

PROVISION OF TECHNICAL ASSISTANCE TO SUPPORT
IMPLEMENTATION OF THE PCB REGULATIONS
(January - December 1983)

by

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GCA/Technology Division
Bedford, MA 01730

Contract No. 68-02-3168
Technical Service Area 3
Work Assignment No. 58

Radford C. Adams
Radian Corporation
Research Triangle Park, NC 27709

Contract No. 68-02-3174
Technical Service Area 3-40
Work Assignment No. 105

EPA Project Officer

David C. Sanchez

Industrial Environmental Research Laboratory
Office of Environmental Engineering and Technology
Research Triangle Park, North Carolina 27711

Prepared for

OFFICE OF RESEARCH AND DEVELOPMENT
U.S. ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

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ABSTRACT

This report summarizes the technical assistance activities continued during 1983 to support implementation of the PCB regulations. These activities, which began in 1981, included regular bimonthly liaison with EPA regional offices and the provision of specific technical and coordinative assistance to these offices as requested.

GCA/Technology Division was assigned to provide assistance to the Eastern EPA Regions I-V and OPTS, while Radian Corporation performed an identical function for the Western Regions VI-X. Individual technical assistance reports were prepared and distributed. Copies of these reports are included in the appendices.

This report is submitted in fulfillment of Work Assignment 58 of Contract No. 68-02-3168 by GCA/Technology Division and Work Assignment 105 of Contract No. 68-02-3174 by Radian Corporation. These work assignments were performed under the sponsorship of the U.S. Environmental Protection Agency. This report covers the period 1 January 1983 to 31 December 1983.

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PROVISION OF TECHNICAL ASSISTANCE TO SUPPORT IMPLEMENTATION OF THE PCB REGULATIONS

INTRODUCTION

Technical assistance activities continued in 1983 at a level comparable to those experienced in 1982. Assistance was again provided by GCA/Technology Division and Radian Corporation (Radian acquired the Environmental Operations of TRW Inc. in 1983. Technical assistance services prior to November 4, 1983 were provided by TRW.) in a twofold direction: the regular bimonthly liaison with EPA regional offices which began in 1981 and which reports on the status of all PCB related submittals; and the provision of specific technical and coordinative assistance efforts to these offices on a quick response, as-needed, basis. GCA was assigned to provide technical assistance to the eastern EPA Regions (I-V), and Radian performed an identical function in the western regions (VI-X). This project report will detail specific advances that were experienced by the PCB program in 1983. A review of the bimonthly reports published during 1983 will serve to describe advances in the PCB disposal industry as well as PCB research and development projects during this year, while a synopsis of individual technical assistance efforts will highlight specific areas of need with regard to administration of the PCB program. This report covers the period of 1 January 1983 to 31 December 1983.

REGIONAL PERMIT ACTIVITIES

Submittals to the EPA regional offices declined sharply in 1983 from the preceding year. Only nine submittals for destruction or detoxification of PCBs and PCB contaminated materials by thermal and non-thermal methods were received. No applications for new landfills

were received. The EPA approved five of the nine applications submitted, of which four were for research and development (R&D) testing. Chemical dechlorination, plasma jet incineration, mechanical shredding and rinsing, and a proprietary process were the process technologies for which the R&D studies were approved.

The EPA regions approved a total of 41 applications during 1983 compared with 64 applications approved in 1982. R&D studies predominated the approvals with 20 R&D applications approved. Also, sixteen new facilities were approved that are available for commercial use and five new facilities were approved for private use. These included two high efficiency boilers.

The tables of Appendices A and B indentify the year end status of regional permit activities. During 1983, responsibility for mobile disposal permitting was transferred to the Office of Pesticidies and Toxic Substances (OPTS) in Washington and little permitting was accomplished while this transfer was being implemented.

The tables of Appendices C and D are initiated with this report to provide additional technical information about PCB disposal facilities that are permitted or being considered for permitting. These tables are useful for identifying those facilities that are available for commercial use, their permit expiration dates, and their permit conditions. PCB disposal capability at the beginning of 1984 is summarized in the following paragraphs. Summary statements about concentration limits, process capacities, test results and frequency of operation are not included because much of this information has been classified as confidential business information (CBI). All available data are listed in the tables of Appendices C and D.

There were a total of 58 permitted thermal destruction/detoxification stationary facilities as the year 1983 ended. Twenty-six were available for commercial use and 16 sites were involved in R&D studies and not available commercially. The rest of the sites treated onsite wastes only or had never been utilized. Eighteen high efficiency boilers were authorized for PCB disposal use.

Disposal methods included thermal destruction, chemical dechlorination, mechanical separations (shredding, container rinsing, etc.), and alternative methods that are primarily still in the research and development stage.

The 34 thermal destruction sites included five R&D facilities, 18 high efficiency boilers and 11 incinerators. Three incinerators and 11 high efficiency boilers were available for commercial use.

There were 13 chemical dechlorination sites, including 6 R&D facilities.

Five facilities used mechanical separation techniques.

Research and development focused on thermal and chemical dechlorination technologies. Chemical dechlorination development included optimization of existing processes and the testing of new solvents. The developing thermal methods included molten salt (2), plasma jet incineration, pyrolysis, fluidized bed incineration and a fluid volume reactor. Non-thermal methods include in-situ dechlorination, solvent extraction, physical absorption, biodegradation, and one method identified only as non-thermal. The process technology at one site was confidential business information (CBI).

Additional R&D work was permitted during 1983 or earlier with expiration dates occurring before the end of the year. There were eight chemical dechlorination, one pyrolysis, one thermal stripping, and two unidentified studies in this category.

At least 19 thermal destruction/detoxification mobile units were permitted in one or more regions (the total number of units may be higher than 20 because the number of units of one operator are not available). There are only two approved mobile incinerators in the country. The rest of the mobile facilities use chemical dechlorination processes, of which two are approved for R&D studies. One test unit is approved for thermal research (fluidized bed incineration). Fifteen chemical dechlorination units are commercially available.

TECHNICAL ASSISTANCE

GCA provided direct technical assistance at the request of EPA Region I to quantify environmental releases of PCBs and potential incomplete combustion products during a PCB destruction efficiency test

of the New Bedford, Massachusetts municipal sewage sludge incinerator. Sampling was completed in February 1984 and sample analysis is underway. Results of this effort will be compiled in a separate report. The test program is described in Appendix E.

The New Bedford sewage sludge incinerator was undergoing repairs during part of 1983 and consideration was given to conducting the needed test with a surrogate incinerator. Radian provided direct technical assistance toward implementation of a test of the Anchorage, Alaska utilities department sewage sludge incinerator. Pretest surveys were conducted and a QA Project Plan was prepared (Appendix F). Anchorage has in storage substantial quantities of waste oil containing PCBs in low concentrations. Anchorage Utilities was preparing an operations plan prior to testing by Radian when public opposition to the test led to a decision to postpone testing indefinitely.

CONCLUSIONS AND RECOMMENDATIONS

During 1983, submittals to the EPA regional offices for PCB disposal authorization declined sharply from the preceding year. Application approvals were also down from 1982 but continued at a brisk pace. These facts substantiate the conclusions found in the last summary report¹ that regular reports of PCB activities, such as those found in Appendices A through D of this report, are unnecessary. Another year has provided further opportunity for regional PCB personnel to have become aware of the activities and the personnel involved in all of the regions. Also, since there is now a single focal point at OPTS headquarters for mobile sites, interaction and liaison between regions regarding these disposal units is no longer necessary. The need for regular bimonthly reports is therefore diminished.

The PCB programs in the regions have been strengthened to the extent that permitting workload has become more predictable and less demanding. Thus, additional manpower needs on an as-call basis to

¹Provision of Technical Assistance to Support Implementation of the PCB Regulations (January - December 1982).

alleviate short term personnel shortages are less likely. In 1983, tests of the performance of thermal devices for the destruction of PCBs were the only short term technical assistance types of activity provided. A continuing need for independent tests of as yet unproven technologies should be anticipated.

Accordingly, a few specific technical assistance efforts appear desirable in the immediate future. Specific recommendations are as follows:

1. Continue independent tests of PCB disposal processes. There was considerable R&D activity in 1983, suggesting that there may be continuing need for independent testing of developing PCB disposal processes and further clarification of the formation of potentially hazardous products of incomplete combustion is needed for validating the ability of combustion processes to dispose of PCBs adequately.
2. Provide waste generators with information about the latest advances in PCB disposal processes (or their deficiencies). Also, making the public aware of the abilities of reliable processes may be equally important.
3. Identify best practice test plans for alternate disposal of PCBs found in illegal or abandoned dump sites. Technical assistance efforts might consist of (a) obtain data of the types of PCB items found at dump sites, (b) identify the optimum disposal process for each dump site, and (c) recommend process technologies.

APPENDIX A

REPORT ON PCB ACTIVITIES AND POLICIES - VOLUME 12
(EPA REGIONS I-V)

December 2, 1983

Office of Pesticides and
Toxic Substances

Volume 12

Introduction

This is the twelfth of a series of reports designed to inform responsible Headquarters, Laboratory and Regional Office personnel of PCB-related activities in U.S. EPA Regions I - V. Together with a companion report for Regions VI - X, it will serve to update the current status of all regional actions related to implementation of the PCB regulations (40 CFR 761).

Permit Activities

The current status of all thermal and nonthermal PCB destruction activities in Regions I through V are reported in Tables A-1 through A-5. The companion newsletter reports these activities for Regions VI - X in Tables B-1 through B-5 of Appendix B. Table A-6 presents data on mobile PCB disposal/destruction systems, which are the responsibility of EPA headquarters staff. Table A-7, which is common to both newsletters, presents the principal PCB and toxic waste contacts in each region, as well as the prime technical assistance contacts for PCB-related assistance. A narrative of the updated data obtained from Regional office contacts for Regions I - V is provided (see Regional Summaries).

