciaux de réglementation. Bien que les provinces et les municipalités puissent adopter des exigences additionnelles ou plus strictes, les recommandations qu'il contient devraient garantir un niveau adéquat de contrôle réglementaire pour une destruction bien gérée des liquides contenant des BPC dans des systèmes mobiles.

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GLOSSARY OF TERMS

Mobile PCB Destruction System	- mobile equipment that is capable of destroying PCBs by thermal means
PCBs (polychlorinated biphenyls)	- chlorobiphenyls (polychlorinated biphenyls) are defined in the federal Chlorobiphenyl Regulation No. 1 as those chlorobiphenyls that have the molecular formula $C_{12}H_{10-n}Cl_n$, where n is greater than 2. (Note: In Ontario, the definition includes all chlorobiphenyls, where n is greater than or equal to 1. All other provinces adhere to the federal definition)
2,3,7,8-substituted PCDDs	- any polychlorinated dibenzo-*p*-dioxin with the molecular formula $C_{12}H_{8-n}Cl_nO_2$, where n is from 4 to 8 and the chlorine atoms are located at the 2,3,7,8 positions on the molecule
2,3,7,8-substituted PCDFs	- any polychlorinated dibenzofuran with the molecular formula $C_{12}H_{8-n}Cl_nO$, where n is from 4 to 8 and chlorine atoms are located at the 2,3,7,8 positions on the molecule
2,3,7,8 TCDD Toxic Equivalents	- an abbreviated term for the sum of the 2,3,7,8,-substituted PCDDs and 2,3,7,8-substituted PCDFs when multiplied by the toxicity equivalent factors set out in Appendix V
PCB Solid	- any material or substance, such as containers, contaminated soils, shredded capacitors, that contains PCBs at a concentration greater than 50 milligrams per kilogram (50 ppm by weight) of the material or substance
PCB Liquid	- any liquid containing PCBs at a concentration of more than 50 milligrams per kilogram (50 ppm by weight) of the liquid (e.g., PCB fluids, PCB-contaminated mineral oil, aqueous suspensions, and contaminated solvents)
PCB Equipment	- any equipment including transformers, capacitators and other manufactured items that contains PCB liquids
PCB Waste	- PCB equipment, PCB liquid or PCB solid that contains more than 50 milligrams of PCBs per kilogram of waste (50 ppm by weight) for which the owner has no further use

Demonstration Test - a "test" or "trial burn" which is undertaken to demonstrate system performance that requires official approval

Combustion Efficiency (CE) - $$CE = \frac{(CO_2)}{(CO_2) + (CO)} \times 100$$

where: (CO_2) = concentration of carbon dioxide, and
(CO) = concentration of carbon monoxide

Destruction and Removal Efficiency (DRE) - the percentage of PCBs destroyed by the destruction process together with any removed from the gas stream by a control device, as expressed by the relationship:

$$DRE = \frac{W_{in} - W_{out}}{W_{in}} \times 100$$

where: W_{in} = mass feed rate of PCBs to the thermal destruction system, and

W_{out} = mass emission rate of PCBs in the flue gases, measured after a control device and prior to release to the atmosphere

Residence Time - residence time of gases in the destruction zone is calculated by dividing the applicable destruction zone volume by the volumetric flow rate of gases at the exit of the destruction zone (at actual pressure and temperature conditions)

Local Municipality - a city, town, village, or township

Lead Regulatory Agency - that government agency which is responsible for promulgating (and ensuring compliance with) emission standards, criteria and/or guidelines; in most instances, excepting federal lands, this is a provincial department of the environment

CCME - Canadian Council of Ministers of the Environment previously known as CCREM (Canadian Council of Resource and Environment Ministers)

Nm^3 (normal cubic metre) - the volume of dry exhaust gas in cubic metres referenced to normal conditions of 25°C and 101.3 kPa

EXECUTIVE SUMMARY

This report presents the Canadian Council of Ministers of the Environment (CCME) recommendations for the assessment, approval and operation of mobile systems* for the destruction of PCB wastes in Canada. These recommendations are procedures and controls that regulatory agencies and technology proponents should consider for the licensing and operation of mobile thermal destruction technologies for PCB wastes.

This document is intended to assist in the development of a uniform system of federal and provincial regulatory programs. Although provinces and municipalities may wish to adopt additional or more stringent requirements, these recommendations provide an adequate level of regulatory control for the well-managed destruction of PCBs in mobile systems.

An overview of the recommended regulatory approvals process for thermal PCB destruction systems is presented in Figure 1. The general approach is consistent with the regulatory approaches adopted by the U.S. Environment Protection Agency (U.S. EPA) and the Ontario Ministry of the Environment (MOE). The emphasis is on evaluating and approving technology. Specific approaches for selecting and approving sites must be stipulated by the provincial permitting agency in consultation with affected municipalities. Pertinent criteria to be considered for siting requirements are suggested.

The approval process shown in Figure 1 requires the systematic evaluation and verification of the ability of a technology to effectively destroy PCB wastes. This ability should be (or should have been) demonstrated by a demonstration test or "trial burn" conducted under carefully controlled and documented conditions. The trial burn should also establish specific operating limits for the system. These limits should then be strictly adhered to during all subsequent waste destruction operations. In addition, the destruction system should use continuous monitoring systems which will automatically shut it down if operating conditions are outside the limits.

The recommended regulatory approvals process requires the proponent to submit information to the permitting regulatory agency **prior to undertaking any tests or operations with PCB wastes.** This submission should include:

- a test plan which addresses all aspects of routine and emergency response activities;
- a description of all monitoring, analytical and assessment procedures to be used during tests and operations;
- a plan for comprehensive process/emission monitoring and evaluation throughout testing and operational activities;
- a plan for controlled disposal of all process residues; and
- a program to monitor the site before, during, and after tests and operations in order to detect any environmental contamination (and, if contamination occurs, to serve as a basis for remedial action).

The procedures and controls recommended in this report are considered necessary and appropriate to provide technical assurances that mobile PCB destruction processes will operate with minimum risk of environmental impact.

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* "mobile PCB destruction system" means mobile equipment that is capable of destroying PCBs by thermal means

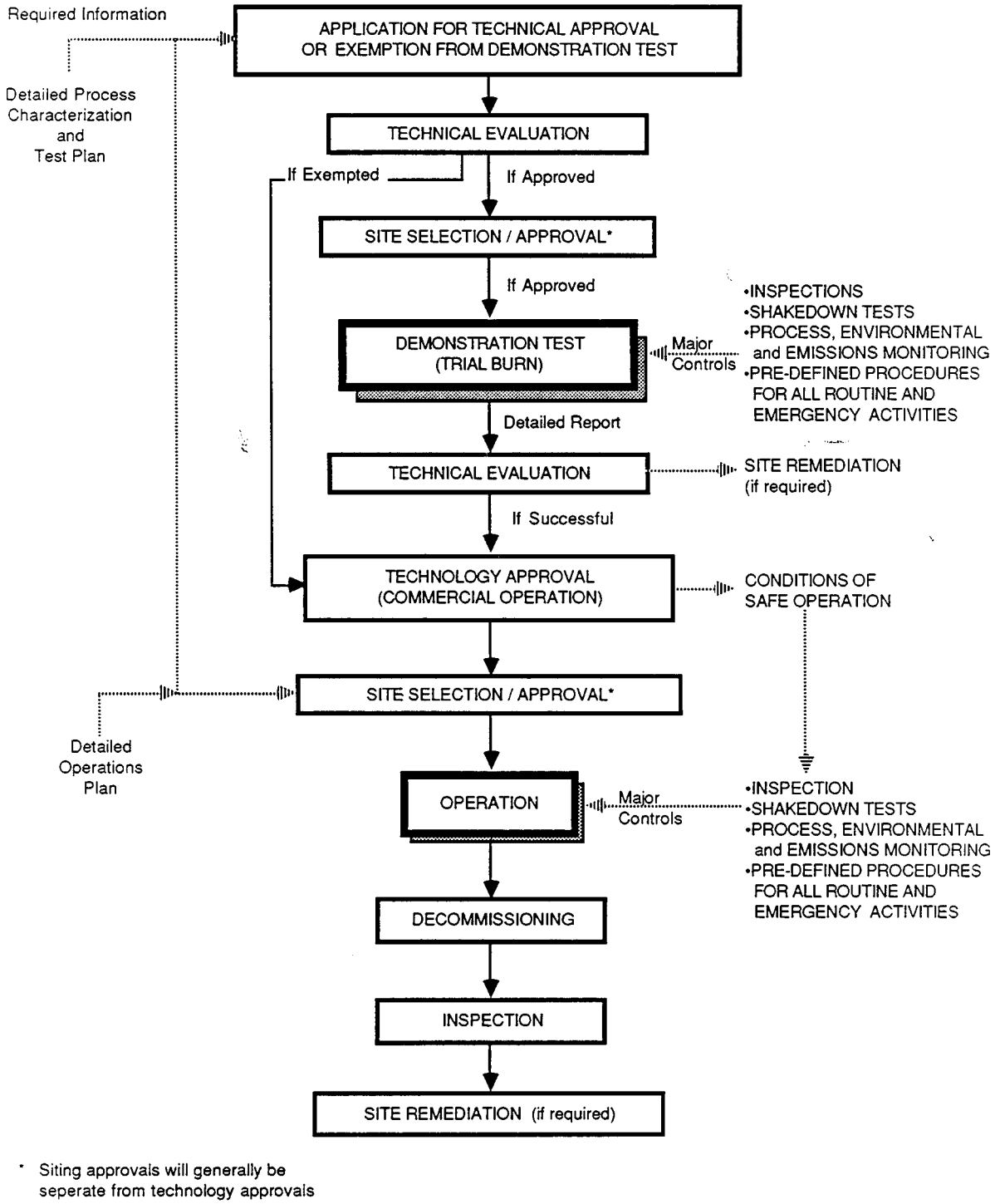

FIGURE 1 OVERVIEW OF THE RECOMMENDED APPROVALS PROCESS FOR MOBILE PCB DESTRUCTION SYSTEMS

1 INTRODUCTION

1.1 Purpose

This report is one in a series dealing with the treatment, destruction, and management of polychlorinated biphenyl (PCB) wastes in Canada. The purpose of this report is to recommend appropriate procedures with respect to the application, siting, and operational requirements for mobile PCB destruction systems in Canada. The technologies addressed include incineration and other high temperature thermal destruction processes.

The recommendations contained herein are not enforceable by law as federal and provincial regulatory agencies have the legal authority and responsibility to develop regulations in their jurisdictions. However, it is important that there are consistent Canadian requirements. Accordingly, it is intended that the recommendations in this document should serve as a guide in attaining a consistent national policy for PCB disposal. These recommendations should be useful to:

- **proponents** seeking federal and provincial government approval to operate PCB destruction facilities, by:
  - delineating the most important application requirements and the scope of evaluation processes, and
  - recommending the essential criteria that should be met in order to operate on a commercial basis;
- **regulators** of waste management practices, by:
  - outlining recommended procedures and criteria that can be used to evaluate data provided in proponent applications for approval,
  - identifying criteria for monitoring the performance of operating facilities, and
  - providing a reference framework which may be used in the drafting of provincial regulations;
- other **interested parties and public,** by:
  - identifying procedures to assure that a consistent policy will be applied in the approvals process and PCB destruction programs.

The primary focus of this report is to describe or recommend protocols for each step of the PCB waste management process for generic mobile technologies that can be applied immediately and/or are most promising for use in Canada. Specific technologies are discussed in an Environment Canada report(1) and a brief summary of

available technologies and their current status is provided in Appendix 1. The generic technologies addressed in this report include high temperature incineration (e.g., rotary kiln, liquid injection) and other thermal degradation techniques (e.g., pyrolysis, thermal radiation, and plasma arc) that are intended to be used to destroy PCB-containing wastes of both high and low concentration.

Information from various reports and documents has been consolidated in preparation of this report. However, in order to maintain consistency, information was mainly derived from reports or publications by Environment Canada[1,2], Canadian Council of Ministers of the Environment [3], Ontario Ministry of the Environment[4-7], and the United States Environmental Protection Agency[8,9]. A report of the same scope has been prepared which is applicable to non-thermal technologies (e.g., chemical dechlorination systems for testing PCB-contaminated oils)[10].

1.2 Appropriate Controls for Mobile Thermal PCB Destruction Systems

Table 1 presents a summary of operating characteristics and PCB management concerns for the application of mobile thermal destruction technologies to PCB wastes using rotary kiln incineration as an example. These characteristics are typical of most thermal technologies and affect the scope of regulatory controls for environmental protection.

Controls for activities involved in the thermal destruction of PCBs can be divided into two levels of sophistication. The simpler level involves material handling activities which can be suitably controlled with planning, procedures and equipment which are relatively straightforward and commonly used in industries dealing with any toxic chemicals. Examples of such controls include:

- providing proper education and training for all personnel who work with or near PCBs;
- providing safe physical packaging and containment of PCBs during all activities peripheral to the destruction process (handling, transportation, and storage); and
- ensuring safe working practices and measures for the protection of personnel who work with or near PCBs.

In contrast, a much higher level of sophistication must be applied to controls required to prevent any widespread release of PCBs or polychlorinated dibenzo-*p*-dioxins (PCDDs) and polychlorinated dibenzofurans (PCDFs). This report devotes special attention to procedures for the control of air emissions from thermal PCB destruction processes, including:

TABLE 1 SUMMARY OF TYPICAL INCINERATOR OPERATIONAL CHARACTERISTICS AND REGULATORY REQUIREMENTS

Technology Type	commercial mobile rotary kiln incinerator
Principal Application	thermal destruction of hazardous wastes, including PCBs
Applicable Waste Characteristics	
Types -	liquids, solids, sludges, soils, capacitors
Concentration -	high- and low-level for all waste types
Duration of Operation at Each Site	weeks to months
Siting Flexibility	flexible
Waste Volume Treatable per Site	in the order of thousands of metric tons
Principal Process Emissions	air emissions, scrubber solutions and solid residues (ash, slag)
Regulatory Requirements	
Air Emissions	to limit atmospheric emissions of unburned PCBs or toxic combustion by-products
Spent Scrubber Solutions and Solid Residues	to ensure that the concentration of PCBs and toxic constituents in residues are acceptable for off-site disposal

- the adoption of a strict performance standard to ensure a high degree of PCB destruction without the generation of toxic combustion by-products;
- detailed technical scrutiny of the process by regulatory agencies before and during operation to ensure that the performance standard is achieved; and
- specifying limits for contaminants in air emissions, scrubber solutions and solid residues and recommending monitoring requirements to ensure compliance with emission limits.

