GUIDELINES FOR MOBILE POLYCHLORINATED BIPHENYL DESTRUCTION SYSTEMS

Canadian Council of Ministers of the Environment

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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

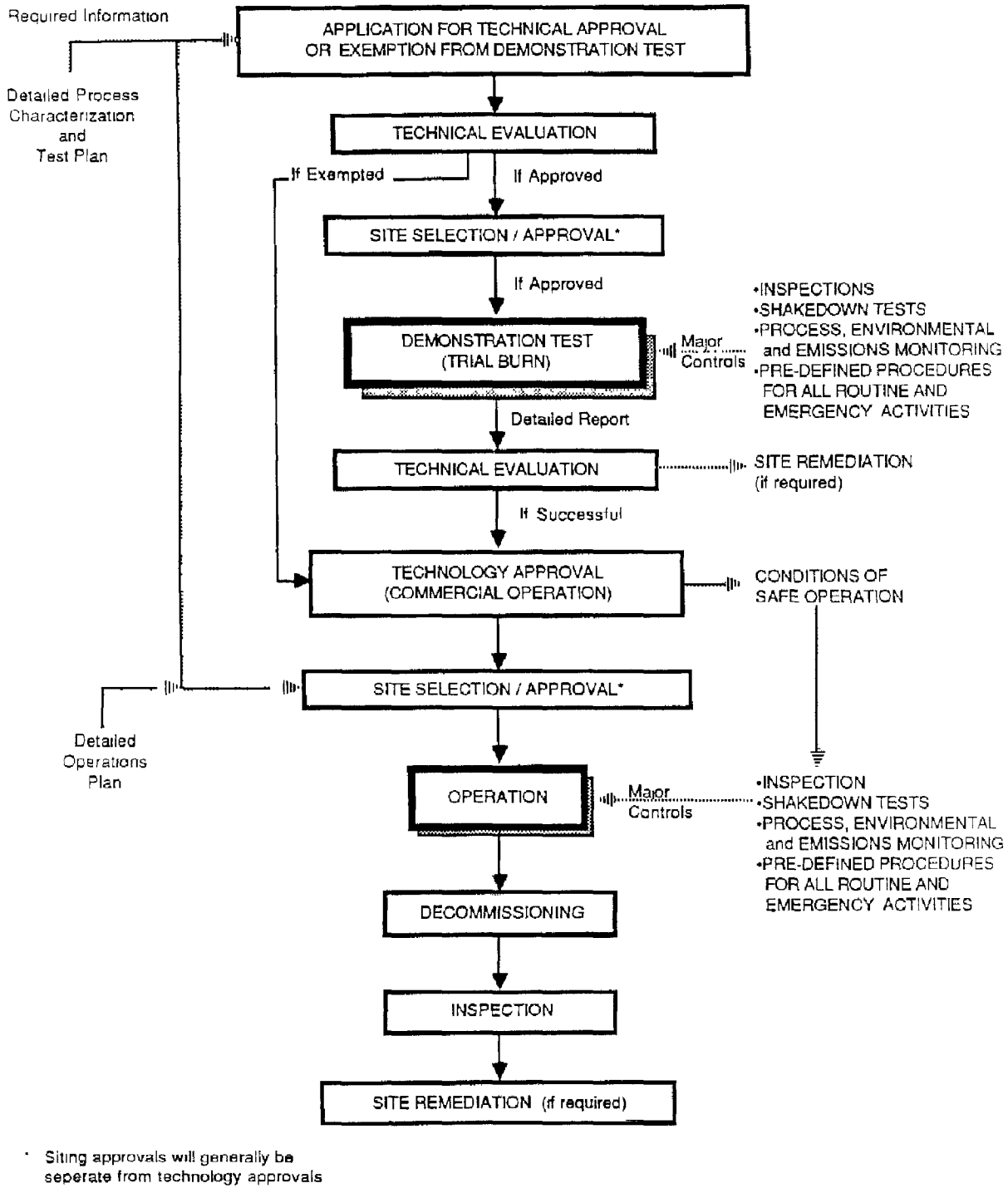

FIGURE 1 OVERVIEW OF THE RECOMMENDED APPROVALS PROCESS FOR MOBILE PCB DESTRUCTION SYSTEMS

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.