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TABLE A-1. INFORMATION ON PCB ACTIVITIES - REGION I

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and Nonthermal Destruction</u>							
Public Service Company of New Hampshire	02/06/80	Merrimac Station, NH	PCB contaminated mineral oil	Thermal	High efficiency utility boiler	No test burn scheduled	Approved 3/3/80.
New England Power Company	10/14/80	Salem Harbor Station, MA	PCB contaminated mineral oil	Thermal	High efficiency utility boiler	No test burn scheduled	Approved 12-80. Not interested in pursuing an actual burn at this time.
General Electric	Spring 1980	Pittsfield, MA	PCB contaminated mineral oil	Thermal	Liquid injection incinerator	Test burn conducted 11/30/81	Approved to burn fluids with 500 ppm on 8/19/80; November 1981 test utilized oil with 20% PCBs. Approved as an Annex I incinerator March 4, 1982.
Northeast Utilities	06/19/80	Middletown Station, Middletown, CT	PCB contaminated mineral oil	Thermal	High efficiency utility boiler	Test burn conducted 09/81	Approved 09/04/80.
Massachusetts Institute of Technology	-	-	-	-	-	-	Informal inquiry made to EPA office, No further action taken.
New Bedford Municipal Sludge Incinerator	-	New Bedford, MA	Municipal/Industrial Sludge containing PCBs	Thermal	Multiple hearth incinerator	-	PCB destruction efficiency testing has been postponed indefinitely due to equipment funding problems.
ACUREX	January 1981 11-15-82	Mobile	PCB contaminated waste oil	Chemical	Dechlorination	Demonstrated nationally 09/09/81	Approved, February 1, 1982, for mineral oil dielectric fluids only. No limit on maximum allowable PCB concentration. Request received in Nov. 1982 to modify approval to accommodate a design change in the system.
SUNOHIO	March 1981	Mobile	PCB contaminated waste oil	Chemical	Dechlorination	Demonstrated nationally 10/24/80	Approved June 1981 for mineral oil dielectric fluids only. No limit on maximum allowable PCB concentration.
Pyro-Magnetics	December 1981	Mobile	PCB contaminated waste oil	Thermal	Incineration	-	Test burn results received May 11, 1982. Letter issued July 9, 1982 qualifying unit as an Annex I incinerator. Region will issue site specific approvals.
PCB Destruction Company	12/13/81	Mobile	PCB contaminated waste oil	Chemical	Dechlorination	-	Demonstration 3-82 in Region VII apparently successful; awaiting additional data.

(continued)

TABLE A-1. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
PPM, Inc.	12/14/81	Mobile	PCB contaminated waste oil	Chemical	Dechlorination		Approved March 26, 1982 for mineral oil dielectric fluids only.
Transformer Consultants, Division of S.D. Myers	04/05/82	Mobile	PCB contaminated mineral	Chemical	Dechlorination	Demonstration run conducted 14,15 April 1982 in Region V	Approved November 29, 1982 for fluids containing up to 3000 ppm of PCBs.
Transformer Services, Inc.	06/01/82	Concord, N.H.	Mineral oil dielectric fluid	Chemical	Dechlorination	Bench scale demonstration 16 June 1982	Bench scale demonstration on 1600 ppm waste successful.
<u>Landfills</u>							
No landfills approved for PCB disposal in Region I.							

TABLE A-2. INFORMATION ON PCB ACTIVITIES - REGION II

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and nonthermal disposal</u>							
General Electric		Waterford, NY	PCB contamin- ated waste oil	Thermal	Incineration	Demonstration test conducted September 1978	Originally approved September 1978 for 3 years; <u>Permit renewed March 31, 1982 for an additional 5 years.</u>
General Electric	12-21-82	Waterford, NY	PCB's, RCRA wastes	Thermal	Rotary Kiln Incineration	Trial burn in preparation	Annex I Incinerator classification sought, meetings held March 1983, responses to EPA questions received 5/18/83, under review. Trial Burn Public Notice issued 11-18-83.
Consolidated Edison of NY	1-80	Ravenswood Station, Astoria, NY	PCB contamin- ated waste oil	Thermal	High effici- ency boiler	-	Withdrew application.
Alcoa	Feb. 1981	Messina, NY	PCB contamin- ated waste oil	Thermal	High-effici- ency boiler	-	Application never completed.
Atlantic Electric	2-81	New Jersey					Informal inquiry.
Trofe	April 1981	Mount Laurel, NJ	PCB contamin- ated solid and liquid waste	Thermal	Multichamber Incinerator	Awaiting test burn plan	Awaiting state approval and other additional information.
Rollins	May 1981 7-25-83	Bridgeport, NJ	PCB contamin- ated liquids and nonliquids	Thermal	Incineration	-	Annex I incinerator classification sought, under review.
NEWCO	Spring 1981	Niagara Falls, NY	PCB contamin- ated trans- formers	Non- thermal	Solvent clean- ing, batch distillation to concentrate residue	Test demonstra- tion authorized 7-20-83	Test protocol, operations plan submitted 11-82. Region II comments sent 12-82. Reply to com- ments received 3-83, currently under review. Region II awaiting data from Phase I testing.
SUNOHIO	Summer 1981	Mobile	PCB contamin- ated waste oil	Chemical	Dechlorination	Demonstrated nationally 10-24-80	Approved April 28, 1982, maximum allowable PCB concentration into reactor-500 ppm. SUNOHIO on 20 July 1982 requested modifications to approval to allow processing of fluids with up to 2500 ppm of PCB. Approved November 9, 1982 for 2500 ppm.
ACUREX	Summer 1981	Mobile	PCB contamin- ated waste oil	Chemical	Dechlorination	Demonstrated nationally 09-09-81	Approved April 28, 1982. Maximum allowable PCB concentration into reactor-1062 ppm. Design change submitted November 4, 1982, approved 1-83 to allow wastes with up to 7500 ppm of PCBs into the reactor. Approval modified 8-1-83 to allow use of DECD as an alternate to THF.

(continued)

TABLE A-2. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Power Authority of New York	Summer 1981		PCB mineral oil	Thermal	High efficiency utility boiler		No longer interested.
EPA Mobile Incinerator (IT Corp.)	October 1981	Mobile	PCB contaminated waste oil	Thermal	Incinerator	Trial burn conducted 1/3-7/83	Trial burn permit issued July 6, 1982. Trial burn results received. Indicate a DRE of 99.99%. Public notice in preparation.
PPM, Inc.	Dec. 1981	Mobile	PCB-contaminated waste oil	Chemical	Dechlorination	-	Authorization issued 4/26/83 for a maximum PCB concentration of 1100 ppm.
Bengart & Memel, Inc.	Feb. 1982	South Buffalo, NY	200 cubic yards of PCB contaminated soil	Nonthermal in-situ	Sodium polyethylene glycol (Na PEG) process	Test demonstration scheduled 8-22-83	Results of the NaPEG testing were unfavorable. A test plan utilizing the KPEG process was requested. Authorization for test demonstration issued 8-15-83. Region II awaiting test results.
Niagara Mohawk	Feb. 10, 1982	Syracuse, NY	PCB-contaminated transformer fluids	Nonthermal	-	-	Requested research and development status to study alternative nonthermal methods of removing PCBs from transformer fluids. Approved for benchscale testing July 20, 1982. Pilot plant authorization issued 6-20-83.
Transformer Consultants	April 1982	Mobile	PCB contaminated mineral oil	Chemical	Dechlorination	-	Authorization issued 4/26/83 for a maximum PCB concentration of 3000 ppm for the batch process and 2100 ppm for the continuous process.
Puerto Rico Electric Power Authority (PREPA)	June 8, 1982	San Juan Station Units 8 & 9	PCB contaminated mineral oil	Thermal	High efficiency utility boiler	-	Application incomplete. Additional data requested July 21, 1982. Inactive.

(continued)

TABLE A-2. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Long Island Lighting Company (LILCO)	August 8, 1982	Barrett Station Unit #2	PCB contaminated mineral oil	Thermal	High efficiency utility boiler	-	Responded to EPA comments 2-83. CO/CO ₂ monitoring data received, under review. Inactive.
Galson Technical Services	February 4, 1982	East Syracuse, NY	PCB contaminated soil	Chemical	Dechlorination	-	Authorization issued 3/10/83 for bench scale research and development.
Marcus Sittenfield Associates	April 28, 1983	Farmingdale, NY	PCB contaminated liquids	Chemical	Dechlorination	-	Pilot scale research and development, issued 8-10-83.
CCA, Inc.	September 13, 1983	Hato Rey, Puerto Rico	PCB contaminated liquids	Thermal	Mobile liquid injection incinerator	-	Informal inquiry.
<u>Landfills</u>							
CECOS No. 2		Niagara Falls, NY	PCB contaminated solids (capacitors, transformer bodies, etc.)	Landfill	-	-	Approved August 1978, now closed.
CECOS No. 3		Niagara Falls, NY	PCB contaminated liquids, sludges (50-500 ppm)	Landfill	-	-	Approved March 1980, open and operating.
CECOS No. 4		Niagara Falls, NY	PCB contaminated liquids, sludge (50-500 ppm)	Landfill	-	-	Approved January 1982. New liner system in use.
CECOS No. 5		Niagara Falls, NY	PCB contaminated liquids, sludge (50-500 ppm)	Landfill	-	-	Under review.