The requirements recommended in this report apply to the procedures and controls that federal and provincial regulatory agencies and proponents should consider in regulating the destruction of PCB wastes. Subsequent sections of this report contain information on the current status of federal and provincial PCB regulations and the recommended national emission criteria which are adequate environmental performance requirements that PCB destruction facilities should achieve. Recommendations are directed toward all major aspects of PCB destruction from technology and site application

considerations, through operational, monitoring and other activities, to facility decommissioning. Overall, the approval process suggested in this report is intended to assure that controls are implemented in a thorough and systematic fashion.

2 SYNOPSIS OF PERTINENT PCB REGULATIONS IN CANADA

2.1 Status of Regulations

Proponents or customers of PCB destruction facilities should be aware of the many acts and regulations which currently govern not only PCB destruction but also the handling, storage, transportation, cleanup, and reporting aspects of PCB waste management. Polychlorinated biphenyls are environmental contaminants and, as such, their regulation and control is considerably more detailed and demanding than most other pollutants.

Federal regulations under the *Canadian Environmental Protection Act* address limitations with respect to PCB use[11], import or sale of PCB equipment[12] and release of PCBs to the environment during commercial, manufacturing, or processing activities[13]. The Interim Order on the Storage of PCB Wastes was issued in 1988 and should be followed by a regulation in 1990[18]. This Order stipulates controls on the proper storage of these wastes. In January 1990, the Federal Mobile PCB Treatment and Destruction Regulations[19] were issued which limit gaseous, liquid, and solid emissions from these facilities operating at federal facilities. A summary of these regulations along with provincial regulatory status is included in an Environment Canada report[2] which presents recommended practices for the management of PCB wastes. Similarly, provincial PCB regulations that are in place or being developed, and those of other countries, are summarized in a report prepared for CCREM[3].

Specific PCB regulations applicable to mobile facilities have been prepared in Ontario[4-7] which specify requirements for that jurisdiction. A summarized flow diagram of the essential features of the Ontario approvals process is provided in Appendix II. Nevertheless, applicable federal, provincial, and municipal regulations must be adhered to, and the appropriate enforcement agencies must be contacted for complete information regarding requirements which may affect the siting and operation of mobile PCB facilities. Relevant provincial PCB incineration performance and emission criteria[3,6] are presented in Table 2.

2.2 Performance Criteria

Existing and proposed regulations controlling the incineration of PCB wastes are primarily performance based. Additional conditions limit the quantities of contaminants in process discharge streams that could affect the environment.

TABLE 2 SUMMARY OF PCB INCINERATION PERFORMANCE, EMISSION, AND ENVIRONMENTAL CRITERIA*

Performance Criteria

Ontario	- destruction and removal efficiency - 99.9999%
Quebec	- combustion efficiency - 99.9% - destruction and removal efficiency - 99.9999% - combustion conditions - minimum temperature of 1250°C for a gas-phase residence time of 2.5 seconds and minimum 3% excess O_2
Alberta	- destruction and removal efficiency - 99.9999% - control system - flue-gas scrubber and electrostatic precipitators or equivalent
British Columbia	- destruction and removal efficiency - 99.9999%
Federal Facilities	- destruction and removal efficiency - 99.9999% - combustion conditions - minimum temperature of 1200°C for a gas-phase residence time of 2 seconds and minimum 3% excess O_2 with average carbon monoxide of 57 mg/Nm^3

Emission Criteria

Ontario	- Liquids	- liquid effluents with up to 5 µg/L PCBs (5 ppb) may be discharged without treatment; - liquid effluents or wastewaters containing tetrachlorinated or octachlorinated dibenzodioxins or tetrachlorinated to octachlorinated dibenzofurans must not be discharged, directly or indirectly, into water unless the concentration is $\leq$0.25 ng/L for each congener group of these chemicals based on a one litre sample size.
	- Solids	- solid residues with $\leq$ 50 mg/kg PCBs are to be disposed of in a properly certified waste disposal site
Quebec	- Air	- flue-gas concentrations limited to the following at 50% excess air on a dry basis: 50 mg/Nm^3 particulate matter 75 mg/Nm^3 HCl
	- Residues	- residues from hazardous waste incineration systems are considered to be hazardous wastes
Alberta	- Air	- flue-gas concentrations are limited to the following at 50% excess air on a dry basis: 70 mg/Nm^3 - particulate matter 150 mg/Nm^3 - HCl 140 mg/Nm^3 - CO
	- Solids	- solid residues may be discharged as a non-hazardous waste in an industrial landfill if they contain less than: 50 ppm PCBs
British Columbia		
	- Air	- flue gas concentrations are limited to the following at 12% CO_2 on a dry basis: 50 mg/Nm^3 particulate matter 70 mg/Nm^3 HCl
Federal Facilities		
	- Air	- flue gas concentrations are limited to the following at 11% CO_2 on a dry basis: 50 mg/Nm^3 particulate matter 75 mg/Nm^3 HCl 12 ng/Nm^3 2,3,7,8-TCDD toxic equivalents
	- Water	5 µg/L PCBs 0.6 ng/L 2,3,7,8-TCDD toxic equivalents
	- Solids	0.5 mg/kg PCBs 1 µg/kg 2,3,7,8-TCDD toxic equivalents

Environmental Criteria

Ontario	- Air	- pertinent maximum 1/2 hour average point of impingement standards are: 0.45 µg/m^3 PCBs 0.00045 µg/m^3 PCDDs and PCDFs (total) 100 µg/m^3 HCl 100 µg/m^3 particulate matter 6000 µg/m^3 CO
Quebec	- Water	1 ng PCBs/L (0.001 ppb)
	- Water	1 ng PCBs/L (0.001 ppb) (100 ng/L recreational)
Manitoba	- Water	2 ng PCBs/L (0.002 ppb)

CCME		Averaging Period	PCB Concentration (ng/m^3)
	- Air	annual	35
		24 hour	150
		0.5 hour	450
	- Water	1 ng PCBs/L (0.001 ppb)	
	- Soil	Agricultural ---------- 0.5	mg/kg
		Residential ---------- 5	mg/kg
		Industrial ---------- 50	mg/kg

* see References 3 and 6 for further discussion on the status of regulations and criteria development

The principal method of regulating PCB incineration performance in the United States [3,8,9] is the stipulation of minimum combustion efficiencies, combustion chamber operating temperatures and minimum destruction and removal efficiencies. The minimum combustion efficiency that must be achieved by incinerators is 99.9%. Combustion criteria stipulated in the U.S. specify maintenance of the introduced liquids for a 2-second dwell (residence) time at 1200°C (±100°C) and 3% excess oxygen in the stack gases, or maintenance of the introduced liquids for a 1.5-second dwell time at 1600°C (±100°C) and 2% excess oxygen in the stack gases. Polychlorinated biphenyl waste feed-rates to the incinerator must be stopped if these combustion criteria are not met; other provisions such as monitoring requirements are also stipulated. No specific stack gas emission limit was set in U.S. regulations for incineration of PCB liquids, although a limit of 1 mg PCBs emitted per kg PCB feed, equivalent to 99.9999% destruction and removal efficiency (DRE) was set for non-liquid PCB substances. However, it is implicit that such combustion criteria are intended to ensure a destruction and removal efficiency of not less than 99.9999% when liquid PCBs are incinerated[14]. Commercial-scale hazardous waste incineration data have led to the conclusion that available incinerators are capable of achieving the required level of performance specified in U.S. regulations[1].

As identified by Chandler et al.,[3] and shown in Table 2, specific emission and environmental criteria in Canada vary according to the federal and provincial regulatory agency. Where PCB regulations exist or are proposed, however, a minimum PCB destruction and removal efficiency of 99.9999% is a standard incinerator performance criterion for both solid and liquid PCB feed.

2.3 Emission Standards

Emission standards regulate the disposal of solid and liquid residues and gaseous emissions from a process. Gaseous emissions may contain trace amounts of unburned organics, hydrogen chloride from the combustion of the chlorinated organic waste, multi-component particulate matter if sludges or solids are burned, products of incomplete combustion (PICs), and other trace constituents. For incinerators, the principal aqueous emission is normally the flue-gas scrubber effluent, which would contain contaminants removed from the flue-gas of the combustion chamber. Solid emissions will be slag and ash from the kiln and ash from the flue-gas particulate control equipment. Flue-gas ash will be dry if removed by a dry control device such as an electrostatic precipitator or a wet slurry if removed by a wet control device such as a venturi scrubber.

If these emission streams contain contaminants above specified levels (see Table 2) they will require further treatment before disposal. Effluent dilution should not be approved as a means of meeting allowable discharge levels.

In some jurisdictions, assessment of the resulting effect of process emissions on the environment also may be required. For process air emissions, this involves calculating maximum one-half-hour average ground-level point-of-impingement concentrations of the contaminants, which are then compared point-of-impingement standards for the given contaminants.

3 TECHNICAL REQUIREMENTS FOR MOBILE PCB DESTRUCTION

The principal purpose of technical requirements is to limit the release of PCBs and other compounds from the destruction process. This is accomplished by careful control of the operation. The primary process control mechanism, during **all** demonstration or commercial operations, is the maintenance of key operating parameters within predetermined ranges which will ensure the required high level of destruction of PCB wastes. In concert with this performance standard, limitations on the releases of PCBs and toxic combustion by-products to the environment are regulated by restricting the allowable concentrations of these compounds in the process residues.

The regulatory requirements for mobile PCB destruction systems and/or limitations on pollutant emissions (e.g., PCBs, chlorobenzenes, HCl, particulate matter and products of incomplete combustion) will be determined by the lead regulatory agency. Federal performance/emission criteria for mobile PCB waste destruction systems are shown in Figure 2. These minimum requirements include:

- **A performance standard of 99.9999% DRE (Destruction and Removal Efficiency) for PCBs.** This means that 99.9999% of the PCBs introduced to the process will be destroyed or removed from the gaseous emissions of the system. This is equivalent to limiting emissions of PCBs in the exhaust gases to 1 mg of total PCBs emitted/kg of PCBs in the waste feed stream.
- **Residence time of two seconds at 1200°C and a minimum of 3% oxygen.** These combustion conditions provide adequate time, temperature, and oxygen to ensure good combustion of the flue gases generated by the incineration process. The temperature and oxygen concentrations are measured at a point downstream from the after burner representing a flue gas travelling time of two seconds, at rated incinerator operating capacity.
- **Average concentration of carbon monoxide of 57 mg/Nm^3 (50 ppmdv).** Low levels of carbon monoxide are an indication of good combustion. The level recommended is an operating target to achieve good combustion and low trace organic emissions.
- **Concentration limitations for PCBs in wastewater (5 µg/L) and solid residues (0.5 mg/kg) from the treatment process.** Residues with PCB concentrations exceeding these limits should not be discharged from the site. Additional treatment or handling as a special or hazardous waste would be required.
- **Concentration limitations for PCDDs and PCDFs given in 2,3,7,8 TCDD Toxic Equivalents.** 2,3,7,8-TCDD toxic equivalents represents the sum of the 2,3,7,8-substituted PCDDs and 2,3,7,8-substituted PCDFs when multiplied by toxicity equivalent factors (Appendix V). Liquid and solid residues containing concentrations greater than those specified for 2,3,7,8-TCDD toxic equivalents, should be reprocessed to reduce these contaminants below the specified levels.

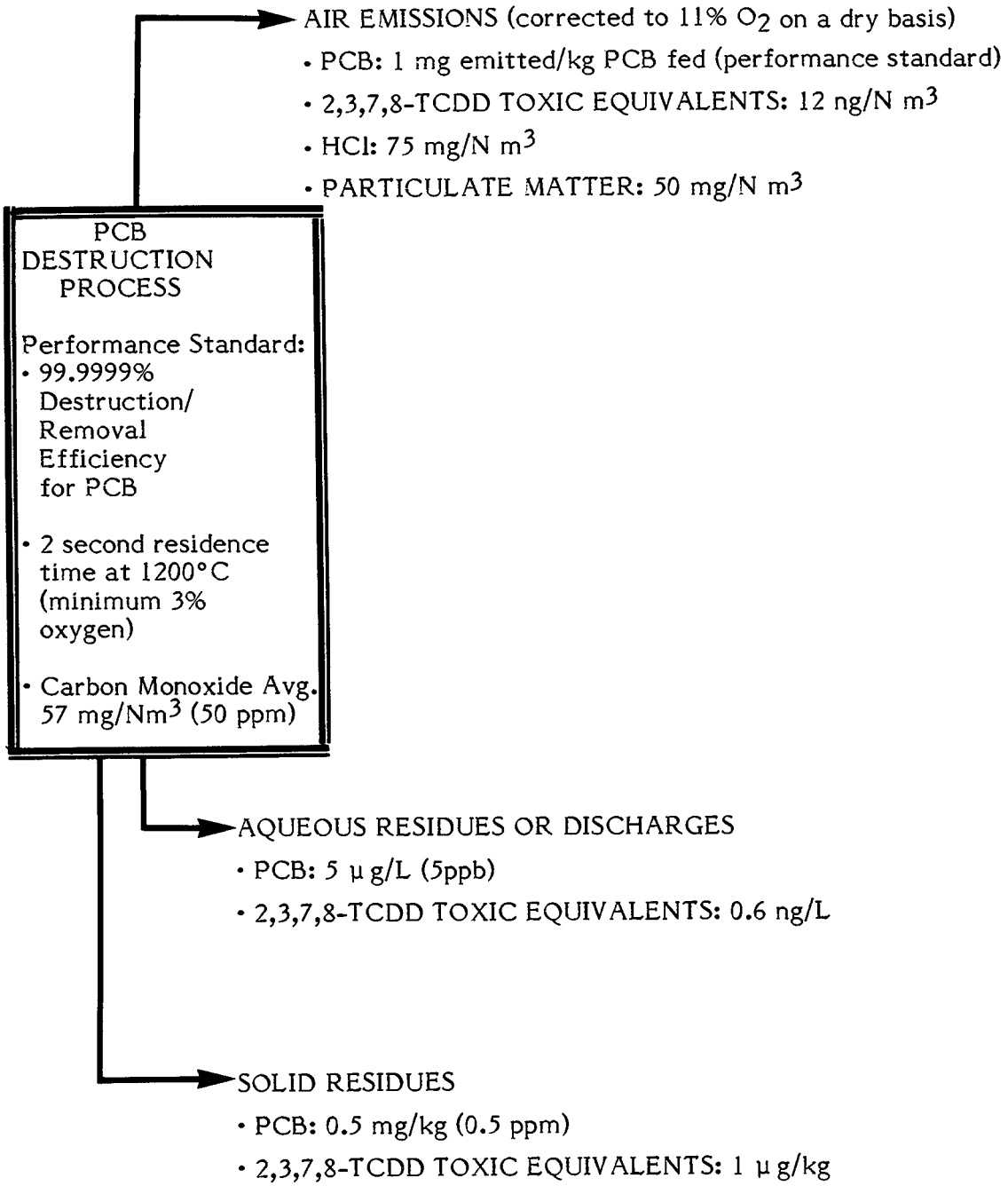

FIGURE 2 FEDERAL PERFORMANCE/EMISSION CRITERIA FOR MOBILE, PCB DESTRUCTION SYSTEMS

These are recommended adequate environmental requirements; therefore, concentrations of these compounds in emissions or discharges should not exceed these or other specific provincial limits (whichever is more stringent).