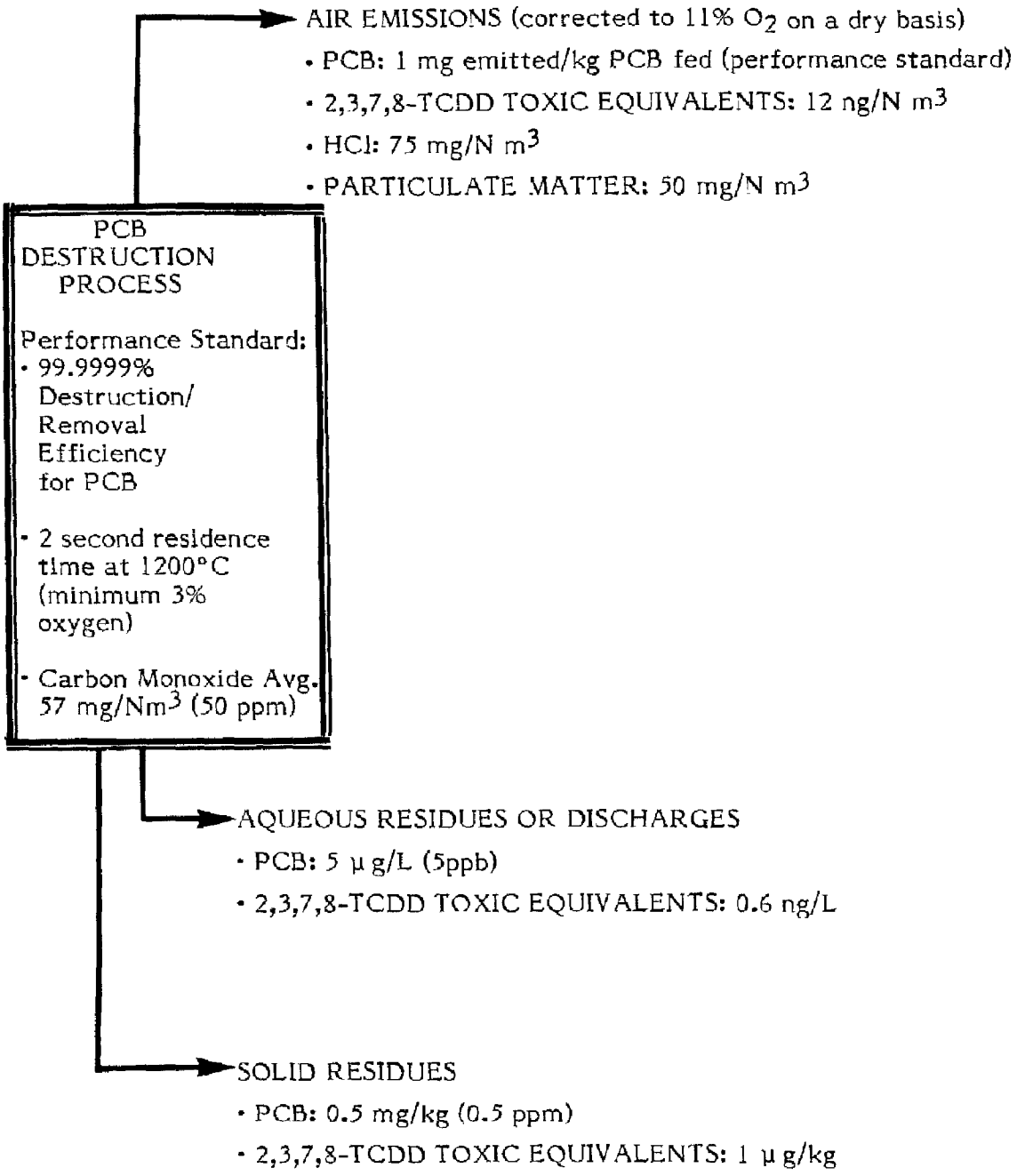

FIGURE 2 FEDERAL PERFORMANCE/EMISSION CRITERIA FOR MOBILE, PCB DESTRUCTION SYSTEMS

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.