(continued)

TABLE A-2. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
SCA Chemical Services No. 7		Model City, NY	PCB contaminated solids, sludges (50-500 ppm)	Landfill	-	-	Approved October 1978, open and operating.
No. 10		Model City, NY	PCB contaminated solids, sludges (50-500 ppm)	Landfill	-	-	Approved April 27, 1982.
NY DEC Hudson River PCB Project Site No. 10		Vicinity of Fort Edwards, NY	Sediment from hot spot dredging of Hudson River	Landfill	-	-	Two phase approval, initial phase under active consideration. EIS out for comment.
NY DEC Moreau Site		Moreau, NY	Dredge spoils	Landfill			Approved September 1978, one time use landfill, now closed.
NY DEC West Glens Falls Site		West Glens Falls, NY	Contaminated soils, capacitors	Landfill			Approved October 1979, one time use landfill, now closed.
NY Dept. of Transportation - Buoy 212		"Off-River" Hudson River, New York	Dredge spoils	Landfill			Approved September 1979, one time use landfill, closed.
- Special Area 13		"	Dredge spoils	Landfill			Approved September 1979, one time use landfill, now closed.
<u>Abandoned Landfill Sites</u> (Agreements made between NY DEC and GE to cover exposed wastes)							
NY DEC/ General Electric		Fort Miller, NY	PCB contaminated solids	Landfill	-	-	Remedial plans under review, engineering plans approved, site work to begin Spring 1982.
NY DEC/ General Electric		6 additional sites (unspecified)	PCB contaminated solids	Landfill	-	-	Remedial plans for all six sites now in preliminary review.

TABLE A-3. INFORMATION ON PCB ACTIVITIES - REGION III

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and nonthermal disposal</u>							
Continental Can Company		Hopewell, VA	PCB contaminated waste oil	Thermal	Lime kiln, high efficiency industrial boiler	-	EPA conducted emission testing on lime kiln and power boilers in 1976.
Potomac Electric & Power	10-09-79	Morgantown Station, MD	PCB contaminated waste oil	Thermal	High efficiency utility boiler	-	<u>Approved</u>
Baltimore Gas & Electric	12-21-79	Crane Station Chase, MD	PCB contaminated waste oil	Thermal	High efficiency utility boiler	-	<u>Approved</u>
Energy Optimization Inc. (EOI)-I	04-16-80	Unknown	PCB contaminated waste oil	Thermal	Diesel engine	-	Approved 01-20-81. Withdrawn
EOI-II	03-03-81	Branchton, PA	PCB contaminated waste oil	Thermal	Lime kiln incineration		Withdrawn
EOI-III	06/81	Pittsburg, PA	PCB contaminated waste oil	Thermal	Cement kiln	-	Withdrawn
Acurex	01-29-81	Mobile	PCB contaminated transformer oil	Chemical	Dechlorination	Demonstrated nationally 09-09-81	Approved 3-26-82 for a Maximum concentration into reactor of 1062 ppm. Approved 11-9-82 for a maximum concentration of 7500 ppm.
Pennsylvania Power & Light	02/81	Montour Station, PA	PCB contaminated transformer oil	Thermal	High efficiency utility boiler	-	Company reviewing disposal options
Best Ltd.	03-19-81	Mobile	PCB contaminated waste oil	Thermal	Mobile rotary kiln incinerator	Pilot scale Test Plan received-No date set	Approved for test burn 07-15-81. Awaiting site approval from state. Test burn will be joint Headquarters and Region effort, with Headquarters taking lead role. Test plan sent to HQ on 12-1-83.

(continued)

TABLE A-3. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Franklin Institutes/Philadelphia Electric	05-28-81	Philadelphia, PA	PCB contaminated transformer oil	Chemical	Dechlorination	Pilot scale demonstration successfully conducted April 21, 1982 on 7406 ppm waste	Approved for pilot disposal study 09-25-81. Approved 9-28-82 for 7406 ppm at reactor. A modification sent to Headquarters for approval.
General Electric	05-29-81	Philadelphia, PA	PCB contaminated transformer oil	Chemical	Dechlorination	Pilot scale demonstration successfully conducted May 14, 1982 on 1050 ppm waste	Approved for pilot disposal study 09-25-81. Approved 9-28-82 for 1050 ppm at reactor.
SUNOHIO	09-11-81	Mobile (Canton, OH)	PCB contaminated transformer oil	Chemical	Dechlorination PCBx process	Demonstrated successfully at 192 ppm in Region V 10/24/80	Approved 5-6-82 for maximum allowable PCB concentration at reactor of 500 ppm. Approved 9-9-82 for 2500 ppm at reactor.
SUNOHIO	7-23-82	Jeannette, PA	PCB contaminated heat transfer fluid	Chemical	Dechlorination (PCBx process)	Test conducted 1-18-83	One-time R&D test approved 12-14-82. Based on test result approval granted 3-21-83 for up to 4500 ppm PCBs in Therminol-55 heat transfer fluid and MODF.
Chemical Decontamination Corporation (formerly Life Enterprises Inc.)	09-24-81 08-20-82 (revised)	Mobile (Douglassville, PA)	PCB contaminated transformer oil	Chemical	Dechlorination	Demonstration runs conducted 11-3-82, 11-17-82 4-15-83	Approved 9-23-82 for small pilot study R&D. Second R&D test series successful on 25 gallons of fluid contaminated with 4179 ppm of PCBs. Company applied to Headquarters for a demonstration permit. Anticipated demonstration run 12-15-83.

(continued)

TABLE A-3. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
PPM, Inc.	12-14-81	Mobile (Overland Park, KS)	PCB contaminated waste oil	Chemical	Dechlorination	Demonstration run scheduled late May 1982.	Approval issued 4-28-83 for maximum allowable PCB concentration at reactor of 1100 ppm.
Transformer Consultants, Division of S.D. Myers	04-05-82	Mobile	PCB contaminated mineral oil	Chemical	Dechlorination	Demonstration conducted April 14-15, 1982 Stow, Ohio	Approval issued 5-26-83 for maximum allowable PCB concentrations of 3000 ppm for the batch process and 2100 ppm for the continuous process.
Atlantic Research Corp.	9-9-83	Alexandria, VA.	PCB material	Proprietary	Proprietary		R&D project, approved 11-30-83.
<u>Landfills</u>							
Brown, Boveri Electric Company	8-19-82	Philadelphia PA	PCB contaminated concrete slab and contaminated soil	Landfill	Variance from drumming during transportation (bulk shipment)		Company completed 95% of work by mid-September, remainder to be completed by 1st quarter 1984.
Goodyear Tire & Rubber Company	9-14-82	Point Pleasant, W.VA	PCB contaminated soil	Landfill	Encapsulation		Proposal under review. EPA comments sent to company 5-9-83.

TABLE A-4. INFORMATION ON PCB ACTIVITIES - REGION IV

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and nonthermal disposal</u>							
Florida Power & Light		Sanford, FA	Undiluted askarel (60-100% PCB)	Thermal	High efficiency utility boiler	Test burn conducted 5/26/76	PCB destruction efficiency >99.99%.
Tennessee Eastman Co.	March 1979	Kingsport, TN	PCB contaminated waste oil	Thermal	High efficiency coal-fired industrial boiler	Test conducted 11/5-9/79	PCB destruction efficiency >99.7%. Facility inspected by Region IV in July 1981, approved and in compliance.
SUNOHIO	March 1981	Mobile	PCB contaminated waste oil	Chemical	Dechlorination PCBx process	Nationally demonstrated 10-24-80	Approved, April 1981. Process Demonstrated at TVA, Muscle Shoals, Alabama, 12-14-81. No PCB concentration limit.
Duke Power Co.	May 1981	Riverbend Station, NC	PCB contaminated mineral oil	Thermal	High efficiency boiler	Test burn conducted 10-81	Test results received. PCB destruction efficiency >99.92 percent.
TVA-Widow's Creek	06/10/81	Bridgeport, AL	PCB contaminated waste oil	Thermal	High efficiency coal-fired utility boiler	Test burn conducted 11-15-81	Test results sent to EPA headquarters.
Chemical Waste Management M.T. Vulcanus	-	Mobile-Offshore Mobile, AL	PCB contaminated waste oil	Thermal	Liquid injection incinerator	Demonstration burn at sea, week of 12-14-81	Federally-approved under Ocean Protection Act. On-shore storage facility inspected by Region IV. Two more trips scheduled. Final approval pending reevaluation of test burn data.
Acurex	July 1981	Mobile	PCB contaminated waste oil	Chemical	Dechlorination	Demonstrated nationally 09-09-81	Approval issued June 4, 1982.
Louisville Gas & Electric	August 1981	Cane Run Station Louisville, KY	PCB contaminated mineral oil	Thermal	High efficiency boiler		Approved (submittal acknowledged) 8-81.
Pyro-Magnetics, Corp.	10-16-81	Tulahoma, TN	PCB contaminated waste oil (PCBs 50% by weight)	Thermal	Incinerator	Pilot burns conducted 12-09-81, March 1982	Process acceptable but site specific approvals required.
PHM, Inc.	12-14-81	Atlanta, GA	PCB contaminated waste oil	Chemical	Dechlorination		Approved March 1, 1982.

(continued)

TABLE A-4. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
American Environmental Protection Corp.	02/82	Jacksonville, FL	PCB-contaminated waste oil	Thermal	Incinerator		Withdrew application.
Transformer Consultants	05-07-82	Mobile	PCB-contaminated mineral oil	Chemical	Dechlorination	-	Approved November 23, 1982.
Florida Power & Light (Gainesville Regional Utilities)	-	Gainesville, FL					Inquiry made, will be submitting formal notification.
Georgia Power & Light							Inquiry made, no formal notification given.
SED	04-26-82	Greensboro, NC	PCB capacitors	Mechanical	Shredding with extraction	-	Approved June 29, 1982 as alternate disposal for capacitors; liquid/liquid extraction used to remove (but not destroy) PCBs.
General Electric	9-8-82		PCB-contaminated transformer oil	Chemical	Sodium (NaPEG)		Approval imminent.
Carolina Power & Light	11-12-82	Cape Fear Station Moncure, NC	PCB contaminated mineral oil	Thermal	High efficiency boiler		Approved (submittal acknowledged) 12-82.
Franklin Institutes	02-10-82		PCB contaminated mineral oil	Chemical	Sodium (NaPEG)		Under review.
<u>Landfills</u>							
Chemical Waste Management	1977	Emelle, AL	Solids, liquids (50-500 ppm PCB)	Landfill			Initial site approval 1978, 5 PCB cells, each cell approved individually; 2 cells now closed 3 cells active (approved 12-80)
Warren County, NC	12/78	Warren County PCB site, NC	PCB spill material	Landfill			One-time landfill of PCB spill material, original approval 06-79, contested in court, resolved in 1981, final approval 12-11-81.
Sagamo Electric	10/79	Pickens, SC	PCB contaminated soil	Landfill			Approved August 1980 - One-time landfill of spill material.