The performance standard for PCB destruction is maintained through continuous monitoring and control of key process parameters. If process conditions vary to the extent of causing airborne release of regulated contaminants in levels greater than those defined by the performance standards, mandatory automatic process control systems should interrupt the waste feed or shut down the process.

The concentration limitations on PCBs, PCDDs and PCDFs in the process residues assure control of releases of these contaminants to the environment. Extensive monitoring of process emissions is required to verify that emissions are in compliance with these limitations.

Additional technical requirements for site activities are primarily directed at ensuring the responsible management of PCB wastes in the various handling and storage activities which support the operation of the destruction facility. These requirements include recommended procedures for the design and operation of the facility in order to provide effective overall control of PCB materials and to minimize exposure to operators, to prevent spills or releases to the environment, to contain and effectively recover any accidental releases, and to prevent fire or explosive release of PCBs or combustion by-products. It is recommended that approval for the operation of a facility by contingent on verification that the proponent will comply with these requirements.

4 RECOMMENDED PERMITTING PROCEDURES AND REQUIREMENTS

Authorization to operate a PCB destruction facility in Canada is a provincial responsibility except for federal activities, and the regulatory framework to authorize operations can be expected to be province-specific. Information on specific jurisdictional requirements or the submission of applications to initiate the approval process should be directed to the appropriate provincial regulatory agency (Table 3).

The types of activities that typically require permits are full-scale operations, demonstration tests and research tests (Appendix III). In accordance with existing provincial regulations, it is recommended that technology permits be separate from facility siting permits.

4.1 Permit Applications

The basic information required in permit applications may vary among jurisdictions and will depend, in part, on the type of technology and the extent of operating experience. An example of a recommended permit application format and content for technology approval for a PCB destruction facility is provided in Appendix III. A summary of these recommended requirements is shown in Table 4.

It is recommended that a formal data quality assurance plan be required and submitted with the application. This plan is the mechanism by which the proponent should designate the specific procedures which will ensure that the precision, accuracy, completeness and representativeness of the data collected during any testing and/or operation are of sufficient quality to meet the requirements of the approval agency(ies). It should address items such as: process operating measurements, monitoring, inspection schedules, report and record-keeping activities. Approval of the plan would be a prerequisite for undertaking tests or routine operation of a mobile PCB destruction system.

4.2 Facility Siting and Scheduling

It is recommended that a definite operating period at a given site be specified as a condition for approval. This period should be determined by site-specific conditions, any jurisdictional stipulations and other factors. The objective of this time constraint is to ensure that mobile facilities do not establish permanently in any one municipality, thereby minimizing the risks associated with the transportation of PCB wastes to the site.

TABLE 3 REGULATORY AGENCIES

Province	Authorizing Agency	Authorizing Branch	Address	Telephone
Northwest Territories	Government of the Northwest Territories, Dept. of Renewable Resources	Pollution Control Division	P.O. Box 1320 Yellowknife, NWT X1A 2L9	(403) 873-7654
Yukon	Dept. of Community and Transportation Services	Community Services	P.O. Box 2703 Whitehorse, Yukon Y1A 2C6	(403) 667-3032
British Columbia	Ministry of the Environment	Waste Management Branch	810 Blanshard St. Victoria, B.C. V8V 1X5	(604) 387-1161
Alberta	Alberta Environment	Environmental Protection Service Standards and Approvals Division Industrial Waste Branch	9820-106 Street Edmonton, Alta. T5K 2J6	(403) 427-5838
Saskatchewan	Saskatchewan Environment and Public Safety	Air and Land Protection Branch Waste Management Section	Walter Scott Bldg. 3085 Albert St. Regina, Sask S4S 0B1	(306) 787-6191
Manitoba	Manitoba Environment and Workplace Safety and Health	Environmental Management Services	Building 2 139 Tuxedo Ave. Winnipeg, Man. R3N 0H6	(204) 945-7094
Ontario	Ministry of the Environment	Waste Management Branch,	40 St. Clair Ave. W. Toronto, Ontario M4V 1P5	(416) 323-5151
Quebec	Ministère de l'Environnement	Direction des substances dangereuses	3900 rue Marly Ste-Foy, P.Q. G1X 4E4	(418) 643-3794
New Brunswick	Municipal Affairs and Environment	Environmental Protection Branch Toxic Substances Section	364 Argyle Place P.O. Box 6000 Fredericton, N.B. E3B 5H1	(506) 453-2861
Nova Scotia	Nova Scotia Dept. of the Environment	Field Services	5151 Terminal Rd. 5th Floor P.O. Box 2107 Halifax, N.S. B3J 3B7	(902) 424-5300
Prince Edward Island	Dept. of the Environment	Environmental Management Division	Jones Bldg. 11 Kent St. P.O. Box 2000 Charlottetown, PEI C1A 7N8	(902) 368-5320
Newfoundland	Dept. of Environment and Lands	Environmental Investigations Branch	Confederation Bldg. West Block, 4th Floor P.O. Box 8700 St. John's, Nfld. A1B 4J6	(709) 576-2559
Federal Facilities	Federal Dept. of the Environment	Industrial Programs Branch	Place Vincent Massey 351 St. Joseph Blvd. Hull, Quebec K1A 0H3	(819) 953-1119

TABLE 4 SUMMARY OF RECOMMENDED CONTENT FOR A TECHNOLOGY PERMIT APPLICATION

To Address	Specific Information
Technology Description	- including process design and emission controls
PCB Feed	- waste types and concentrations to be destroyed with description of storage handling, and automated shutdown systems
Process Controls	- control features and performance monitoring procedures
Expected Emissions	- identify expected air emissions and process discharges with monitoring procedures
Quality Assurance Plan	- procedures to validate data
Inspection	- procedures for inspection and record keeping
Emergency Plan	- spill prevention and safety measures with emergency contingency plans
Operational Plan	- including startup, shutdown and site closure
Waste Disposal	- identify solid/liquid waste disposal procedures
Performance Data	- data to verify successful PCB destruction and adherence to existing regulations
Organization	- delineate staff functions, training, and responsibilities

Note: see also Appendix III

Proponent applications for siting facilities (see Section 5) should include the following types of information:

- other certificates of approval (e.g., other site operations);
- the location and characteristics of the proposed site and information to indicate how it satisfies available jurisdictional site selection criteria;
- if required by jurisdictional regulations (Ontario Regulation 308, for example), the calculation of ground level point-of-impingement pollutant concentrations that could result from gaseous emission from the system; and
- a proposed operating schedule which specifies activities from initial site preparation to final closure of the facility including the proposed frequency of operations at any site within the same municipality.

4.3 Liability Coverage

A large liability could be incurred from an accidental discharge, spill, or fire, that would require cleanup. The proponent's application for approvals should describe the type and amount of insurance coverage or other compensatory means for such accidents.

In addition, prior to testing or operating at each candidate site, it is recommended that a proponent be required to provide a monetary assurance to the regulatory agency (e.g., posting of bond or other asset in an amount defined by the regulator) to ensure that adequate funds are available for site restoration. It is regarded as a requirement in addition to insurance needs. Claims on this monetary assurance would be relinquished after it has been determined by regulator inspection that no site restoration is required.

4.4 Permit Evaluation and Approval

It can be expected that permit applications for operating PCB destruction facilities will be closely scrutinized and reviewed. It is the regulator's responsibility to develop criteria for evaluating the completeness and quality of the proponent's application. Using these criteria, the regulator may:

- approve or refuse approval of the facility to operate without further testing;
- require submission of additional information; or
- require demonstration tests to be performed according to the regulator's stipulations.

Destruction facilities that meet specified regulations and criteria should then receive technology approval which permits the facility to operate at any location within the province after site approval has been granted. In determining site approval, the regulator may solicit public comment, which will need to be addressed in considering the application. Upon satisfying siting requirements, operations should be permitted to commence in accordance with specified conditions and procedures as recommended in subsequent sections of this report and/or stipulated by provincial regulatory agencies.

4.5 Need for Demonstration Testing and Test Plan Submission

4.5.1 Test Need. In reviewing permit applications, regulators must decide whether or not a process demonstration (i.e., trial burn) is required. This decision is based upon the degree to which the technology has been developed or used, operating experience in other jurisdictions, and the extent of environmental risk pertaining to the type of technology. In order for regulators to support an application for facility approval without

further testing, the applicant must satisfy the regulator that all operational and environmental standards, criteria, or guidelines within the jurisdiction can be consistently met.

4.5.2 Test Plan. Should a process demonstration be required, the proponent should submit a test plan to the lead regulatory agency in order to receive a permit that allows operation on a limited amount of PCB-containing waste. The objective of the demonstration test is to establish process parameters and characterize emissions by comprehensive monitoring in order to demonstrate that the required destruction efficiency can be achieved by the facility for a given PCB waste feed rate and composition.

A summary of the basic recommended technical content of the demonstration test plan and other discussion pertinent to tests are included in Appendix IV. In conjunction with facility information provided in applications, the test-specific plan should contain: the test strategy and operating parameter ranges to be tested, detailed monitoring (sampling/analysis) plans, a detailed activity schedule and characteristics of the proposed test location.

4.5.3 Approval. After critical review and approval of the demonstration test plan, a permit for conducting the test should be issued. The demonstration test should be performed in accordance with the requirements outlined in this report, and any other jurisdictional requirements, and witnessed by the lead regulatory agency. Following the trial burns, a test report should be submitted to the lead regulatory agency.

Upon acceptance of the process demonstration test report and a determination that the process has met all the pertinent requirements and conditions of the demonstration test permit, the regulator should issue final approval for commercial operation of the technology. The proponent then requires site approval to conduct further operations.

5 SITE SELECTION

Criteria that should be considered in evaluating and selecting sites for commercial operation of mobile PCB destruction facilities, or for conducting demonstration tests and/or research and development tests are outlined in this section. Although ideally all criteria should be considered, it may be impractical to attempt to select a site which meets all of the criteria. Site selection, therefore, must be regarded as a tradeoff between attempting to meet ideal site criteria and providing mitigative measures to compensate for those siting criteria which are not fully met. Specific approaches and criteria for selecting and approving sites should be stipulated by the lead regulatory agency in consultation with affected communities.

5.1 Siting Criteria

5.1.1 Separation from Receptors. The purpose of providing a separation distance or buffer zone between destruction facilities and sensitive receptors (e.g., occupied buildings and other establishments) is to provide an added level of protection in case of accidents. Various jurisdictions have specified minimum separation distances and should be contacted regarding the actual distances to be considered in siting. For example, a 250-m separation distance of mobile thermal PCB destruction facilities from sensitive receptors is required in Ontario(6).

5.1.2 Land Use. The mobile destruction facility site should be compatible with surrounding land use (e.g., zoned industrial). For example, existing industrial sites, sewage treatment or municipal refuse disposal areas may, in some cases, satisfy these siting criteria and should be preferentially considered for both demonstration testing and operation.

5.1.3 Separation from Surface Waters. To provide a second level of control for spill prevention and containment measures, minimum separation distances from surface waters should be maintained. Every effort should be made to meet this criterion. Actual specified separation requirements should be ascertained from local regulatory officials. For example, a 100-m minimum separation of facilities and associated waste storage areas from watercourses is regulated in Ontario(6).

5.1.4 Surface Geology and Groundwater. The surficial geology of the site should be such that groundwater migration of spills or leaks will not occur. This criterion for

relatively impermeable surface geology is to provide a level of protection additional to normal spill containment and prevention measures.

5.1.5 Proximity to Wastes. Mobile PCB destruction units should be located within reasonable access to the wastes to be destroyed. This is an important consideration in siting mobile units. As the site becomes further removed from the source of wastes, the risks, costs, and logistics of waste transportation may increase to the point that advantages of adopting mobile technologies are defeated.

5.1.6 Site Services and Access. The site should have suitable provisions for services such as power, water, space for the units, waste storage and treated liquid effluent containment or discharge. Adequate road access for the mobile destruction unit is a requirement. For example, some components of mobile units are transported on 14-m trailers which require minimum clearances for units. Sufficient load-bearing capacities on roads also should be available.

5.1.7 Topography and Size. The site should be level with suitable foundation and surface area for the destruction units, support equipment and waste storage area. Appropriate access should exist for proper implementation of spill cleanup procedures (if required).

5.2 Operator and Regulatory Agency Responsibilities

The selection of the site is the responsibility of the proponent or operator of the destruction unit. In site applications, the operator should address and consider the previously mentioned criteria in the site evaluation and selection process. It is the joint responsibility of the operator and the lead regulatory agency to decide on the specifics of siting requirements, such as separation distances.

One agency in each province should act as the lead agency for all government requirements and permitting (see Table 3). The lead agency should provide a list of all agencies imposing requirements with contact names and addresses. On the other hand, actual site authorization can be expected to be granted, where appropriate, by provincial regional officers in co-operation with local municipal officials (e.g., municipality clerk, medical officer, fire official).

Public notification of preferred sites should be required by the lead regulatory agency. It is recommended that solicitation of public comment should be the responsibility of the lead regulatory agency or designee. This may be in the form of public notices and/or hearings within each affected municipality. The mechanism should

be stipulated by the lead regulatory agency. Both the proponent and regulator should be prepared to address public concerns with respect to the site selection and/or the application of the technology, and to ensure that the public is accurately informed of the reasons for the selection of the site.

6 OPERATING REQUIREMENTS AND PROCEDURES

The objective of the following requirements is to prevent releases of PCBs and associated contaminants to the site of the thermal destruction process and surrounding environment. These requirements apply to both demonstration testing and subsequent operations unless specifically noted.

6.1 Facility Startup

6.1.1 Approvals. The startup of **any** PCB destruction facility should require prior formal approval from the lead regulatory agency. It is recommended that the procedures and controls for the preparation and operation of such facilities as outlined in this report be adopted as minimum requirements. These minimum requirements include the prior approval of all plans submitted in technology and site applications.

6.1.2 Inspection and Startup Procedures. Prior to startup, the lead regulatory agency should inspect the facility to verify its ability to operate in compliance with all regulatory requirements.