TABLE A-5. INFORMATION ON PCB ACTIVITIES - REGION V

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and Nonthermal Disposal</u>							
Peerless Cement Company		Detroit, MI	PCB contaminated waste oil	Thermal	Cement kiln	-	EPA-sponsored destruction efficiency test in 1978. Facility applied for approval in 1980, then withdrew application.
Merlin Assoc./ Envirocycle Corp. (now owned by Genstar Conservation Systems Inc.)	05-03-79	Kankakee, IL	PCB contaminated waste oil	Thermal	Incinerator		Under review, awaiting construction completion. Estimated completion date is unknown.
SUNOHIO (A)	05-16-80 (To OPTS)	Mobile	PCB contaminated waste oil	Chemical	Detoxification PCBx process	Second demonstration run scheduled 5-11-82	Approved 4-13-82, maximum allowable PCB concentration into reactor-500 ppm. Approved 7-14-82 for maximum concentration of 2500 ppm. Approved for 4500 ppm and for additional types of PCB contaminated fluids, 5-6-83.
SUNOHIO (B)	03-29-82	Mobile	PCB contaminated waste oil	Chemical	Detoxification PCBx process	-	Research and development on PCBx process, debug, fine-tune new mobile units, approved 4-13-82. R&D report received 5-9-83. Extension for additional R&D requested, approved 7-1-83. Modification to the extension approved 10-3-83.
Illinois Power Company	06-18-80	Baldwin, IL	PCB contaminated mineral oil	Thermal	High efficiency utility	PCB burn conducted 11-21-80	Stop burn order issued 03-10-81 due to waste oil storage uncertainties, issue resolved 05-25-81
Acurex (A)	02-06-81	Mobile	PCB contaminated waste oil	Chemical	Detoxification	Demonstrated nationally 09-09-81	Approved 3-2-82, maximum allowable PCB concentration into reactor-1062 ppm. Approval amended 5-6-83 to allow up to 7500 ppm when THF is used, 1300 ppm when DEGD is used.
Acurex (B)	08-01-81	Cincinnati, OH	PCB capacitors	-	-	-	Research and development project to decontaminate PCB capacitors. Approved 12-30-81.
Acurex	11-22-82	Mobile	PCB contaminated waste oil	Chemical	Detoxification	Demonstration run conducted 2/14-16/83	Research and development process optimization, approved 1-13-83, demonstration results received 3-10-83.
Acurex	12-13-82	Cincinnati, OH	PCB contaminated soils	Chemical	Dechlorination		Research and development of soils decontamination, bench scale, approved 3-8-83.
Acurex	12-13-82	Kingsbuck, IN	Polygone proprietary solvent	Chemical	Dechlorination		Research and development, joint venture with Polygone Corp., Approved 3-9-83, request for R&D extension received 7-1-83

(continued)

TABLE A-5. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
General Motors Corp. Chevrolet Division	05-01-81	Bay City, MI	PCB contaminated waste oil	Thermal	High efficiency oil-fired industrial boiler	Verification burn conducted 05-80	Approval issued 07-10-81.
Metropolitan Sewer District	06-22-81	Cincinnati, OH	PCB contaminated waste oil	Thermal	High efficiency industrial boiler	Requested trial burn plan 7/20/81	Reconsidering due to public opposition.
PCB Eliminators, Inc.	08-10-81	Mobile	PCB contaminated mineral oil and dielectric fluid	Chemical	Detoxification	Requested trial run plan 09-11-81	Awaiting additional information, bench scale test conducted in Region VII. Company has apparently been dissolved per Region VII.
Otter Tail Power Company	10-01-81	Fergus Falls, MN	PCB contaminated mineral oil	Thermal	High efficiency utility boiler		Approved 11-04-81. Amended authorization conditions issued 12-10-81.
Goodyear Tire & Rubber Co.	10-13-81	Akron, Ohio	PCB contaminated waste oil	Chemical	Detoxification		Approved 10-30-81. Research and development project.
Transformer Consultants	10-15-81	Akron, OH	PCB contaminated waste oil	Chemical	Detoxification	Test run conducted in Stow, Ohio 14-15 April 1982.	Approved 11-02-81. Research and development project. Approved for extension of R&D work 5-28-82, test report received. Approved 11-29-82.
Transformer Consultants	10-09-82	Akron, OH	PCB contaminated waste oil	Chemical	Detoxification		R&D process optimization, approved 12-15-82. Request for R&D extension received 4-27-83, approved 6-29-83.
Polygone Corp.	10-28-81	Warrenville, IL	PCB contaminated waste oil	Chemical	Detoxification		Approved 11-24-81. Bench scale research project. Report submitted 6-25-83.
Polygone Corp.	12-13-82	Kingsbury, IN	PCB contaminated hydraulic fluids	Chemical	Solvent extraction		Approved 1-14-83, R&D report requested 2-22-83, submitted 6-25-83, request for R&D extension received 7-1-83, approved 7-25-83, plan for process demonstration received 10-12-83, additional data requested 11-14-83.
Pyro-Magnetics Corp.	11-03-81	Laporte, IN	PCB contaminated waste oil	Thermal	Mobile incinerator	Pilot burn 2-7 March 1982 Tullahoma, TN	Trial burn report received. Draft approval conditions and technical findings completed. Approved 12-17-82.
Columbus & Southern Ohio Edison	5-80						Informal inquiry.

(continued)

TABLE A-5. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Northern States Power Company	12-18-81	Minneapolis MN	PCB transformer fluids	Thermal	High efficiency boiler		Approved 1-8-82.
PCB Destruction Company	12-14-81	Kansas City, MS	PCB contaminated waste oil	Chemical	Mobile detoxification	Demonstration run conducted in Region VII 25 March 1982	Under review. Second test run requested. Inactive.
Dowzer Electric Company	01-07-82	Mount Vernon, IL	PCB contaminated waste oil	Chemical	Detoxification (Goodyear process)	Test run on 10-5-82 unsuccessful. Second run 4-5-83.	Research and development project approved 2-21-82. Approval renewed 4-4-83, test plan approved 9-16-82, second test plan approved 1-4-83. Second test run successful, third R&D approval requested 5-10-83, process approved for commercial application 7-7-83, maximum allowable PCB concentration 450 ppm.
PPM-PCB Management	01-11-82	Kansas City, MS	PCB contaminated waste oil	Chemical	Mobile detoxification	-	Approved 2-18-83 for 1100 ppm.
Transformer Service, Inc. (A)	04-22-82	Akron, Ohio	PCB contaminated waste oil	Chemical	Mobile detoxification		Inactive.
Transformer Service, Inc. (B)	05-17-82	Akron, Ohio	Mineral oil dielectric fluid	Chemical	Detoxification	-	Bench scale research and development project approved 8-5-82. Request for extension approved 12-3-82. R&D report received 2-25-83, request for additional R&D extension 2-28-83, approved 4-14-83. Report submitted 7-29-83. 3rd R&D extension received 9-23-83, denied 11-21-83.
CHEM Oil Corporation	06-17-82	Warren, Ohio	Mineral oil dielectric fluid	Chemical	Detoxification	-	Research and development project. Approved 9-3-82. R&D report received 3-30-83, R&D extension approved 4-21-83. Request for additional R&D extension received 9-12-83, approved 10-24-83.
RTE Corp.	06-21-82	Waukesha, Wisconsin	Mineral oil dielectric fluid	Chemical	Detoxification	-	Research and development project, approved 6-28-82. Final R&D report received 1-26-83.
Midland-Ross	06-28-82	Toledo, Ohio	Solid PCB contaminated material	Thermal	Pyrolysis	-	Research and development project, approved 7-16-82.
Transformer (A) Recovery	8-2-82	Brighton, MI	PCB contaminated mineral oil	Chemical	Dechlorination		Inactive.

(continued)

TABLE A-5. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Transformer (B) Recovery	8-2-82	Brighton, MI	Capacitors	Chemical	Decontamination		Research and development project, approved 10-8-82. Submitted test report 12-2-82. Submitted additional test results 4-15-83, request for R&D extension received 6-21-83, approved 7-19-83.
U.S. Transformer	8-2-82	Jordan, MN	PCB contaminated mineral oil	Chemical	Decontamination		Research and development project, approved 9-1-82. EPA requested status report 10-11-83, company responded, say no work had been conducted.
General Electric	9-8-82	Mobile Schenectady, NY	PCB contaminated mineral oil	Chemical	Catalyzed sodium detoxification		Additional information requested, 10-18-82, inactive.
SCA Chemical (A) Services	9-2-82	Chicago, IL	PCB contaminated waste oil PCB capacitors	Thermal	Incineration	5 test burns conducted Sept. 30 - Oct. 7, 1982	Trial burn plan approved 9-16-82. Test burn results received 3-15-83 draft approval, public notice draft approved 6-1-83, public meeting held 8-11-83, approved 9-26-83.
Pollution Science International	9-15-82	Glen Coe, IL	PCB contaminated sediments	Thermal	Stripping		Research and development project, approved 10-18-82. Request for R&D extension received 5-31-83, approved 6-24-83.
Hoosier Energy, Inc.	10-13-82	Bloomington, IN	PCB contaminated dielectric fluid	Thermal	High efficiency boiler		Approved (submittal acknowledged) 12-7-82.
Excell, Inc.	11-10-82	Cincinnati, OH	PCB contaminated oil	Thermal	Molten salt		Research and development project, approved 4-21-83. Request for R&D extension received 8-21-83, approved 9-14-83.
Dow Corning Corp.	11-12-82	Midland, MI	PCB contaminated silicon fluids	Physical	Absorption		Bench scale, approved 3-2-83. Request for R&D extension received 7-27-83, approved 8-22-83.
Energystics, Inc.	7-15-83	Toledo, OH	PCB contaminated oil	Thermal	Plasma Jet Incineration		Additional data requested 7-26-83, submitted 7-29-83, approved 9-14-83.

(continued)

TABLE A-5. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Landfills</u>							
Clermont Environmental Reclamation Co.							
No. 3	07-26-78	Williamsburg, OH	Chemical	Landfill			Approved 09-28-78. Now closed.
Nos. 4/5	02-04-80	Williamsburg, OH	Chemical	Landfill			Approved 05-09-80, nearly filled and closure is commencing.
Nos. 6-17	03-25-81	Williamsburg, OH	Chemical	Landfill			Approved 07-31-81.
Allis Chalmers	02-17-81	Appleton, WI	Chemical	Landfill	Sodium Polyethylene glycolate (NaPEG) process		Test of NaPEG Process approved 09-09-81. Approval expired 3-82.
Tecumseh Prod.	04-07-81	Sheboygan Falls, WI	Chemical	Landfill			On-site one time disposal, approved 6-24-82.
John Sexton Contractors	08-28-81	Des Plaines, IL	PCB contaminated dredge materials	Landfill			Approved 10-13-81. Request for variance from conditions of approval rec. 11-25-81. Dredging will not take place, approval will expire.
TRW	06-20-83	Minerva, OH	Chemical	Landfill			Additional data requested 8-9-83. Partial response 9-2-83, meeting to be held 12-83.
Madison Metropolitan Sewage District	08-1-83	Madison, WI	Municipal sludge	Landfill			Request for alternate disposal status, PCB hot spots >50 ppm, memo sent to EPA Headquarters 9-6-83 requesting involvement, HQ is reviewing submittal.
Chemical Waste Management	11-9-83	Vickery, OH	PCB contaminated solids	Landfill			On-site one time disposal, under review.

TABLE A-6. INFORMATION ON PCB ACTIVITIES - HEADQUARTERS

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
EPA headquarters assumed responsibility for approving facilities or disposal technologies that operate in more than one region on April 29, 1983, per, the Federal Register, Volume 48, No. 62, Wednesday, March 30, 1983, 40 CFR Part 761.							
The headquarters team consists of							
Glenn Kuntz, Team Leader		(202) 382-2326					
Jared Flood		382-3990					
Leo Kokoszka		382-3937					
Pyrotech Systems Inc.		Mobile		Thermal	Incinerator		Ltr of deficiencies sent 12-23-83.
Zengo, Inc.	1-11-84	Mobile		Thermal	Incinerator		Ltr sent 2-22-84 requesting additional info.
Best Ltd.		Mobile		Thermal	Incinerator		Ltr of deficiencies sent 2-10-84.
Electro Petroleum		Mobile		Thermal	Incinerator		Demo. plan being prepared.
Oil Purification Systems, Inc.				Chemical			Ltr of deficiencies sent 1-25-84.
Sunohio				Chemical			Region X permit extended 1-84, awaiting demo plan.
Transformer Consultants				Chemical			No nationwide permit application received.
PPM, Inc.				Chemical			No nationwide permit application received.
GE				Chemical			Ltr sent 1-30-84 stating existing permits expire 12-31-84, giving guidelines for new demo.
Franklin Institutes				Chemical			Research permit extended 12-83.

TABLE A-6. (continued)

Company	Application Date	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Atlantic Research				Light Activated			Demo plan received 2-8-84.
Acurex				Chemical			Ltr sent 2-17-84 detailing data needs, awaiting additional data on demo.
Chemical Decontamination Corp.				Chemical			Response to deficiency ltr, revised operating manual received 2-27-84.

TABLE A-7. EPA REGIONAL OFFICE AND TECHNICAL ASSISTANCE CONTACTS AT
REGIONS I-X

Region/Address	Contact*	Division	Telephone No.	Region/Address	Contact*	Division	Telephone No.
U.S. EPA, Region I John F. Kennedy Bldg. Room 2303 Boston, MA 02203	Paul Heffernan	Air Management	(617) 223-4859	U.S. EPA, Region VI 1201 Elm Street Dallas, TX 75270	Jim Sales Regional PCB Coordinator	Technical Section Air & Waste Management Division	(214) 767-8941
	Chuck Lincoln	Air Management	(617) 223-7740		Martin Allen	Technical Section Air & Waste Management Division	(214) 767-8941
	Tom Michel	Air Management	(617) 223-1916		Larry Thomas Regional Toxic Coordinator	Pesticides & Toxic Substances Branch	(214) 767-2734
U.S. EPA, Region II Federal Office Bldg. 26 Federal Plaza New York, NY 10007	John Brugard	Air & Waste Mgmt.	(212) 264-2637	U.S. EPA, Region VII 324 East 11th Street Kansas City, MI 64106	Phil Schwandt	Environmental Services Division	(214) 767-2727
	Garrett Smith	Air & Waste Mgmt.	(212) 264-3467		Steve Busch	Waste Management Branch	(816) 374-6531
	Jerry McKenna	Env. Services	(201) 321-6645		Marvin Frye Regional PCB Coordinator	Toxic & Pesticides Section	(816) 374-3036
	Arthur H. Gevirtz	Env. Services	(201) 321-6667		Steve Farrow Regional PCB Coordinator	Toxic Substances Branch	(303) 837-3926
	Dan Kraft	Env. Services	(201) 321-6667		Dean Gillam Regional Toxic Coordinator	Toxic Substances Branch	(303) 837-3926
U.S. EPA, Region III Curtis Building Sixth & Walnut Streets Philadelphia, PA 19106	Hermon Phillips	Public Awareness	(212) 264-2515	U.S. EPA, Region VIII 1860 Lincoln Street Denver, CO 80203	Dean Gillam Regional Toxic Coordinator	Toxic Substances Branch	(303) 837-3926
	Edward Cohen	Environmental Services	(215) 597-7668		Steve Farrow Regional PCB Coordinator	Toxic Substances Branch	(303) 837-3926
	Christopher Pilla	Environmental Services	(215) 597-4651	U.S. EPA, Region IX 215 Fremont Street San Francisco, CA 94105	Raymond Seid	Toxic and Waste Management Branch	(415) 974-8389
U.S. EPA, Region IV 345 Courtland, NE Atlanta, GA 30365	Michael Vaccaro	Regional Council	(215) 597-9477		Jim Suhrer	Office of Technical & Scientific Assistance	(415) 974-8192
	K.K. Wu	Environmental Services	(215) 597-7683		Charles W. Rice	Waste Management Branch	(206) 442-2728
	Ralph Jennings Regional Toxics & PCB Coordinator	Air & Waste Management	(404) 881-3864	U.S. EPA, Region X 1200 6th Avenue Seattle, WA 98101	Roger Fuentes Regional PCB Coordinator	Waste Management Branch	(206) 442-1254
	Don Hunter	Air & Waste Management	(404) 881-3933		Jim Everts	Permits & Compliance Branch	(206) 442-1090
	Howard Zeller	Enforcement	(404) 881-2211				
	Constance Allison	Air & Waste Management	(404) 881-3864				
U.S. EPA, Region V 230 S. Dearborn St. Chicago, IL 60604	James Fingar	Surveillance & Analysis	(404) 546-3136				
	Francis Redman	Public Awareness	(404) 881-3004				
	Y. J. Kim	Waste Management	(312) 353-1428				
	Bill Munro	Waste Management	(312) 886-6136				

For technical assistance and review of disposal technology please contact:

U.S. EPA, Region I-V
GEA Corporation
Bedford, MA
Bob McInnes (617) 275-5444 ext. 4206

U.S. EPA, Region VI-X
Radian Corporation
Research Triangle Park, NC
Rad Adams (919) 541-9100

*The first contact listed for each Region is the primary contact for information contained in this report.

REGIONAL SUMMARIES: REGIONS I-V

REGION I - PAUL HEFFERNAN

Region I has requested the use of GCA technical assistance in the PCB destruction efficiency testing of the New Bedford Municipal Sewage Sludge Incinerator. This request is under consideration. Other than this there has been essentially no PCB related activity in the region since the last update.

REGION II - JOHN BROGARD

A public notice for the trial burn to be conducted on the General Electric Company Annex I Incinerator was issued on November 18, 1983. Phase I testing on the NEWCO Project has been completed and Region II is awaiting a test report. Trial burn results from the EPA Mobile Incinerator indicate a destruction and removal efficiency in excess of 99.99%. A public notice for approval of this unit is being prepared. Region II is awaiting test results from Bengart & Memel on the test demonstration of their soil decontamination process. One informal inquiry was received from CCA, Inc. on a mobile liquid injection incinerator, however, no formal documentation has yet been provided.

REGION III - ED COHEN

A test plan was received from Best Ltd, on their mobile incinerator. This plan was forwarded to Headquarters. Chemical Decontamination Corporation has applied to Headquarters for a demonstration permit for their chemical dechlorination process. The demonstration run is tentatively scheduled for December 15. A new submittal was received by Atlantic Research Corporation for a proprietary process research and development project. This submittal was approved on November 30, 1983. Work on the Brown Boveri Company landfill was 95 percent complete by mid September, with the remainder to be completed by early 1983.

REGION IV - RALPH JENNINGS

There has been essentially no PCB related activity in the Region since the last update. No new submittals were received during the past three months and no approvals were granted to active submittals.