The proponent should be required to follow a written startup procedure which has been reviewed and approved by the lead regulatory agency. Startup procedures should include:

1. **A Monitoring System Check:** Prior to startup and/or the introduction of waste feed to the process, the proponent should demonstrate the proper functioning and calibration of all monitoring instruments. This should be carried out in accordance with the Data Quality Assurance (DQA) Plan.

2. **An Operating Systems Check:** The maintenance of operating parameters, within the allowable ranges specified as conditions of approval, should be demonstrated by operating the destruction system on clean, supplementary fuel for a specified test period prior to feeding wastes.

3. **An Automatic Shutdown System Check:** The proper function of automatic shutdown systems should be demonstrated during the operating systems check with clean supplementary fuel.

4. **Waste Transport:** The transport of PCB wastes to a site must comply with federal and provincial requirements. It is recommended that approval to transport PCB wastes to the site, where applicable, be contingent upon demonstration that the PCB destruction system can comply with the conditions and system checks described in this report. Furthermore, it is recommended that PCB waste transported to the site should be limited to that needed to complete the startup procedure.

6.2 Nature and Quantity of Waste to be Destroyed

6.2.1 Documentation. The specific source, identity, and nature of all PCB wastes intended for disposal at the site should be clearly documented in accordance with procedures defined in the proponent's submission for approval. This documentation must be consistent with the Environment Canada and provincial PCB waste inventories as well as complying with federal and provincial marking and transportation requirements.

Documentation should also verify compliance with any constraints on the quantity, type and concentration of PCB waste brought to, stored, or destroyed at the site. Such constraints should be specified in advance by provincial regulatory agencies in consultation with local municipalities.

6.2.2 Waste Type. Wastes transported to the site should be compatible with the type and concentration of wastes within the storage, handling, and destruction capabilities of the facility. It is recommended that the waste characteristics (e.g., solid/liquid, PCB concentration) used for demonstration testing, should be as representative as possible to the types of wastes that require destruction.

6.2.3 Waste Quantity. In the case of a demonstration test, the total quantity of waste brought to the site should not exceed the quantity required for the demonstration. In the case of approved commercial operation at a site, the total quantity of waste transported to and destroyed at the site will normally be stipulated as a condition of approval. Limitations may also be placed on the total quantity of waste stored at the site. Storage capabilities at the site should be such as to minimize transport of waste to the site.

6.3 Supplementary Fuel

6.3.1 Limitations. Clean supplementary fuel should be required for demonstration tests. The use of waste solvents or oils as supplementary fuel during approved operation of destruction facilities should require the specific approval of the permitting agency. The destruction of solvent rinses from **approved** PCB container decontamination should be allowed with prior approval.

6.3.2 Analysis. If appropriate, chemical analysis of supplementary fuels should be required to identify fuel contaminants which may result in emissions regulated by the permitting agency. Any contaminants identified should be subsequently monitored during demonstration tests.

6.4 On-site PCB Waste Storage

6.4.1 Objective. On-site PCB waste storage should be confined to a designated and clearly defined area as recommended by Environment Canada[2][18] and/or stipulated within each jurisdiction. The designated area should be used exclusively for PCB waste storage and should be designated and operated to minimize all PCB releases to air, ground, and water including releases resulting from floods, storms or fire-fighting activities. The operator must provide secure, controlled storage which prevents direct contact of persons with wastes. The storage area should be designed to prevent spills or releases of PCBs to the surroundings, including direct or indirect releases to a watercourse or groundwater. Effective provision must be made for quick containment and cleanup of any PCB releases which may occur accidentally.

6.4.2 Site-specific Requirements. The term of operation, stored waste quantity, and local conditions will influence the specific design of on-site PCB waste storage facilities. In addition to the following recommended requirements, PCB waste storage facilities must comply with all applicable federal, provincial and local regulations, requirements, and guidelines.

6.4.3 On-site Location. The primary on-site waste storage facility should have safe and controlled access to the destruction system, separation from combustible and/or explosive materials, including solvents and fuels, and separation from any other activities which may endanger safe storage.

The on-site storage facility should be located at last 100 metres from the nearest watercourse and site features should generally comply with the siting requirements specified by the lead regulatory agency.

6.4.4 Containment. A leakproof containment system must be provided for liquid PCB storage areas. Liquid PCB wastes must be stored in sealed containers or tanks within the containment area. The storage area should provide effective containment for the worst-case spill event. Provisions should be made for effectively removing spilled liquids from the containment area.

Solid PCB wastes should be stored in appropriate closed containers on solid surfaces which are durable, dry, and readily cleanable.

6.4.5 Enclosure. An indoor, covered and enclosed, storage area is preferred. If this is impractical, effective measures should be provided to completely prevent the

infiltration of precipitation to all storage areas. Precipitation which contacts waste containers and/or enters the waste storage area must be retained and, if necessary, disposed of as contaminated wastewater.

Where applicable, appropriate precautions should be taken to prevent PCB releases resulting from container or equipment rupture due to mechanical shock or exposure to extreme ambient temperatures.

6.4.6 Ventilation. Good ventilation should be provided for enclosed areas where PCB liquids are stored, especially where temperatures may exceed 25°C. Vapours from bulk liquid PCB tanks should be vented to the atmosphere through activated carbon filters.

6.4.7 Security. The storage area should be fenced or enclosed with controlled access through lockable gates or doors. Access to the area should be limited to authorized personnel. Effective protection should be provided to prevent entry by vandals or unauthorized personnel.

6.4.8 Signing and Container Marking. The storage area should be clearly identified as a PCB waste storage area. Waste containers should be identified in accordance with Environment Canada labelling requirements and any other provincial, federal or user-equivalent marking requirements.

6.4.9 Housekeeping. The storage area should be kept clean and orderly. Waste containers should be placed in an orderly and systematic arrangement giving attention to conventional rules of safety concerning stacking and impact protection of containers where vehicular access to the area is allowed.

6.5 Controlling and Monitoring Operational Parameters

The maintenance of key operating parameters within ranges which will ensure the required destruction of PCB wastes (99.9999% DRE) is the primary control mechanism for PCB destruction processes. **Prior to approvals** for any demonstration testing or operation, these key parameters will be determined from a review of detailed process and monitoring data that have been submitted to the regulator.

6.5.1 Allowable Ranges of Key Parameters. The allowable operating ranges of key parameters, as indicated by existing test data or prior operational results in other jurisdictions, will be confirmed during the performance of demonstration tests. The

allowable ranges will pertain only to the specific waste-feed conditions for which approval is sought.

All operations of the PCB destruction system (subsequent to the completion of the demonstration tests) will require the key parameters to fall within the allowable ranges which have been either demonstrated or stipulated as a condition of the approval to operate.

6.5.2 Monitoring and Automatic Shutdown. Key operating parameters should be monitored continuously during all operations including demonstration tests and subsequent approved operation. The monitoring equipment, procedures, and record keeping will be in accordance with the detailed Data Quality Assurance Plan.

The PCB waste feed to the system should be automatically interrupted if the monitored values of key parameters fall outside allowable ranges. The system should also automatically initiate any other appropriate shutdown actions.

6.6 General Operational Controls

The operators of mobile PCB destruction facilities should comply with the minimum requirements for PCB waste storage, handling, transportation, occupational health and safety, and contingency planning as presented in this document. Equipment and practices must also comply with provincial and local regulatory requirements or codes and should comply with Environment Canada recommendations as set out in the "Handbook on PCBs in Electrical Equipment"(15).

6.6.1 Documentation of Specific Controls. The specific controls and procedures to be applied at a given site should be detailed as a part of the proponent's approvals application. Compliance with these requirements should be a condition of approval to operate the destruction system under all circumstances.

6.6.2 Prevention of PCB Releases. The facility should be designed and operated to minimize fugitive emissions and PCB spills, and the equipment should incorporate PCB compatible materials. The number of connections used in piping for transferring PCB liquids should be minimized. All vapours containing PCBs should be vented through adsorbent (e.g., activated carbon) cartridges or returned to the destruction process.

6.6.3 Containment. Effective containment should be provided at all potential points of PCB leakage or spillage. Precautions should be taken to prevent the infiltration of precipitation to impoundments, spill trays, or containment systems. Where such infiltration occurs, the liquid must be retained and treated as an aqueous waste.

6.7 Emission and Compliance Monitoring

6.7.1 Demonstration Tests. Detailed process, emissions, and environmental monitoring will be required during demonstration tests. The object of this monitoring is to verify the allowable operating ranges of key process parameters (Section 7) which will ensure the required destruction efficiency and compliance with emission regulations. Environmental monitoring may also be required to verify that site contamination does not occur and/or that site restoration activities are satisfactory.

Pre-test, test, and post-test monitoring will generally be required for demonstration tests. The specific procedures and controls for the tests, including a Data Quality Assurance Plan, should be detailed in writing as a part of the approvals application.

As a minimum, the monitoring should provide sufficient reliable data, assembled, presented, and assessed in accordance with the approved Data Quality Assurance Plan, to verify that the process meets the recommended performance standard of 99.9999% DRE. This determination should be based on accurate analysis of all process inputs and outputs. In addition, it must be shown (using approved methods) that any emissions of PCBs, PCDDs and PCDFs comply with emission regulations. Conventional air contaminants should also be regulated at source.

In addition to these requirements, any applicable provincial ambient air criteria for PCBs, PCDDs and PCDFs must be met. Similarly, Interim Environmental Quality Objectives for PCBs in ambient air, that have been accepted by CCME, should not be exceeded. The Canadian Council of Ministers of the Environment has recently accepted Ontario ambient air quality criteria for PCBs.

Waste destruction during demonstration tests should be immediately terminated if: key parameters undergo excursions from allowable operating ranges; air pollution guidelines or standards are found to be exceeded; or any other unsafe conditions are identified.

6.7.2 Approved Operation. The operations of facilities approved for the destruction of PCB wastes will be controlled by continuous monitoring of key process parameters, with automatic shutdown if excursions occur outside allowable ranges of parameters. In addition, periodic compliance monitoring of source emission levels for PCBs, PCDDs and PCDFs is required by some provincial regulations and is recommended here. The minimum recommended requirement is for continuous monitoring of process parameters

and for at least one source compliance test for PCB, PCDD and PCDF emissions during routine operations at each site.

All monitoring and data reduction and assessment during approved operation should be in accordance with the Data Quality Assurance Plan.

6.8 Material Discharges

6.8.1 Wastes and Residues. All liquid and solid wastes and residues and any other potentially PCB-contaminated equipment or material resulting from the operation of the PCB destruction system should be retained on-site until analyzed for PCB, PCDD, and PCDF content and disposal is authorized by the lead regulatory agency.

Disposal of process residues and other waste materials should comply with the minimum requirements of Section 10 and additional requirements of provincial and local regulatory agencies.

6.8.2 Decontamination Activities. The on-site decontamination of equipment and/or waste containers should require the specific approval of the lead regulatory agency. It is recommended that tank trucks for transporting PCB bulk fluids be dedicated vehicles. Decontamination and subsequent alternative use of such vehicles should be stringently regulated by certificates of approval issued by the permitting agency. The re-use and/or disposal of waste drums or containers for PCB wastes should be in accordance with the requirements.

6.8.3 Storm Runoff. Precipitation should be prevented from contacting equipment and materials which could result in PCB contamination. Where such contact inadvertently occurs, the contaminated rainwaters should be retained and treated as aqueous waste.

Surface runoff from the site should be periodically monitored in accordance with the requirements of the lead regulatory agency. The need for and frequency of such monitoring should be determined from site-specific conditions and stipulated as a condition of approval for operation on the facility.

6.9 Operator Training

All operators at the facility should receive comprehensive training appropriate to the safe performance of their duties as well as for the safe handling of PCB materials. The training program should be described in detail in the approvals application. The program should provide appropriate training in the following specific areas:

- features and function of the destruction facility;
- knowledge of physical/chemical properties, and workplace and environmental hazards of PCB wastes and other dangerous materials used at the facility;
- occupational health and safety regulations, environmental regulations and handling guidelines for PCB wastes and any other dangerous materials used at the facility;
- knowledge of the function and effective use of safety and emergency response equipment; and
- implementation of the emergency contingency plan for the facility, including emergency response measures for spills and fires and reporting procedures for emergencies.

6.10 Data Reporting, Record Keeping

Detailed procedures for all aspects of record keeping and data reporting should be addressed in the Data Quality Assurance Plan which is submitted as a part of the approvals application.

Operator records for each disposal site should contain: descriptions of PCB wastes processed, owner/operator names, pertinent activity dates/times, monitoring and analytical data, descriptions of spills or other accidental occurrences, inspection records, facility waste data and disposal methods, and other relevant information. It is recommended that records of treatment activities be retained for five years.

It is also recommended that a written report of activities at each site be provided by the operator or owner to the designated regulatory agency. This will assist in the overall PCB waste management strategy by providing a mechanism for the regulator to review all destruction activities and maintain accurate PCB waste inventories.

6.11 Duration of Operation

If the requirements of this report are observed, then there are no technical concerns which justify limiting the term or frequency of operation at a given site. Federal, provincial, or local agencies, however, may wish to stipulate a maximum period of operation for demonstration tests and/or subsequent approved operation. In such cases, the operational period should be determined by site-specific conditions including waste quantity, cost constraints and allowances for facility setup, shakedown, and decommissioning. It is emphasized that the imposition of short operating periods may make the application of such mobile processes prohibitively expensive because of the high mobilization costs associated with these facilities.

6.12 Site Security

The site should be securely fenced with access controlled by a locked gate. When an attendant is not present, appropriate measures should be taken to prevent unauthorized entry and vandalism. The 24-hour presence by an attendant is recommended. When the facility is in operation, all activities should be adequately and continuously supervised.

7 MONITORING AND INSPECTION PARAMETERS

All permit applications for demonstration testing and subsequent operations should require a plan that addresses the monitoring of operational, emission, and environmental parameters. The purpose of monitoring is to verify the destruction performance of the facility and to document operational compliance with all pertinent regulations. More extensive monitoring will be required during demonstration tests than during commercial operation. In general, the recommended minimum monitoring requirements are:

- **continuous monitoring of key process parameters** during demonstration tests and during routine operation;
- **waste feed sampling and analysis** during both demonstration tests and operation;
- **extensive emission sampling and analysis** during demonstration tests and periodic confirmatory tests during operation;
- **sampling and analysis of liquid and solid wastes from the process** during demonstration tests and/or routine operations, to ensure that they can be properly disposed of; and
- **environmental sampling and analysis** before, during, and after demonstration tests and routine operation.

The primary monitoring considerations which should be reviewed and approved by the lead regulatory agency, are: the monitoring locations, parameters, procedures to be used, and monitoring frequency.