REGION V - BILL MUNO

A modification to the SUNOHIO research and development submittal was approved by the region on October 3, 1983. The Polygone Corporation submitted a plan for a process demonstration of their solvent extraction process on October 12, 1983. Region V has requested additional data. A third extension request was received from Transformer Service on September 23, 1983 and this request was denied on November 21, 1983. The Chem Oil Corporation requested an extension to their R&D approval on September 12, 1983 and this request was approved October 24, 1983. The SCA Annex I Incinerator was approved for PCB disposal on September 26, 1983. A request for an R&D approval extension was received from Excell on August 21, 1983 and approved by the region on September 14, 1983. Similarly, an R&D approval extension for Dow Corning was approved on August 22, 1983. The Energystics Plasma Jet Incineration submittal was approved by the region on September 14, 1983. A submittal from U.S. Transformer has been inadvertently left off the list. This application, for a chemical decontamination process research and development project was initially approved September 1, 1982. In November 1983, Region V requested a status report on the project, and U.S. Transformer responded by stating that no work had been conducted on the project. Relative to landfills, Region V plans to meet with TRW concerning the company's submittal. The Madison Metropolitan Sewage District submittal was forwarded to Headquarters for review and comment, while a new submittal for a chemical waste management landfill is currently under review.

HEADQUARTERS - JARED FLOOD

No new submittals have been received by Headquarters since the last update and no approvals have been issued for the applications currently in house.

APPENDIX B

REPORT ON PCB ACTIVITIES AND POLICIES - VOLUME 12
(EPA REGIONS VI-X)

December 1, 1983

Office of Pesticides and
Toxic Substances

Volume 12

Introduction

This is the twelfth in a series of reports designed to inform responsible Headquarters, Laboratory and Regional Office personnel of PCB-related activities in the U.S. EPA Regions VI-X. Together with a companion report for Regions I-V (Appendix A), it will serve to update the current status of all regional actions related to implementation of the PCB disposal regulations (40 CFR 761).

Permit Activities

The current status of all thermal and nonthermal PCB destruction activities in Region VI through Region X are reported in Tables B-1 through B-5. The companion report presents permit activities information for Regions I-V in Tables A-1 through A-5 of Appendix A. Table B-6, which is common to both reports, presents the principal PCB and toxic waste contacts for PCB-related assistance. A narrative of the updated data obtained from Regional Office Contacts for Regions VI-X is provided in Appendix A.

Responsibility for mobile disposal units has been transferred to OPTS Headquarters. Thus, region contacts had nothing to report on the mobile units. The latest mobile unit status has been continued in Tables B-1 through B-5 until the transfer has been fully implemented (see Table A-6 of the companion report).

Radian Corporation
Research Triangle Park, North Carolina 27709
(919) 541-9100

Technical Assistance Under This Program

An objective of this program is to provide technical and coordinative assistance as required to Regional Offices (Regions I-X) in the implementation of the PCB Regulations. The technical assistance will be provided on a first-come first-served basis and will include, but will not be limited to, the following:

Item 1 - Provision of background information on the conduct of thermal or non-thermal PCB destruction/disposal operations in accordance with Federal requirements and guidelines.

Item 2 - Providing (pre-notice) facility inspections and evaluations in order to establish the expected quality of any disposal/destruction activities that could be conducted at the facility. Such evaluation shall identify the "verification test" potential of the facility.

Item 3 - Review and comment on source "test plans" for the destruction/disposal of PBC waste materials in accordance with Federal requirements and guidelines.

Item 4 - Monitoring and reporting on the conduct of "test destructions" and data obtained in accordance with quality assurance/quality control systems audit procedures.

For technical assistance under this program, please contact David C. Sanchez, Environmental Protection Agency, IERL, Research Triangle Park, North Carolina, telephone number (919) 541-2979.

TABLE B-1. INFORMATION ON PCB ACTIVITIES - REGION VI

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and nonthermal destruction</u>							
Energy Systems Company (ENSCO)	March 1978	El Dorado, AR	PCB contaminated solid waste	Thermal	Incineration	Test burn conducted Dec. 1981, results available.	Approved Feb. 7, 1983. Company applied for a PCB drum reclamation permit on March 17, 1983. Approved August 26, 1983.
Dow Chemical	September 1979	Freeport, TX	Process waste stream (vinyl chloride)	Thermal	Incineration	Test burn complete, results are available.	Approved April 1982.
Dow Chemical	September 1979	Plaquemine, LA	Process waste stream (vinyl chloride production)	Thermal	Incineration	Test burn complete, results are available.	Approved June 1982.
Dow Chemical	September 1979	Oster Creek, TX	Process waste stream (vinyl chloride production)	Thermal	Incineration	Test burn complete, results are available.	Approved June 1982.
Vulcan Materials	January 1980	Geismar, LA	Process vinyl chloride waste	Thermal	Incineration	First test burn conducted June 1981. Second test burn conducted Nov. 1981.	Approved May 3, 1983.
Rollins Environmental Services	April 1980	Deer Park, TX	PCB contaminated solid waste	Thermal	Incineration	First test burn conducted Nov. 9-13, 1981. Tests were also conducted in June and July 1982.	Approved Jan. 1983.
LaPort Chemical Corporation	July 1980	Pasadena, TX	Heavy bottoms, vinyl chloride process waste	Thermal	Incineration	Test burn conducted July 1981.	Approved June 1982.
PPG	1980	Lake Charles, LA	Process waste stream	Thermal	Incineration	Trial burn conducted.	Trial burn results were received and are being reviewed.
SUNOHIO	September 1981	Mobile	Mineral oil dielectric fluid	Chemical	Dechlorination	Demonstrated nationally Oct. 24, 1980.	Approval granted Oct. 21, 1982, to treat mineral oil dielectric fluids with 2500 ppm PCBs.

(continued)

TABLE B-1. (continued)

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Pyro-Magnetics	November 1981	Mobile	PCB contaminated waste oil	Thermal	Incineration ✓	First pilot burn conducted Dec. 9, 1981, Lullahoma, TN in Region IV. Second pilot burn conducted March 5, 1982.	Approved June 13, 1983. ✓ Company acquired by Inesco.
Acurex	November 1981	Mobile	PCB contaminated oil	Chemical	Dechlorination	Demonstrated nationally Sept. 9, 1981.	Approved May 3, 1982. Modified to treat up to 7500 ppm PCBs.
PPM, Inc.	December 1981	Mobile	PCB contaminated mineral oil	Chemical	Dechlorination	Demonstration tests were conducted in Nov. 1981 in Region VII. Test results are available.	Approved March 7, 1983
Los Alamos Scientific	February 1982	Los Alamos, NM	PCB contaminated transformer fluid	Thermal	Incineration ✓	Pretest meeting conducted on May 10-11, 1982. Test burn conducted in June 1982.	Test burn final report is being reviewed. ✓
Transformer Consultants	May 1982	Mobile	PCB contaminated mineral oil	Chemical	Dechlorination	Demonstration tests were conducted on April 14, 1982 in Region V. Test results are available.	Approved March 7, 1983.
San Angelo Electric Company	June 1982	San Angelo, TX	PCB contaminated mineral oil	Chemical	Dechlorination	Demonstration tests not scheduled at this time.	Company's intent was to treat mineral oil up to a maximum of 900 ppm PCBs. The operator has cancelled plans to conduct demonstration test.
General Electric	August 1982	Mobile	PCB contaminated mineral oil	Chemical	Dechlorination	Demonstration tests were conducted in May 1982 in Region III. Test results are available.	Approved March 7, 1983.

(continued)

TABLE B-1. (continued)

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Franklin Institute Research Laboratory	October 1982	Mobile	PCB contaminated mineral oil	Chemical	Dechlorination	Pilot scale demonstration successfully conducted April 21, 1982 on 7406 ppm waste in Region III.	Approved March 7, 1983.
SED Inc.	October 1982	Mobile	PCB contaminated capacitors	Mechanical	Shredding and rinsing of capacitors	Demonstration tests not scheduled at this time.	Under preliminary review. Waiting for response to questions.
Huber Corp.	December 1982	Borger, TX	PCB contaminated soil	Thermal	Pyrolysis	Pilot scale test planned for Sept. 1983.	Research test results were received and are being reviewed.
Biotechnology, Inc.	January 1983	Houston, TX	PCB sludge	Biological biodegradation	--	Research project conducted Jan. 1983. Demonstration test expected by end of Sept. 1983.	Finishing up laboratory work on research project. Demonstration test is expected to be completed by the end of November, 1983.
<u>Landfills</u>							
Lipitzs	December 1980	Waco, TX	PCB contaminated oils	Landfill	--	--	Applicant is closing out site.

TABLE B-2. INFORMATION ON PCB ACTIVITIES - REGION VII

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and nonthermal destruction</u>							
SUNOHIO	October 1980	Mobile	PCB contaminated mineral oil	Chemical	Dechlorination	Demonstrated nationally Oct. 24, 1980.	Approved Nov. 1981 for mineral oil dielectric fluids up to 10,000 ppm PCBs.
PCB Destruction Company	May 1981	Mobile	Dielectric mineral oils up to 10,000 ppm PCBs	Chemical	Dechlorination	First full scale test conducted Dec. 1980. Second test conducted March 25, 1982.	Interim approval granted from June 1, 1982 to Dec. 1, 1982. Results from second tests show PCB concentration reduced from 1000 ppm to 1 ppm.
Acurex	May 1981	Mobile	Dielectric mineral oils up to 10,000 ppm PCBs	Chemical	Dechlorination	Demonstrated nationally Sept. 9, 1981.	For 3 year period starting in Oct. 1982. Request received for permit modification.
Environmental International Inc.	May 1981	Kansas City, MO	PCB solids (capacitors)	Nonthermal	Mechanical shredding	Demonstration complete Aug. 1981.	Approval granted Feb. 17, 1982.
Alcoa Corp.	June 1981	Davenport, IA	PCB contaminated fuel oil (2.5 million gal)	Thermal	Incineration in aluminum melting furnace	Test burn conducted the week of July 27-31, 1981. Test results are available.	Approved Dec. 1981.
Rose Chemical Co. (PCB Div.)	June 1981	Holden, MO	PCB contaminated mineral oils up to 10,000 ppm PCBs	Chemical	Dechlorination	Bench scale tests were successful. Full scale tests conducted in July 1982.	Final approval granted March 1983. Disposal of PCB contaminated natural gas condensate has been requested. EPA has requested additional information.
PPM Inc.	October 1981	Mobile	PCB contaminated mineral oils up to 10,000 ppm PCBs.	Chemical	Dechlorination	Full scale demonstration tests completed in Nov. 1981. Results are available.	Final approval granted Aug. 1982. Approval was modified to allow treatment of PCB contaminated kerosene and heat transfer fluids.
Pyro-Magnetics	November 1981	Mobile	PCB contaminated waste oil (50% PCB concentration)	Thermal	Incineration	First pilot burn conducted Dec. 9, 1981, Tullahoma, TN in Region IV. Second pilot burn conducted March 5, 1982.	Final approval granted Sept. 1, 1982.