7.1 Process Monitoring

Key operating parameters of the process should be monitored continuously in order to ensure proper process control. The minimum key parameters to be continuously monitored in an incineration process are indicated in Table 5. Although specific monitoring locations and parameters depend on the process type, configuration and type of emission control device, the primary parameters to be monitored include:

- rates of waste feed, burner fuel, and air;
- temperature and combustion conditions; and
- inlet/outlet flows of scrubber liquid.

Key process monitoring data that will be used to verify proper operation of the process include:

- temperature
- excess oxygen,
- residence time, and
- combustion efficiency.

TABLE 5 RECOMMENDED CONTINUOUS MONITORING REQUIREMENTS OF OPERATING PARAMETERS FOR AN INCINERATION PROCESS

Monitoring Parameter	Unit	Possible Monitor Location[a]
Waste Feed Rate	kg/h	transfer line from bulk storage or other feed
Auxillary Fuel Feed Rate	kg/h	fuel supply
Combustion Air Flow	am^3/min.*	combustion air supply
Incinerator Pressure	kPa	primary and afterburner chambers
Combustion Temperature	°C	primary and afterburner chambers
Oxygen	%	afterburner chamber (b)
Carbon Monoxide	ppm	afterburner chamber (b)
Carbon Dioxide	%	afterburner chamber (b)
Scrubber Liquid Flow	m^3/min.	scrubber inlet
Scrubber Pressure Drop	kPa	scrubber chamber
Scrubber Liquid Makeup Flow	m^3/min.	water supply
Scrubber Liquid Discharge Flow	m^3/min.	scrubber outlet
Quench Water Makeup Flow	m^3/min.	water supply
Quench Water Discharge Flow	m^3/min.	quench chamber outlet
Calculated Parameter		
Total Thermal Load	Megawatts	
Residence Time	seconds	
Combustion Efficiency	%	

Notes: (a) - for an incinerator configuration comprising a primary and afterburner chamber with a quench chamber, liquid scrubber, and spray tower

(b) - these parameters may be alternatively monitored after the gas scrubber

* am^3/min. - actual cubic metres per minute - referring to actual temperature and pressure

Monitoring elements for these key parameters should be linked to an automatic waste feed cut-off or process shutdown system that will be triggered if the predetermined range of operating parameters is exceeded. For incineration, the minimum parameters that should be linked to an automatic feed-shutdown system are temperature and excess oxygen. Automatic feed stoppage also should occur in case of failure of monitors for temperature, oxygen (O_2), carbon monoxide (CO) and carbon dioxide (CO_2). Specific monitoring equipment and procedures, including mechanisms used to compensate for momentary abnormal excursions of key parameters, should be specified in the proponent's applications and approved by the lead regulatory agency.

7.2 Emission Monitoring

Detailed monitoring of process input streams and all discharges to air, water, and soil will be required during demonstration testing, especially with respect to facilities operating for the first time. Recommended minimum sampling and analytical requirements, based primarily on Ontario regulations[6], are provided in Table 6. Sampling and analytical methodologies, monitoring locations, monitoring frequency and parameters to be monitored should be approved within each jurisdiction. As a minimun, PCBs, chlorobenzenes, PCDDs, PCDFs, and chlorophenols should be determined in all waste streams. Other components such as trace metals, total chlorine and sulphur also may require analysis depending on the type of feed. Replicate measurements should be performed for each type of waste feed (e.g., triplicate measurements using wastes containing PCBs at concentrations up to the maximum for which approval is sought). Air emissions should be characterized by monitoring at a point downstream of air pollution abatement equipment and prior to release to the atmosphere. An automated weather station should be operated in conjunction with these tests.

During subsequent operation at destruction sites, confirmatory emission monitoring for at least PCBs, PCDDs, and PCDFs should be performed, at a frequency stipulated by the permitting agency (e.g., at least once during operations at each site). Solid and liquid process wastes should be analyzed on a routine basis for PCBs, PCDDs, and PCDFs and retained at the site until authorization is received for disposal. During confirmatory emission monitoring tests, the waste feed should be analyzed for PCBs. Results of incoming and outgoing stream monitoring should demonstrate that PCBs are destroyed by the process without the creation of other pollutants that exceed environmental standards, criteria, and guidelines.

TABLE 6 RECOMMENDED MINIMUM EMISSION MONITORING REQUIREMENTS FOR MOBILE PCB THERMAL DESTRUCTION PROCESSES

Sample Types	Recommended Frequency(a)	Minimum Analysis	Other Specific Analysis(b)
PCB Feed(c)	composite samples taken at specified intervals during emission sampling period(s) for each PCB waste concentration	PCBs, chlorobenzenes	chlorophenols
Scrubber Water Influent	same as PCB Feed	PCBs, chlorobenzenes	
Supplementary Fuel	same as PCB Feed	PCBs, chlorobenzenes	
Stack Emissions(c)(d)	three six-hour tests for each PCB waste	PCBs, chlorobenzenes, PCDDs and PCDFs, chlorophenols, O_2, CO, CO_2, HCl, Cl_2, THC, PAHs particulate matter	trace metals
Liquid Effluent(c)(d)	same as PCB Feed	PCBs, chlorobenzenes, PCDDs and PCDFs, chlorophenols, PAHs	trace metals, chlorine
Ash/Other Solids(c)	same as PCB Feed	PCBs, chlorobenzenes, PCDDs and PCDFs, chlorophenols, PAHs	

Notes:

(a) The number of samples per test and sampling intervals depend on expected test durations, specific jurisdictional requirements and the types of parameters being monitored.

(b) Analysis of these components may be required depending on the nature of the feed and jurisdictional requirements.

(c) Sampling and analysis of these media are recommended during both demonstration tests and routine operation. The frequency and parameters to be monitored will depend on jurisdictional requirements.

(d) Separate sampling units may be needed for specific compounds classes. In some instances, (e.g., stack emissions, liquid effluents), separate analysis of particulate and vapour or filtered liquid components may be required.

7.3 Environmental Monitoring

The requirements for environmental monitoring should be predetermined by the lead regulatory agency. It should be the responsibility of the proponent to carry out the monitoring program. In some circumstances, environmental monitoring will also be undertaken by the regulatory agency.

Contaminants should be measured in environmental media as required to detect the presence of fugitive or unanticipated airborne emissions, the occurrence of spills, and any potential effect of PCB destruction activities on the local environment. The recommended minimum environmental monitoring requirements are shown in Table 7. Prior to demonstration tests, samples of soil, receiving water, vegetation and ambient air should be collected at the site and analyzed for background contaminant levels (e.g., PCBs and chlorobenzenes as a minimum). Similar monitoring, of soil and water, should be done after demonstration tests, as well as before and after subsequent operations at each site. These data should be used to document any significant differences from background concentrations that could result from destruction operations and to define the need for site restoration. In addition, some jurisdictions may require ambient air measurements during trial burns and periodically, on a less frequent basis, during subsequent operation of the facility. Ambient measurements can be used to confirm compliance with any air quality guidelines or point-of-impingement standards of the permitting agency and to determine the extent of any fugitive emissions.

7.4 Inspection

Facility inspection should be undertaken by the permitting agency in addition to routine inspection by operators of the destruction system.

Demonstration test activities should be thoroughly inspected both before and during testing to confirm that all operational controls, monitoring devices and associated procedures are properly functioning. Similarly, each destruction site should be inspected before and after operations to determine the condition of the site and any need for restoration. Inspection or surveillance during operations should be done on both a ramdom and scheduled basis in order to verify that systems comply with all regulations. It is recommended that at least one inspection be done by regulatory personnel per month of operation. Records of the operator should be available for regulatory review at any time. If any emission or waste disposal regulations are found to be violated, or if any other unsafe condition is identified, operations should be terminated until approved to resume.

TABLE 7 RECOMMENDED MINIMUM ENVIRONMENTAL MONITORING REQUIREMENTS FOR MOBILE PCB THERMAL DESTRUCTION PROCESSES

Sample Types[a]	Location	Minimum Analysis	Other Specific Analysis[b]
Soil	each of 4 compass point locations surrounding the facility [c]	PCBs, chlorobenzenes PCDDs and PCDFs	chlorophenols, trace metals, total chlorine, and sulphur
Vegetation	same as Soil, taken only if location warrants	PCBs, chlorobenzenes, PCDDs and PCDFs	trace metals, total chlorine, and sulphur
Water	same as Vegetation	PCBs, chlorobenzenes, PCDDs and PCDFs	chlorophenols, trace metals, total chlorine
Ambient Air[d]	Same as Soil	PCBs, chlorobenzenes PCDDs and PCDFs	chlorophenols, trace metals, SO_X, HCl, NO_X, THC

Notes:

(a) Sampling of these media should be done before and after demonstration tests and/or subsequent operations at each approved site. Sampling locations will depend on the characteristics of both the site and the facility and specific locations should be selected in consultation with the permitting agency and approved as part of the data quality assurance plan.

(b) Although samples should be collected, analysis of these components may be waived depending on other sample results.

(c) Soil sampling in the immediate vicinity of the facility also is recommended in order to detect the occurrence of spills and to define cleanup requirements.

(d) Ambient air measurements are recommended to be done on an occasional basis in order to provide assurance that air quality is not adversely affected by unanticipated emissions.

8 OCCUPATIONAL HEALTH

8.1 Exposure Limit

The protection of workers and the environment are fundamental requirements of PCB destruction operations. Proponents will be required to ensure safe working practices, use precautionary measures that will limit the risk of exposure to PCBs and other contaminants, and adhere to occupational health regulations and guidelines.

Most provinces have adopted workplace air concentration limits set by the American Conference of Governmental Industrial Hygienists[16] that are associated with exposure to specific PCB mixtures (i.e., askarels). These air concentration limits, expressed as Threshold Limit Values (TLVs) and Short-term Exposure Limits (STELs), are:

42% Cl: 1 mg PCBs/m^3 air over 8 hours (TLV)
2 mg PCBs/m^3 air over 15 min. (STEL)

54% Cl: 0.5 mg PCBs/m^3 air over 8 hours (TLV)
1 mg PCBs/m^3 air over 15 min. (STEL)

Threshold Limit Values are limits defined as the maximum time-weighted average exposure level for an 8-hour working day and STELs are limits defined as the maximum exposure level for no longer than a 15-minute duration and no more than four times per day,

The current occupational health guideline used in Ontario for time-weighted average exposure to PCBs is 50 $\mu g/m^3$ of air for a 40-hour workweek. This guideline represents an airborne concentration to which it is believed that most workers may be repeatedly exposed on a daily basis within a 40-hour workweek, over a working lifetime, without adverse effects. An important provision of this guideline states that employees should be protected from skin contact with these compounds by the use of impervious materials.

8.2 Work Practices and Personal Protective Equipment

All persons handling, operating or maintaining PCB equipment should be adequately trained and familiar with occupational health and safety practices. Polychlorinated biphenyls are readily absorbed by inhalation, ingestion, and skin contact. As the volatility of PCBs increases with increasing temperature, it is important that all systems and especially processes involving elevated temperatures (i.e., 155°C, are completely enclosed and/or served by adequate exhaust control and ventilation. Periodic

air sampling (once per month) should be conducted to ensure that workers are not exposed to airborne concentrations higher than those previously specified. When such airborne concentrations are suspected or encountered, workers should be provided with air-supplied respirators, particularly if work is to be conducted in enclosed spaces. Polychlorinated biphenyl working areas should be clearly delineated, with restricted access policies in place. Similarly, containers and other equipment (e.g., transfer lines) should be labelled for inspection purposes and to ensure correct handling procedures. It is essential that good housekeeping practices be maintained at all times.

In working with PCBs, strict personal hygiene practices should be observed and skin contact avoided. To protect against dermal exposure, impervious protective clothing, such as gloves, boots, overshoes and overalls should be supplied to the workers.(2) Eye protection should be used to avoid injury by liquid splashes. In addition, eye wash fountains and deluge showers should be available, if practical, in the event of skin contact.

Disposal clothing is preferred, otherwise, work clothing should be regularly inspected to ensure that it remains clean, and in good condition. Work clothing should be retained on location and laundered regularly in a system reserved exclusively for contaminated clothing. Thorough personal washing should be done after removing protective equipment and before eating, drinking, or smoking. Eating and other such activities should not be permitted in PCB work areas. Similarly, all tools in contact with PCBs or PCB-contaminated materials should be washed at the end of each day or after use with an appropriate solvent (e.g., varsol, kerosene).

8.3 Medical Surveillance Programs

Polychlorinated biphenyl destruction facility operators potentially exposed to PCBs on a frequent or continuous basis should undergo pre-placement and periodic medical examinations and any clinical tests at intervals required by the examining physician. Employee exposure records (e.g., results of air sampling), medical histories, and clinical test results should be documented and retained for future reference.

9 TRANSPORTATION OF PCB WASTES AND MOBILE DESTRUCTION SYSTEMS

9.1 PCB Wastes

All PCB wastes must be transported to the treatment site in accordance with the requirements of current federal and provincial legislation. It is recommended that the proponent of the PCB destruction system should clearly indicate, in the approvals application, the specific plans for waste transportation. At minimum, all parties involved should be identified and the specific arrangements for waste receiving at the destruction site should be addressed. In addition, the contractual arrangements bearing on responsibility for transportation accidents and associated liability should be clearly indicated.

Regulations under the federal *Transportation of Dangerous Goods Act* (TDGA) and complimentary provincial legislation specify standards and requirements for the safe handling and transportation of dangerous goods and/or hazardous wastes by all modes of transportation within Canada. **Under federal TDGA Regulations,** wastes or articles containing PCBs are included in Division 1 and 2 of Class 9 and are to be identified by the Product Identification Number (PIN) 2315. These regulations stipulate the requirements for safety markings and documentation, packaging, safety precautions and training, and emergency training.

The TDGA Regulations and associated provincial regulations also require a completed manifest for each shipment of PCB waste. Copies of the manifest must be completed by each party involved (consignor, carrier and consignee). In addition, the regulators stipulate reporting requirements for spills of PCBs during transportation and related activities.

Amended regulations specific to the transportation of PCBs are now in force. The ammended regulations are summarized in the Dangerous Goods Special Bulletin, TP 2711E, ISSN 0710-0914. Information on the summary document is available from the offices presented in Table 8.

Provincial legislation complements the TDGA Regulations and may require all parties involved in transportation of PCB wastes to obtain provincial approvals or licenses. These approvals may stipulate additional contractual responsibilities for these parties. The specific agencies to contact for questions about requirements in each of the provinces are listed in Table 8.