(continued)

TABLE B-2. (continued)

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Environmental International Inc.	January 1982	Mobile	PCB contaminated waste oil	Chemical	Dechlorination	Full scale demonstration was conducted on Jan. 14, 1982. Results show PCB concentration reduced from 570,000 ppm to less than 2 ppm.	Final approval was granted effective until Sept. 17, 1985 to treat waste oils up to 570,000 ppm PCBs.
Union Electric Company	April 1982	St. Louis, MO	PCB contaminated mineral oil up to 50,000 ppm PCBs	Thermal	High efficiency boiler	Test burn conducted week of May 17, 1982.	Final approval granted Jan. 1983.
Transformer Consultants, Division of S.D. Meyers	June 1982	Mobile	PCB liquids	Chemical	Dechlorination	Test conducted in Region V, April 1982.	Interim approval granted from Oct. 1, 1982 to April 1, 1983 to treat PCB liquids up to 10,000 ppm PCBs.
PCB Treatment Inc.	August 1982	Kansas City, MO	PCB liquids	Chemical	Dechlorination	Demonstration tests conducted Sept. 8, 1982.	Approval extended effective September 15, 1983 to September 15, 1986.
Franklin Institute Research Laboratory	October 1982	Mobile	PCB contaminated dielectric mineral oil	Chemical	Dechlorination	Test conducted April 1982 in Region III.	Under preliminary review.
General Electric	October 1982	Mobile	PCB contaminated dielectric mineral oil	Chemical	Dechlorination	Pilot scale demonstration successfully conducted May 14, 1982 on 1050 ppm waste in Region III.	Interim approval granted March 1983.
Rose Chemical Co.	November 1982	Holden, MO	PCB capacitors	Mechanical	Shredding and rinsing	Demonstration conducted Dec. 1982.	Final approval issued on November 7, 1983 and effective from October 15, 1983 to October 15, 1986.
SED Inc.	November 1982	Mobile	PCB contaminated capacitors	Mechanical	Shredding and rinsing of capacitors	No tests are scheduled at this time.	Under preliminary review.
PPM Inc.	January 1983	Kansas City, MO	PCB contaminated transformers and capacitors	Mechanical	Solvent cleaning	Research and development.	Request received Jan. 1983. Under review.

(continued)

TABLE B-2. (continued)

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
PCB Treatment Inc.	January 1983	Kansas City, MO	PCB capacitors	Mechanical	Shredding and rinsing	Demonstration conducted Feb. 28, 1983.	Interim approval granted July 5, 1983 for the period Aug. 1, 1983 to Feb. 1, 1984.
Chemical Waste Management	February 1983	Kansas City, MO	PCB contaminated transformers	Mechanical	Solvent cleaning	Research and development.	Approved June 9, 1983.
Rose Chemical Co.	March 1983	Holden, MO	PCB contaminated transformers	Mechanical	Draining, rinsing, and salvaging metals	Research and development.	Approved July 8, 1983. Limited to five transformers.
PCB Specialist	--	Kansas City, MO	Mineral oil dielectric fluid	Chemical	Dechlorination	Tests are not scheduled at this time.	Informal letter of intent submitted Oct. 21, 1982. Further action by company is not expected.
PCB Disposal Systems, Inc.	October 1983	Kansas City, MO	Mineral oil dielectric fluid	Chemical	Dechlorination	Demonstration requested for early December.	Request under review.
PCB Disposal Systems, Inc.	October 1983	Kansas City, MO	Capacitors and potentially transformers	Mechanical	Shredding and rinsing	Demonstration requested for early December.	Request under review.
Environmental International Electrical Services	August 1983		PCB contaminated transformers	Mechanical	Mechanical separation, cleanup and salvaging of metals	EPA observed demonstration conducted on October 7, 1983.	Awaiting analytical results.
<u>Landfills</u>							
Corps of Engineers	January 1980	Kansas City, MO	Contaminated dredge soil from 251 ppm to 0.02 ppm PCB concentration	Landfill	--	Site plan available and acceptable to Region VII.	Conditional approval granted in July 1981. Project has been held up for lack of funds (no change in status since March 1982).
Alcoa Corp.	October 1982	Davenport, IA	PCB contaminated sediment from surface impoundment facility under 500 ppm PCBs	Landfill	Contaminated area insitu disposal	--	Under final review.

TABLE B-3. INFORMATION ON PCB ACTIVITIES - REGION VIII

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and normal destruction</u>							
Rockwell International and Department of Energy	March 1980	Commercial Mobile Unit	PCB contaminated liquids	Thermal	Fluidized bed incineration	Test burn completed May 19, 1981 (test done in Rock Flats nuclear weapon plant) test burn results are available.	Evaluation complete. No action on this permit is necessary. Results are acceptable. (PCB destruction efficiency 99.9999.)
Acurex	March 1981	Mobile	PCB liquids up to 1000 ppm	Chemical	Dechlorination	Demonstration test completed Sept. 9, 1981. Results are available.	Permit was granted on Jan. 12, 1982, for up to 1000 ppm PCBs. Permission to treat up to 7500 ppm PCBs granted Sept. 1982.
I&R Electric	June 1981	Coleman, SD	PCB liquids up to 500 ppm	Chemical	Dechlorination	Ongoing testing program.	Final approval granted Sept. 1, 1982.
PCB Eliminators Inc.	September 1981	Mobile	PCB contaminated liquids	Chemical	Detoxification	Bench scale tests conducted in Region VII were successful. Full scale tests not yet planned.	Prototype bench scale operation. Will be converted into a full-scale commercial mobile unit at a later date. No change in status since March 1982.
SUNOHIO	October 1981	Mobile	PCB liquids up to 1000 ppm	Chemical	Dechlorination	Tests completed Nov. 1980 (test results are available).	Permit was granted on Jan. 29, 1982. Request to amend the permit to treat PCB liquids up to 2500 ppm was granted in Sept. 1982.
Pyro-Magnetics Corporation	November 1981	Mobile	PCB liquids up to 41% by weight PCBs	Thermal	Incineration	First pilot burn conducted Dec. 9, 1981 in Tullahoma, TN in Region IV. Second pilot burn conducted March 5, 1982. Test results are available.	Permit was granted on Sept. 12, 1982 to treat PCB liquids up to 41% PCB by weight.
PPM Inc.	December 1981	Mobile	PCB contaminated waste oil	Chemical	Dechlorination	Demonstration tests were completed Nov. 1981 in Region VII.	Permit granted (March 25, 1982) to process PCB liquids up to 1000 ppm PCBs.

(continued)

TABLE B-3. (continued)

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
PCB Destruction Company	December 1981	Mobile	PCB liquids PCB concentration unknown at this time	Chemical	Dechlorination	First demonstration tests were conducted in Region VII on Dec. 18, 1981. Second tests were conducted on March 25, 1982 in Region VII.	Under review. First demonstration tests were unsuccessful. Awaiting second test results from Region VII.
Environmental International Incorporated	January 1982	Mobile	PCB liquids	Chemical	Dechlorination	Full scale demonstration was conducted on Jan. 14, 1982 in Region VII. Results show PCB concentration reduced from 570 ppm to 2 ppm.	Permit granted (March 25, 1982) to process PCB liquids up to 1000 ppm PCBs.
Transformer Consultants	April 1982	Akron, OH	PCB contaminated waste oil up to 2000 ppm PCBs	Chemical	Detoxification	Test conducted on April 13-14, 1982 in Region V. About 300 gallons of oil containing 2000 ppm PCBs were treated during the tests. Test results are available.	Permit granted July 30, 1982.
PCB Specialist	October 1982	Mobile	Mineral oil dielectric fluid	Chemical	Dechlorination	Demonstration tests will be conducted in Region VII.	Under preliminary review.
Franklin Institute Research Laboratory	October 1982	Mobile	Mineral oil dielectric fluid up to 7500 ppm PCBs	Chemical	Dechlorination	Pilot scale demonstration successfully conducted April 2, 1982 in Region III.	Permit granted Feb. 1983 for fluids up to 7500 ppm PCBs.
General Electric	November 1982	Mobile	Mineral oil dielectric fluid up to 1000 ppm PCBs	Chemical	Dechlorination	Pilot scale demonstration successfully conducted May 14, 1982 in Region III.	Permit granted Feb. 1983 for fluids up to 1000 ppm PCBs.
Otter Tail Power Co.	N/A	Big Stone, SD	Mineral oil dielectric fluid	Thermal	High efficiency boiler	N/A	After meeting with EPA and state, company has agreed to install CO monitor. Once installed they can proceed with the disposing of PCBs.

Landfills

No landfills approved for PCB disposal in EPA Region VIII.

N/A: not applicable.