TABLE 8 CONTACTS FOR INQUIRIES ABOUT TRANSPORTATION OF PCB WASTES

Jurisdiction	Responsible Agency	Telephone
Federal	Transport Canada Place de Ville (Tower C), 6th Floor Ottawa, Ontario K1A 0N5	(613) 992-4624
Yukon	Department of Community and Transportation Services P.O. Box 2703 Whitehorse, Yukon Y1A 2C6	(403) 667-5832
Northwest Territories	Pollution Control Division Department of Renewable Resources Yellowknife, N.W.T. X1A 2L9	(403) 873-7654
British Columbia	Solicitor General Motor Vehicle Branch 2631 Douglas St. Victoria, B.C. V8T 5A3	(604) 387-5585
Alberta	Dept. of Public Safety Services Dangerous Goods Control 10320-146 Street Edmonton, Alta. T5N 3A2	(403) 422-9600
Saskatchewan	Dept. of Highways and Transportation 1855 Victoria Ave. Regina, Sask. S4P 3V5	(306) 787-5527
Manitoba	Dept. of Environment, Workplace Safety and Health Box 7, 139 Tuxedo Ave. Winnipeg, Man. R3C 3Z1	(204) 945-7094
Ontario	Ministry of Transportation Compliance Branch West Tower, 1201 Wilson Ave. Downsview, Ont. M3M 1J8	(416) 235-3579
Quebec	Ministère des Transports 700, boul. Saint-Cyrille est Québec, P.Q. G1R 5H1	(418) 643-2990
New Brunswick	Dept. of Transportation Kings Place, York Street, Box 6000 Fredericton, N.B. E3B 5H1	(506) 453-2407
Nova Scotia	Dept. of Transportation 6061 Young Street, Box 156 Halifax, N.S. B3J 2M4	(902) 424-2727
P.E.I.	Transportation and Public Works Box 2000, 17 Havilland St. Charlottetown, P.E.I. C1A 7N8	(902) 368-5200
Newfoundland	Dept. of Transportation Box 8710 St. John's, Nfld. A1B 4J5	(709) 576-3454

9.2 Process Vehicles

Mobile PCB destruction facility transport vehicles must comply with all conventional requirements for transport vehicles. Since these vehicles are not expected to transport PCB waste materials, it is anticipated that the regulations governing waste transport would not directly apply. However, regulations are still under development and individual provinces may wish to stipulate specific precautions or conditions for the movement of mobile PCB destruction systems. It is recommended that the proponent's approval application to operate a mobile PCB destruction system contain a description of the equipment and procedures for transport. This will aid in identifying any appropriate conditions or precautions for equipment cleanup, decontamination or preparation prior to and during transport.

10 PROCESS WASTE TREATMENT AND DISPOSAL

As indicated in Section 6.8, all liquid and solid wastes and residues (or any other potentially contaminated equipment or materials) resulting from the operation of the PCB destruction system should be retained on-site until analyzed for PCBs, PCDDs, and PCDFs and disposal is authorized by the lead regulatory agency.

Disposal of process residues and other waste materials should comply with the requirements of the following sections and all additional requirements of federal, provincial, and local regulatory agencies.

10.1 Solid Waste Disposal

The requirements of this section refer to the conditions of disposal for solid residues of the PCB destruction facility such as incinerator ash, collected flue gas particulate matter or control device sludge. These recommendations are based primarily on contaminant limitations in the "Federal Mobile PCB Treatment and Destructions Regulations".

- It is recommended that process solid wastes with a PCB content less than or equal to 0.50 mg of PCB/kg of waste (0.5 ppm) be defined as non-hazardous solid industrial wastes and disposed of in land disposal sites or any facilities that are certified to accept such waste or in accordance with any other applicable regulations of the province.

- Solid wastes discharged from the incinerator with PCB contents greater than 0.50 mg/kg of waste require further on-site treatment by the mobile PCB destruction system. This standard is for the treatment of solids containing greater than 50 ppm PCBs and represents best available control technology for the destruction of the PCBs contained in these wastes when treated.

- It is recommended that disposal of solid process residues should not be allowed if the concentration of 2,3,7,8-TCDD toxic equivalents exceeds 1 µg/kg of the waste (1 ppb). When concentrations in treatment residues exceed this limit, it is recommended that residues be reprocessed in the PCB destruction system.

10.2 Container Disposal

Polychlorinated biphenyl waste containers of all forms and types should be subject to the general disposal requirements listed in the previous section. The following specific requirements should apply:

- The decontamination of any equipment or containers which contact PCB wastes should require the specific formal approval of the lead regulatory agency.

- The re-use of dedicated drums or waste containers should be allowed, subject to careful inspection to ensure that they are in good condition and meet the general requirements of PCB waste containers.

Alternatively,

- Drums for disposal should be triple rinsed with solvent which can be disposed of in the test facility. It is suggested that the volume of each rinse be at least 10% of the container volume. Specific procedures for decontamination activities should be stipulated as a part of the approvals submission and approved as a condition to test or operate the facility.

- It is recommended that drums rinsed in such a manner be disposed of as non-hazardous waste in landfills or other facilities that are certified for such disposal, or, properly rinsed drums can be recovered as scrap metal in a facility properly certified to accept such materials.

- Re-use of rinsed drums (except as containers for non-hazardous waste to be deposited in a certified landfill) should not be allowed.

10.3 Bulk Transport Vehicle Decontamination

The use and subsequent decontamination of tank trucks for transporting **bulk** PCB liquids or vehicles used for the transport of **bulk** PCB solids should be specifically addressed in the approvals application. If decontamination of vehicles is required, specific approval for procedures should be a condition of approvals to test or operate the facility.

10.4 Liquid Effluent

10.4.1 Disposal of Wastewaters. Formal approval should be required for discharge of **all** aqueous wastes from the disposal facility following verification that these discharges contain contaminants below regulated levels.

The recommended maximum concentration of PCBs in aqueous wastes is 5 µg/L. Acceptable disposal methods[6] for wastewaters which have a PCB content less than or equal to 5 µg of PCB/L of wastewater (as determined by approved analytical methods) include discharge to:

- a municipal sewage treatment plant,
- a receiving water body,
- deep-well injection, or
- to soil.

It is recommended that these wastes be retained at the site until analyses are complete and disposal approval has been received. Wastewaters that have a PCB content greater than 5 µg/L must be treated to a PCB content of less than 5 µg/L before discharge.

Dilution of such wastes as a means to achieve allowable discharge levels should not be permitted.

It is recommended that the maximum concentration of 2,3,7,8-TCDD toxic equivalents in aqueous wastes should not exceed 0.6 ng/L. Aqueous wastes that exceed this limit should not be discharged but should be treated until levels are reduced to or below the allowable limit.

10.4.2 Contaminated Precipitation. The generation of contaminated runoff should be avoided by preventing the infiltration of precipitation to impoundments or containment areas.

Where precipitation or runoff becomes contaminated, this liquid should be retained and treated as wastewater according to the requirements listed in the previous section.

11 EMERGENCY RESPONSE AND CONTINGENCY PLANNING

11.1 Responsibilities of the Proponent

The proponent of a PCB destruction facility should have (at a minimum) the following obligations and responsibilities regarding emergency response and contingency planning:

- A detailed emergency response and contingency plan should be submitted as a part of the application for regulatory approvals. This plan should be site-specific and should address each component of an emergency plan as defined in Section 11.3.
- Before PCB destruction activities take place at a site, the facility operator should demonstrate that the required emergency response equipment is on-site, readily accessible and in proper working order.
- Before PCB destruction activities occur, the facility operator should demonstrate that on-site personnel are properly trained in the effective use of equipment and are ready and able to implement all parts of the emergency response plans.

11.2 Potential Emergency Events

As a minimum, the emergency response plan should address the following:

- spills of PCB liquid (e.g., bulk PCB waste fluids stored on-site);
- release of PCB-contaminated fluids, including runoff from storm events, aqueous wastes generated by the treatment process (e.g., scrubber fluids), and aqueous runoff from fire-fighting activities;
- fires involving PCB liquids or wastes (with attention to minimizing dispersal of soot and other residues of fire-fighting activities);
- failure of key process monitoring and shutdown controls; and
- catastrophic process failure (e.g., explosion and/or fire involving process equipment or key process controls).

11.3 Elements of Emergency Action Plans

The specific form and content of an emergency response plan will be dictated by the lead regulatory agency. As a minimum, the plan should include:

- identification of site-specific, high-risk situations;
- advanced notification of local fire officials of site activities;
- advanced consideration and definition of specific actions and equipment for responding to the types of emergency events identified in Section 11.2 under the full range of local weather conditions;
- clear assignment of staff duties, responsibilities and accountability for implementing all aspects of the plan;

- designation of a contact person to notify appropriate officials of an emergency;
- identification and utilization of local emergency response resources; and
- consideration of the following aspects of the action plan:
    - event discovery,
    - notification of on-site response personnel,
    - first-action response (e.g., immediate containment of spills, immediate actions to protect or evacuate personnel, alerting off-site resources),
    - notification of appropriate regulatory agencies,
    - definition of response action options,
    - action implementation,
    - documentation,
    - assessment of response effectiveness, and
    - reporting.

11.4 Considerations for Specific Emergency Events

The potential severity of the emergency events listed in Section 11.2 varies significantly. Spills of PCB solids are of relatively low hazard and are relatively easy to contain and clean up. Large spills of PCB liquids are of greater immediate concern to the environment and require a higher degree of protection for cleanup personnel. Events involving the partial combustion of PCBs in fires may pose a severe hazard because of the generation of highly toxic polychlorinated dibenzofurans and dibenzodioxins[17]. Polychlorinated biphenyls, PCDFs, and PCDDs can be widely dispersed in soot and fire-fighting residues. Widespread dispersal of these residues can pose a serious health and/or environmental threat as well as causing severe difficulties and high costs in carrying out a thorough cleanup.

11.4.1 Spills. Compliance with the general design and operating requirements of this report and with the emergency planning considerations outlined in Sections 11.1 and 11.3 should provide sound protection against PCB releases resulting from spills.

11.4.2 Fires. In addition to the general design and operating requirements of this report and the emergency planning considerations outlined in Sections 11.1 to 11.3, **particular care should be taken to prevent fires involving PCB materials.** Special precautions should include the following:

- Isolate PCB wastes from all flammable materials including supplementary fuels.
- Provide rapid and effective fire extinguishers in all potential fire areas. Chemical foam or carbon dioxide extinguishers are recommended. The use of water to control fires involving PCBs will generate contaminated wastewaters which may be difficult to contain and/or dispose of.
- Give special attention to measures which will facilitate the rapid detection of fires.
- Provide effective protective gear for fire-fighting personnel. Self-contained breathing apparatus should be mandatory and personnel should be informed and trained about health and environmental concerns regarding exposure to PCDFs and PCDDs.
- Consider design and response measures which will minimize the dispersal of fire residues via all routes.
- Consult the lead regulatory agency (in consultation with Environment Canada) for guidance on site cleanup.

11.4.3 Failure of Key Process Monitoring and Shutdown Controls. Operating controls include the continuous monitoring of key process parameters with interruption of the waste feed and/or automatic shutdown of the process if allowable operating ranges of the parameters are exceeded. Since failure of the shutdown system under upset conditions potentially could result in excessive release of PCBs and/or PCDFs and PCDDs in the stack gases, the contingency plan should address the detection of such failures and the description of manual procedures for interrupting waste feed and/or shutting down the waste destruction system.

11.4.4 Catastrophic Failure. Although a major fire or explosion involving the process or key controls is highly unlikely, the emergency response plan should consider these potential situations. As a minimum, off-site resources for dealing with a major emergency should be identified and integrated with the emergency response plan. The area of impact for catastrophic failure should be defined with appropriate actions stipulated in the response plan (e.g., evacuation of affected off-site areas).

12 SITE CLEANUP AND CLOSURE

Upon termination of operations at each site, prior to or concurrent with movement to a new location, the proponent will be required to restore the site to a condition satisfactory to the regulator. Site decommissioning should be done according to the closure plan of the application and any stipulations of approvals. This will normally involve removal of equipment, temporary structures, containers, berms, process wastes, and possibly may involve site cleanup and disposal of additional cleanup materials. Recommended guidelines pertaining to decontamination activities and waste disposal have been addressed in Section 10.

Although the sequence of decommissioning activities may vary, the general activities and recommended requirements after process termination are:

- container or other equipment decontamination as per approval;
- submission of process waste samples for analysis by an independent laboratory approved by the regulatory agency and procurement of results and regulator approval prior to waste disposal;
- disposal of all operational wastes in an approved manner;
- the conduct of post-test environmental monitoring in the vicinity of waste handling/processing areas;
- submission of operational reports to the regulator;
- inspection of the site; and
- transportation of the mobile destruction process to a new location in accordance with new site application/approval requirements.

In the event that residues of PCBs or other compounds in soils or other post-operational environmental samples are found to exceed levels measured before operations, the proponent will be required to take remedial site restoration measures. That is, the site areas should be cleaned and restored to a condition acceptable to the regulatory agency as defined by jurisdictional guidelines.

REFERENCES

1. Environment Canada, The Evaluation of Mobile and Fixed Facilities for the Destruction of PCBs, Ontario Research Foundation, Environment Canada Report, EPS 3/HA/5 (1989).

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3. Chandler, A.J., M.J. Eamon and R.B. Caton, Interim National Emission Criteria for PCB Destruction Facilities, report prepared by Concord Scientific Corp. for the Canadian Council of Resource and Environmental Ministers (CCREM) (March, 1986).

4. Ontario Ministry of the Environment, Preliminary Hearing Document on Proposals for the Regulation of Mobile Destruction Facilities in Ontario, September 1984, including Revision (January 21, 1985).

5. The Commission on the Regulatory Control of Mobile PCB Destruction Facilities, report of the Commission (Ontario) (June 28, 1985).

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9. U.S. Environmental Protection Agency, Guidance Manual for Hazardous Waste Incinerator Permits, NTIS PB84-100577 (July, 1983).

10. Canadian Council of Ministers of the Environment (CCME), Guidelines for Mobile Polychlorinated Biphenyl Treatment Systems, CCME-TS/WM-TRE012 (March, 1990).

11 *Environmental Contaminants Act*, Chlorobiphenyl Regulations No. 1 Amendment, The Canada Gazette, Part II, 114 (13): 2272 (July 9, 1980).

12. *Environmental Contaminants Act*, Chlorobiphenyl Regulations No. 2 (Product), The Canada Gazette, Part II, 119 (10): 2145 (May 15, 1985).

13. *Environmental Contaminants Act*, Chlorobiphenyl Regulations No. 3 (Release), The Canada Gazette, Part II, 119 (10): 2147 (May 15, 1985).

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18. Environment Canada, The Storage of PCB Wastes, Interim Order (September, 1988).

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APPENDIX I

SUMMARY OF AVAILABLE TECHNOLOGY

APPENDIX I SUMMARY OF AVAILABLE TECHNOLOGY

The recommendations in this manual apply to any mobile thermal destruction technology which is intended for PCB wastes. This includes proven, conventional liquid injection and rotary kiln incinerators and also developing thermal technologies such as pyrolysis, thermal radiation, or plasma arc systems.

A detailed description and assessment of commercial, near-commercial and developing PCB destruction technologies is presented in a recent Environment Canada report entitled "Evaluation of Mobile and Fixed Facilities for the Destruction of PCBs"(1), and only a brief discussion is presented here. Using incineration as an example of a proven thermal destruction technique, Figure 3 depicts an overview of the waste types accepted and the nature of process emissions that require control.

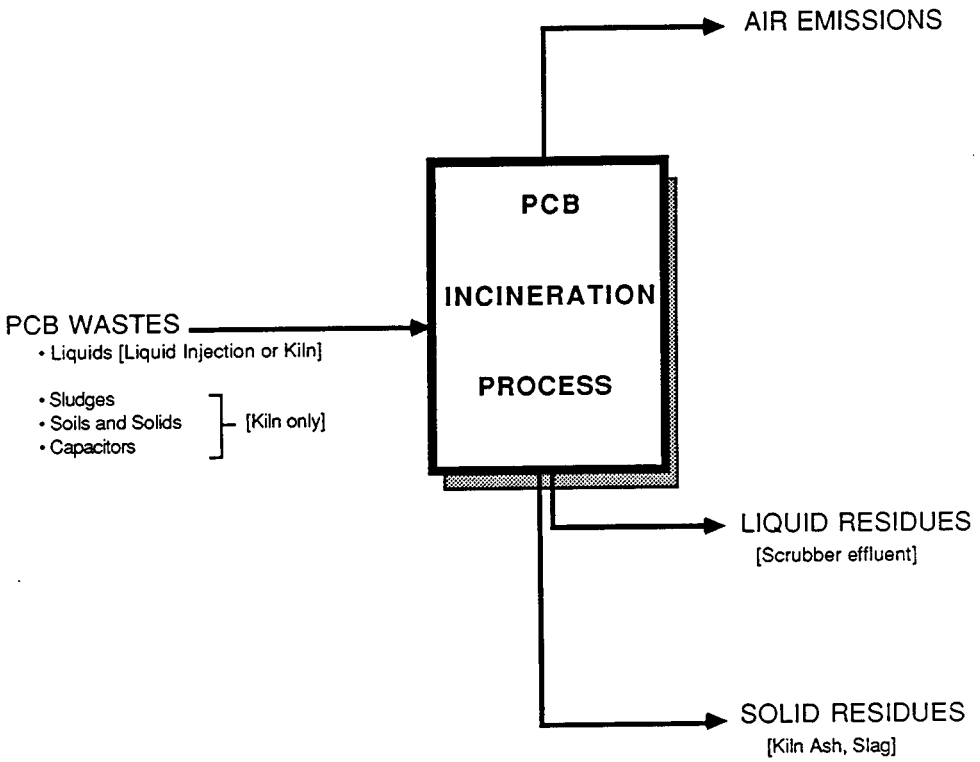

FIGURE 3 OVERVIEW OF PCB INCINERATION PROCESSES

The technology used in rotary kilns and liquid injection incinerators consists of size-reduction (solids) and/or atomization (liquids) of the waste feed and introduction into a refractory-lined chamber where the waste is oxidized by controlled flame combustion. Where PCB materials are the sole waste feed, an auxilliary fuel is required for combustion. Several years of experience have been gained with stationary facilities in

some countries. Commercial operations of these stationary systems have demonstrated the capability for obtaining 99.9999% destruction and removal efficiencies (DRE) with PCB wastes while producing acceptably low or non-detectable levels of toxic combustion by-products including PCDDs or PCDFs.

The demand for transportable or mobile waste destruction systems has increased during the last five years, and numerous mobile thermal systems have been or are being developed for commercial use in North America(1). The design of the mobile equipment is largely based on the design of the stationary PCB destruction systems.

One mobile liquid injection system has been approved by the U.S. EPA for the commercial destruction of liquid PCB wastes in six EPA regions; however, for economic reasons it has not operated in a mobile mode. A number of transportable systems have also been licensed by EPA for the commercial destruction of PCB solid wastes. The capability and flexibility of these systems could lead to their eventual application for the destruction of PCB liquid and solid wastes in Canada.

Full-scale, mobile rotary kiln destruction systems are transportable on a number of tractor-trailer units comprising a waste feed handling system, a rotary kiln unit, a secondary combustion chamber, a water quench or waste heat recovery boiler, a flue-gas scrubbing system, a scrubber effluent treatment system, and a control room and laboratory. These systems are self-contained and sophisticated in design with full micro-processor control.

Rotary kiln-based technology will accept a wide range of waste feeds for destruction including liquids, sludges, and solids including soil and shredded capacitors. Although the systems are generally classed as mobile, a 6 to 8 week on-site set-up and shakedown period can be required and a minimum job-size of the order of 5000 tonnes of waste could be required for the system to be cost-effective.

As described in Reference 1, several promising thermal destruction technologies are under development for commercial application. These technologies include pyrolysis by near-infrared radiation or in a plasma arc, and combustion in a bed of molten salt. These technologies have been demonstrated at pilot or full-scale levels, but are not yet proven with PCB wastes under commercial conditions.

APPENDIX II

OVERVIEW OF APPROVAL REQUIREMENTS AND PROTOCOL USED IN ONTARIO

APPENDIX II OVERVIEW OF APPROVAL REQUIREMENTS AND PROTOCOL USED IN ONTARIO

Figure 4 represents an overview of application protocols, authorization stages and general components and time constraints involved in conducting demonstration tests and operating a mobile PCB destruction facility in Ontario.

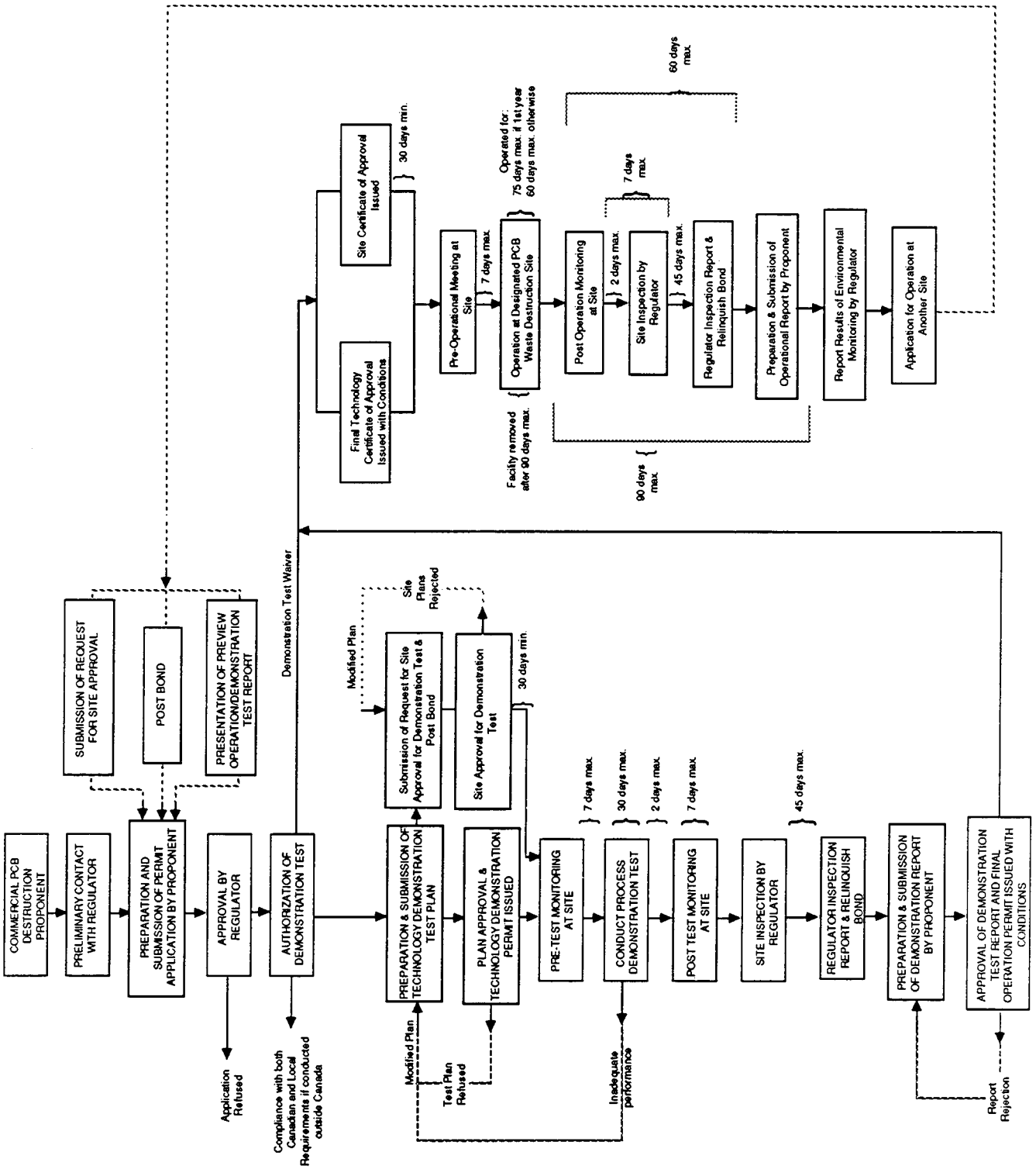

FIGURE 4 GENERAL APPROVAL REQUIREMENTS AND PROTOCOL USED IN ONTARIO

APPENDIX III

RECOMMENDED CONTENT OF A TECHNOLOGY PERMIT APPLICATION FOR MOBILE PCB DESTRUCTION SYSTEMS

APPENDIX III RECOMMENDED CONTENT OF A TECHNOLOGY PERMIT APPLICATION FOR MOBILE PCB DESTRUCTION SYSTEMS

Specific approvals and formal written permits should be required prior to operating any commercial mobile PCB destruction facility in Canada. Accordingly, a proponent of any technology should satisfy the regulator that the facility can be operated in an environmentally safe manner and that all pertinent operational and environmental standards/criteria, defined within a given jurisdiction, can be consistently met. The types of activities that typically require permits are:

Full-scale Operation: A formal regulatory approval should be required for each PCB destruction facility before operation and a separate approval also is recommended for every new location at which the facility is temporarily located. Specific operational time limits may be imposed by the regulator so that operations are minimized in a given locale.

Demonstration Tests: Prior to issuing an operating permit, regulators may request a process demonstration test for new technologies or those which may have been approved or tested in another jurisdiction. Both technology and site approvals should be obtained before testing/operating any commercial facility. A demonstration test permit should include operational conditions and specify a limited time and quantity of waste to be treated at one location for purposes of defining process performance.

Research Tests: The testing of any laboratory/pilot-scale facility being developed to destroy PCBs should have prior approval by regulators. This may be obtained on an individual and less formalized basis than required for commercial facilities. Although primarily applicable to commercial processes, recommended procedures addressed in this report may become the ultimate, longer-term requirement for research-type facilities. Generally, much smaller waste quantities would be involved in such tests than in demonstration tests or commercial operation. In any case, the emission or discharge regulations of a given jurisdiction must be complied with for the destruction of any PCB waste and information on potential emissions and verification procedures should be supplied to regulators.

The following general information is provided to proponents of commercial and developing technologies that intend to submit an application to operate a commercial PCB destruction facility in Canada.

1. **Application Procedures.** In applying for permits, it is recommended that preliminary contact be made with the appropriate government agency for the jurisdiction in which the planned facility is to be located in order to obtain information on specific jurisdictional requirements. Depending on the previous operating experience of the applicant, applications may be submitted for one of the permit types together with supporting documentation on the facility. In the event that a demonstration test is required or considered likely, a separate demonstration test plan would be submitted at a later date.
2. **Recommended Application Information.** An application to be submitted for technology approval should include (as a minimum) the information found in the following table.

RECOMMENDED CONTENT FOR A TECHNOLOGY PERMIT APPLICATION FOR MOBILE PCB DESTRUCTION SYSTEMS
(modified from Reference 8)

1. PERMIT COVER
   - Technology Identification (standardized terminology)
   - Company identification (name, address, contact)

2. SUMMARY
   - Process
   - Approval Status
   - Location of Facility

3. PROJECT ORGANIZATION
   - Chart
   - Text
   - Contractual Arrangements
   - Staff Functions/Responsibilities

4. WASTE DESCRIPTION
   - Type/Concentration Range
   - Total Amount/Feed Rate
   - Physical/Chemical Description
   - Heating Value

5. PROCESS ENGINEERING DESCRIPTION (Facility Description)
   - General Overview
     - description of key components and configuration
     - flow diagram
     - mobility features and transportation requirements
     - size of facility and components
   - Waste Feed and Handling System
     - storage handling and distribution system (waste and other process inputs)
     - design and actual maximum/minimum feed rates
   - Waste Feed Shutdown System
   - Destruction System
     - safety features
     - principle and mode of operation
     - temperature/residence time (primary/secondary combustion)
     - feed/operational restrictions (temperature)
   - Pollution Control System
     - air, water, waste descriptions (control equipment, stack height)
     - expected emission (types, concentrations)
     - fugitive emission control
   - Process Operating Parameters
     - run duration (minimum, maximum if applicable)
     - temperature/pressure control
     - auxillary fuel requirements
   - Facility Service and Support
     - power, water, other service requirements
     - laboratory and other support requirements
   - Liquid/Solid Residue Handling Systems and Disposal
     - storage capability and handling systems
     - pollution control device effluent and ash quantities, rates and handling systems
     - disposal requirements and procedures

6. OPERATIONAL PLAN
   - Startup, Shutdown Procedures
   - Operating Conditions
   - Proposed Activity Schedule

7. MONITORING PLAN
   - Scope and Extent of Monitoring (process, emission, environmental)
   - Monitoring Parameter List
   - Input/Output Monitoring and Material Balance Calculations
   - Monitoring Frequency
   - Monitoring Design (frequency, locations)

8. PERFORMANCE MONITORING PROCEDURES
   - Appropriate Methods and Degree of Automation
   - Written Protocols
   - Apparatus/Equipment
   - Calibration and Maintenance
   - Data Reduction and Storage
   - Data Reporting

9. INSPECTION PROCEDURES
   - Waste Feed System
   - Destruction Feed System
   - Waste Feed Cut-off System
   - Pollution Control System
   - Alarms
   - Fire Extinguisher Systems

10. SPILL AND ACCIDENT PREVENTION CONTROL AND COUNTERMEASURES PLAN
    - Appropriate Preventative Measures and Contingencies (spills, fire, explosions)
    - Containment and Cleanup Procedures/Equipment
    - Pollution Control and Operational Upset Feedback/Shutdown Systems
    - Vandalism Prevention

11. OCCUPATIONAL HEALTH AND SAFETY PLAN
    - Operation Protection (impervious clothing, respirators, wash facilities, housekeeping)
    - Medical Surveillance Programs

12. TRAINING PLAN
    - Knowledge of Facility and Emergency Response Procedures
    - Knowledge of Waste Handling and Occupational Health Guidelines

13. INSURANCE COVERAGE
    - Liability Coverage
    - Other Monetary Assurance

14. QUALITY ASSURANCE PLAN
    - Format
    - Organization and Responsibility
    - QA Objectives (precision, accuracy, completeness, representativeness)
    - Monitoring, Sampling, Analysis Procedures
    - Calibration Procedures and Frequency
    - Data Reduction, Validation and Reporting
    - Internal/External Quality Control Checks
    - Preventative Maintenance
    - Specific Procedures to Assess Data
    - Corrective Action
    - QA Report

15. CLOSURE PLAN
    - Facility Decommissioning and Waste Removal
    - Site Cleanup (as required)
    - Activity Report

16. TEST DATA OR ENGINEERING PERFORMANCE CALCULATIONS
    - Previous Test Descriptions and Results
    - Engineering Calculations (destruction efficiency, material balance, combustion efficiency)
    - Emission Compliance Information
      - air (PCBs, PCDDs, PCDFs, acid gases)
      - Liquid/solid waste

With reference to the foregoing table, specific explanatory notes on some sections of the application follow.

a) **Process Engineering Description (Facility Description)**

A description of the facility should include information such as: process equipment and design details, process mobility and waste handling features, services required, facility enclosure/containment capabilities, emission controls and waste discharge information. In addition, pertinent information regarding company organization and project staffing should be provided. These descriptions should contain sufficient detail to allow the regulator to evaluate the capabilities of the destruction equipment and staff qualifications of the proponent and/or operator.

b) **Waste Description**

The nature and quantity of PCB wastes to be destroyed should be indicated, including the applicable PCB concentration range and composition. The proponent should specify intended feed rates for each type of PCB waste (e.g., maximum and minimum rates as a function of PCB concentration), feed pre-treatment requirements and feed handling/storage equipment and procedures. As feed analysis generally will be a requirement during operation and the PCB concentration limit to be allowed will be set at the approvals stage, descriptions of feed capabilities and analytical methods should be given in sufficient detail to meet the requirements of the approval agency(ies).

c) **Process Operating Conditions**

The applicant should define an operational plan related to the specific types of PCB wastes to be destroyed. This should include conditions and parameters under which the facility will operate such as: facility start-up procedures, control of PCB waste feed-rates within specified ranges, process parameters and emission controls, record keeping and other staff functions, proposed methods to dispose of solid wastes/liquid effluents, shutdown and equipment decontamination strategies where applicable. The operating conditions indicated in the plan must be technically sound and based on previous demonstration and/or commercial operation of the facility with types of PCB wastes similar to those requiring destruction. The proposed operating conditions, and other information supplied, will assist in defining the need for a demonstration test upon review by the regulator.

d) **Monitoring and Inspection**

Information in the application should address all monitoring aspects and should identify all types of expected air and water emissions in conjunction with points of discharge and associated control techniques. For example, the proponent should provide: methods that have been and/or will be used to continuously monitor critical process operating parameters; procedures to monitor emission streams as required; and details of any environmental measurements that may be required. The extent of monitoring, especially performance and environmental monitoring requirements, may vary between jurisdictions and procedures identified in the submission will need to comply with those of the given jurisdiction. Routine inspection procedures of all facility components also should be indicated as should a quality assurance plan. This information supplied in the application, in conjunction with previous performance monitoring of the facility, can also be expected to form the basis in determining the need for a demonstration test.

e) **Staff Training, Safety and Emergency Contingency Plans**

Applications should contain information relating to procedures, safety measures, preventative measures and contingency plans to prevent/control spills, fires, vandalism or other emergency situations. Additional information should be provided regarding safe work practices and available protective equipment to minimize operator exposure to PCBs and other chemicals in conjunction with occupational health requirements of the jurisdiction. The proponent also should indicate operator qualifications and training that is required, or currently exists, in operating the facility, especially with regard to knowledge of the facility and emergency response protocols.

f) **Facility Performance Data**

All data regarding facility performance should be provided, including previous operating data, demonstration test data and/or reports, which can be used to demonstrate successful PCB destruction by the specified facility and adherence to existing provincial environmental regulations. Recommended performance requirements for mobile thermal destruction systems are discussed in Section 3. Alternatively, results of pilot or bench-scale tests which have established successful destruction of PCBs without generation of undesirable products or other pollutants should be submitted as the basis for the proposed commercial-scale facility. This documentation, or a part of it, may be required as a separate report to be submitted with the application.

g) **Application for Facility Siting and Activity Scheduling**

A separate application for siting facilities will normally be required after receiving technology approval. Proponent applications for siting facilities should include the following types of information: other approvals (e.g., technology, other sites), the location of the proposed site and information to indicate how it satisfies available jurisdictional site selection criteria and a description of the proposed site characteristics. In some jurisdictions, calculation of ground level point-of-impingement concentrations will be required with the application to ensure that certain air pollutants emitted from the facility comply with jurisdictional ambient air quality criteria at the specific site.

The applicant should also define any site preparation requirements specific to the facility and procedures that will be used.

The proponent also should indicate the proposed operating duration at a given site, an operating schedule which specifies activities from initial site preparation including sufficient time for public notification (where required) to final closure of the facility and the time interval required after closure to submit a report on site operations. The activity schedule should not exceed any time limitations that are regulated for temporary site operations. The frequency of operations at any site within the same municipality should be outlined in the application as this also may be regulated for specific types of mobile destruction facilities. Specific liability insurance and other monetary assurances should be required for operations at each site.

APPENDIX IV

RECOMMENDED CONTENT OF A DEMONSTRATION TEST PLAN FOR THERMAL DESTRUCTION TECHNOLOGIES

APPENDIX IV RECOMMENDED CONTENT OF A DEMONSTRATION TEST PLAN FOR THERMAL DESTRUCTION TECHNOLOGIES

Types of Activities Requiring Permits

1. **Test Plan.** In the event that procedures, results, test durations, and other specific requirements provided in facility applications and other documentation comply with those being regulated or considered acceptable by the regulatory authority, a process demonstration could be waived. Alternatively, the regulator may request collection and analysis of additional data using approved methods or require a comprehensive demonstration test to be performed with conditions stipulated by the regulator.

   Should a process demonstration be required, the proponent will need to obtain written permission (e.g., test permit) that allows operation on a limited amount of PCB-containing waste. A demonstration test plan should then be submitted, preferably after the regulator's comments on the technology application have been received and it has been determined that a demonstration test is needed. If required, the test plan should present the test objectives and the manner in which the test will be conducted. Because the conditions defined for process demonstration will probably form the basis and scope of subsequent operations, the demonstration test plan should be as thorough and complete as possible.

   The following table is a summary of the basic recommended technical content of the demonstration test permit application. Documentation on each of the items should be provided in the plan. Unless there are test-specific changes, some of the information already provided in the application of technology approval need only to be referenced or briefly discussed in the plan (e.g., facility description and organization). Methodologies to monitor process parameters and all sampling and analytical techniques to measure total PCB content (and other parameters, where required) in each proposed type of feed, in the corresponding emission or effluent streams and in environmental samples should be clearly indicated. Emission monitoring should be designed to ensure that sufficient data will be available to determine the environmental significance of operations. Documentation should also be submitted to show an adequate level of operator training under both normal and emergency situations. Similarly, the test strategy, activity schedule and the proposed test location should be identified and sufficient time allowed for public comment.

2. **Test Conduct.** The demonstration test should be conducted for a limited term with a limited amount of PCB waste. Feed quantities, however, should be sufficient to allow normal operations to proceed so that adequate amounts of samples can be acquired for technology performance assessment/confirmation. Process testing activities must demonstrate compliance with operation controls, monitoring and record-keeping requirements that have been approved in the test plan.

   The range of process monitoring parameters, within which acceptable emissions are expected to be achieved, should be established and/or confirmed during testing. If excursions occur beyond the range, the facility should be immediately shut down. Additional information regarding demonstration test requirements (e.g., monitoring, operation, etc.) is provided in the appropriate sections of the manual.

RECOMMENDED CONTENT OF A DEMONSTRATION TEST PERMIT APPLICATION

ACTIVITY PLAN	CONTENT DESCRIPTION
1. Operating Requirements during Demonstration	
Operational Plan and Test Parameters	- supply information on mobility features which may require demonstration and the mode of facility operation specific to planned test (e.g., batch/continuous) - define process operating parameters/conditions to be maintained at the start, during testing and upon shutdown with stated limitations to be demonstrated (e.g., temperature, combustion efficiency, etc.) - define operational controls to be tested and pollution control operating parameters - describe any shakedown requirements (e.g., pretest with non-PCB containing feed) - identify procedures to establish proper operating conditions before introduction of PCB feed - define test strategy (e.g., number of tests per type/concentration of PCB waste) - specify supplementary fuel requirements and availability for test
Waste Feed Plan	- define procedures for unloading/storing/transferring PCB feed to the process - identify bulk storage requirements and waste volumes expected to be handled during tests and means of transport to the site - define planned minimum/maximum feed rates and PCB concentrations by type of waste (e.g., solid/liquid) - indicate any waste preparation requirements (e.g., shredding)
Other Functional Plans	- describe plans to test waste feed or process cut-off systems when process conditions deviate beyond stated limits - define tests for alarms, fire extinguisher systems and other contingency plans during process demonstration - identify facilities for spill prevention/containment, retention of solid/liquid process waste streams or products until discharge is permitted (i.e., sufficient capacity for entire demonstration, test), means to prevent accumulation of PCBs or other pollutants in precipitation - demonstration of operator training under normal and emergency situations (e.g., knowledge of facility, environmental and safety concerns of PCBs, emergency response procedures)
2. Sampling and Monitoring Plan	
General Requirements and Monitoring Locations	- the designed plan should include both process and environmental monitoring to ensure that sufficient samples and data are available to characterize the environmental significance of operations (some samples may be required for historical purposes) - identify critical process parameters that require continuous monitoring during tests - describe all process/emission monitoring and environmental sampling locations - specify the number of samples per location and test
Monitoring Parameters a) Process and Emissions	- the design should indicate the monitoring parameters and a summary of data to be obtained - examples of parameters to be measured are: PCBs and other pollutants in both PCB waste feed and fuels introduced, operating parameters such as temperature and pressure, PCBs and other pollutants in the final product or liquid/solid/sludge effluents, PCBs and other pollutants in emissions to air including stacks or vents
b) Environmental	- the plan should incorporate environmental sampling that may be required associated with pre-and post-testing and during demonstration tests - examples are: PCBs and other pollutants in ambient air and nearby soils, water and vegetation - in some instances, this or a portion of the environmental monitoring may be undertaken by the regulatory body
Sampling and Monitoring Methods	- specify proposed sampling and monitoring methods for each measurement which, in most cases, will require approval by the regulator - indicate the frequency, replication and sample size (e.g., feed composition may require continuous collection) - define any sample transport or preservation requirements
a) Analysis Method	- specify proposed analytical methods for each type of sample indicating the procedures/instrumentation to be used for analysis with information on calibration standards/procedure, anticipated detection limit
b) Recording/ Record Keeping	- identify data reduction procedures - provide calculation methodology that will be used to demonstrate destruction efficiency or material balances using appropriate engineering units - identify record keeping and sample custody plans
3. Discharge Containment Plan	- define measures to contain any liquid effluent, solid wastes, material products, contaminated materials, etc. that result from demonstration testing until disposal approval is received
4. Quality Assurance Plan	- define quality assurance procedures with respect to test-specific information such as: system performance, inspections, preventative maintenance - define quality assurance procedures with respect to measurements and data validation such as: sampling/analytical methods, calibration, precision, accuracy, sample representativeness
5. Site-specific Plan	- define the test location and how it conforms to any required site selection criteria - specify the proposed operating schedule (e.g., planned daily activities and proposed dates) and test duration in conformance with any jurisdictional time-constraint requirements

Note: Data provided should be specific to the planned demonstration test and reference made to additional information supplied in the technology permit application unless different (e.g., project organization, technology description).

3. **Test Report.** After a demonstration test has been performed, a report of the results should be prepared and submitted to the regulator. The report should contain: a description of the test; all monitoring/operating parameters; any period of anomalous operation; tables of all pertinent results; demonstrated performance data (e.g., destruction efficiency) including calculation methods; quality assurance information; and inspections that were conducted. The regulator should review the report to determine if it contains all necessary elements and the degree to which the demonstration has met the objectives of the test. It can be expected that test results will be critically reviewed for:

   - completeness (i.e., if all test data have been taken);
   - representativeness and validity;
   - material balance calculations;
   - a determination whether or not test data meet destruction efficiency requirements; and
   - any potential environmental impact of the facility.

   The regulator should also approve disposal of any residual waste generated by the facility during testing in accordance with approved methods in the event that the PCB content (or other contaminants) meets disposal standards.

4. **Facility Approval.** Upon acceptance of the process demonstration test report and a determination that the process operates within all of the pertinent jurisdictional requirements and conditions of the demonstration test permit, the regulator should issue final approval to permit commercial operations of the technology. The proponent then requires site approval to conduct further operations.

APPENDIX V

TOXICITY FACTORS

APPENDIX V TOXICITY FACTORS

Congener	Toxicity Factor
PCDDs	
1. 2,3,7,8-T4CDD	1.0
2. 1,2,3,7,8-P5CDD	0.5
3. 1,2,3,4,7,8-H6CDD	0.1
4. 1,2,3,6,7,8-H6CDD	0.1
5. 1,2,3,7,8,9-H6CDD	0.1
6. 1,2,3,4,6,7,8-H7CDD	0.01
7. 08CDD	0.001
PCDFs	
8. 2,3,7,8-T4CDF	0.1
9. 1,2,3,7,8-P5CDF	0.01
10. 2,3,4,7,8-P5CDF	0.5
11. 1,2,3,4,7,8-H6CDF	0.1
12. 1,2,3,6,7,8-H6CDF	0.1
13. 1,2,3,7,8,9-H6CDF	0.1
14. 2,3,4,6,7,8-H6CDF	0.1
15. 1,2,3,4,6,7,8-H7CDF	0.01
16. 2,3,4,6,7,8,9-H7CDF	0.01
17. 08CDF	0.001