TABLE B-4. INFORMATION ON PCB ACTIVITIES - REGION IX

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and nonthermal destruction</u>							
SUNOHIO	June 1980	Mobile	Dielectric mineral oils up to 1000 ppm, PCBs	Chemical	Dechlorination	Test complete Nov. 1980. Test results are available.	Final approval granted Dec. 1981.
Dow Chemical	September 1980	Pittsburg, CA	Process waste (PCB contaminated waste)	Thermal	Incineration	Test completed Jan. 1983.	Trial burn results are being reviewed.
Thagard Research Corporation	July 1981	Irvine, CA	PCB contaminated solids	Thermal	High temperature fluid volume reactor	Research and development ongoing tests.	R&D permit granted June 7, 1982 to treat soil contaminated with high concentrations of PCBs. No further action anticipated.
Rockwell International	October 1981	Ventura County, CA	PCB oils no limit specified	Thermal	Molten salt reactor process	Not planned.	Research permit granted Jan. 26, 1982.
Pyro-Magnetics Corporation	November 1981	Mobile	PCB contaminated waste oils	Thermal	Incineration	1st pilot burn conducted Dec. 9, 1981, Tullahoma, TN in Region IV. 2nd pilot burn conducted March 5, 1982. Test results are available.	Permit issued May 25, 1983.
Acurex	January 1982	Mobile	PCB contaminated mineral oil up to 7500 ppm PCBs	Chemical	Dechlorination	Demonstrated nationally on Sept. 9, 1982. Test results are available.	Permit granted Aug. 22, 1982.
Transformer Consultants	April 1982	Mobile	Transformer oils	Chemical	Dechlorination	Demonstration tests conducted in Region V; April 1982. Test results are available.	Under review. Draft approval is being prepared. Additional information requested.
Baird Corporation	May 1982	Irvine, CA	PCB contaminated solids	Thermal	High temperature fluid volume reactor.	Research and development on going tests.	R&D permit granted June 21, 1982, to treat sediment up to 10,000 ppm PCBs.
Franklin Institute Research Laboratory	October 1982	Mobile	PCB contaminated dielectric mineral oil	Chemical	Dechlorination	Test conducted April 1982 in Region III.	Under review. Additional information requested.

(continued)

TABLE B-4. (continued)

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
General Electric	October 1982	Mobile	PCB contaminated dielectric mineral oil	Chemical	Dechlorination	Pilot scale demonstration successfully conducted May 14, 1982 in Region III on wastes containing 1050 ppm PCBs.	Under review. Additional information requested.
<u>Landfills</u>							
Chemical Waste Management, Inc.	October 1980	Kettleman Hills, CA	PCB solids	Landfill	--	--	Approval to Operate amended November 14, 1983 to increase capacity of one portion of landfill.
U.S. Ecology	November 1981	Beatty, NV	PCB solids only	Landfill	--	--	Usage approved Oct. 27, 1982.

TABLE B-5. INFORMATION ON PCB ACTIVITIES - REGION X

Company	Application	Site location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
<u>Thermal and nonthermal destruction</u>							
SUNOHIO	August 1980	Mobile	Dielectric mineral oil up to 1500 ppm PCBs	Chemical	Dechlorination	Demonstrated nationally Oct. 24, 1980.	Approval granted Jan. 21, 1982 to treat mineral oil dielectric fluids up to 1500 ppm PCBs. Approval for fluids up to 2500 ppm PCBs granted Oct. 1982.
Washington Water and Power Company	October 1980	Spokane, WA	Dielectric mineral oils below 500 ppm	Thermal	High efficiency boiler	Burn tool place for 36 hours in Dec. 1981.	Approved Dec. 1981.
Acurex	January 1981	Mobile	Dielectric mineral oils	Chemical	Dechlorination	Demonstration test complete Sept. 9, 1981.	Approved April 19, 1982 for mineral oil dielectric fluids with 1500 ppm PCBs. Increased to allow treatment of oil up to 7500 ppm PCBs in Dec. 1982.
Environmental International Inc.	September 1981	Mobile	Capacitors	Chemical	Capacitor disposal technology	Full scale demonstration was conducted on Jan. 14, 1982 in Region VII. Test results are available.	Final stage of approval.
PPM Inc.	September 1981	Overland Park, KS	Dielectric mineral oils below 500 ppm	Chemical	Dechlorination	Demonstration test conducted Nov. 1981 in Region VII. Results are available.	Approval granted July 1982, will expire Jan. 1, 1985. Modified to include kerosene as well as dielectric mineral oils up to 1500 ppm PCBs in Nov. 1982.
Pyro-Magnetics	November 1981	Mobile	PCB contaminated waste oil up to 41.7% by weight PCBs	Thermal	Incineration	First pilot burn conducted Dec. 9, 1981, Tullahoma, TN in Region IV. Second pilot burn conducted March 5, 1982. Test results are available.	Under review. Final phase of approval. Public comment period ended Dec. 19, 1982.

(continued)

TABLE B-5. (continued)

Company	Application	Site Location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
PCB Destruction Company	December 1981	Mobile	PCB contaminated waste oil	Chemical	Dechlorination	First tests were conducted in Region VII on Dec. 18, 1981.	Under review. Awaiting second test results from Region VII.
Environmental International Inc.	February 1982	Mobile	PCB contaminated waste oil	Chemical	Dechlorination	Full scale demonstration was conducted on Jan. 14, 1982 in Region VII. Test results are available.	Under review. Draft letter of approval is complete.
Transformer Consultants	April 1982	Akron, OH	PCB contaminated dielectric mineral oil	Chemical	Dechlorination	Test run conducted in Region V, April 14-15, 1982.	Approved Dec. 8, 1982, for wastes up to 2100 ppm PCB.
Franklin Institute Research Laboratory	October 1982	Mobile	PCB contaminated dielectric mineral oil up to 7406 ppm PCBs	Chemical	Dechlorination (Na PEG process)	Test conducted April 1982 on 7406 ppm waste in Region III.	Final phase of approval. Draft approval letter is ready. Test results are available. Public notice period ends March 31, 1983.
General Electric	October 1982	Mobile	PCB contaminated dielectric mineral oil	Chemical	dechlorination	Pilot scale tests successfully conducted May 14, 1982 in Region III on waste containing 1050 ppm PCBs.	Final phase of approval. Draft approval letter being planned. Test results are available. Public notice published March 21, 1983.
Aqua-Tech	October 1982	Hillsboro, OR	Oily waste contaminated with PCBs up to 100 ppm	Biodegradation	--	Research and development ongoing tests.	No further action from company is expected.
SED Inc.	November 1982	Mobile	PCB contaminated capacitors	Mechanical	Shredding and rinsing of capacitors	Demonstration test not scheduled at this time.	Under preliminary review.
PCB Specialist	--	Mobile	PCB contaminated dielectric mineral oil	Chemical	Dechlorination	Demonstration test will be conducted in Region VII.	Letter of Intent submitted March 1983.

(continued)

TABLE B-5. (continued)

Company	Application	Site location	Type of Waste	Disposal Method	Process Utilized	Demonstration Plan or Burn	Status
Anchorage Utilities	--	Anchorage, AK	Dielectric mineral oil up to 50 ppm	Thermal	Multiple hearth sewage sludge incinerator	Research and development.	Further action has been postponed at least until Spring 1984 pending decision by operator to continue.
<u>Landfills</u>							
Envirosafe Services of Idaho, Inc.	February 1977	Grandview, ID	All waste permitted under regulations	Landfill	--	Site plan complete, inspection complete.	Approval renewal granted March 5, 1982.
Chemical Security Systems, Inc.	February 1977	Arlington, OR	All waste permitted under regulations	Landfill	--	Site plan complete, inspection complete.	Approval renewal granted March 25, 1983.
Washington Waste Treatment, Inc.	July 1982	Batum, WA	All waste permitted under regulations	Landfill	--	Initial application review completed.	Reports are being developed to meet Subpart B requirements.

TABLE B-6. EPA REGIONAL OFFICE AND TECHNICAL ASSISTANCE CONTACTS AT REGIONS I - X

Region/Address	Contact*	Division	Telephone No.	Region/Address	Contact*	Division	Telephone No.
U.S. EPA, Region VI 1201 Elm Street Dallas, TX 75270	Jim Sales Regional PCB Coordinator	Technical Section, Air & Waste Management Division	(214) 767-8941	U.S. EPA, Region I John F. Kennedy Building Room 2303 Boston, MA 02203	Paul Heffernan	Air Management	(617) 223-0585
	Martin Allen	Technical Section, Air & Waste Management Division	(214) 767-8941		Chuck Lincoln	Air Management	(617) 223-7740
	Larry Thomas Regional Toxic Coordinator	Pesticides & Toxic Substances Branch	(214) 767-2734		Tom Michel	Air Management	(617) 223-5137
	Phil Schwindt	Environmental Services Division	(214) 767-2727	U.S. EPA, Region II Federal Office Building 26 Federal Plaza New York, NY 10007	John Brogard	Air and Waste Management	(212) 264-2637
U.S. EPA, Region VII 324 East 11th Street Kansas City, MI 64106	Steve Busch	Waste Management Branch	(816) 374-6531		Gaffett Smith	Air and Waste Management	(212) 264-3467
	Marvin Frye Regional PCB Coordinator	Toxic and Pesticides Section	(816) 374-3036		Jerry McKenna	Environmental Services	(201) 321-6645
					Arthur H. Gevirtz	Environmental Services	(201) 321-6667
U.S. EPA, Regions VIII 1860 Lincoln Street Denver, CO 80203	Steve Farrow Regional PCB Coordinator	Toxic Substances Branch	(303) 837-3926		Dan Kraft	Environmental Services	(201) 321-6667
	Dean Gillingham Regional Toxic Coordinator	Toxic Substances Branch	(303) 837-3926	U.S. EPA, Region III Curtis Building Sixth and Walnut Streets Philadelphia, PA 19106	Herman Phillips	Public Awareness	(212) 264-2515
U.S. EPA, Region IX 215 Fremont Street San Francisco, CA 94105	Raymond Seid	Toxic and Waste Management Branch	(415) 974-8389		Edward Cohen	Environmental Services	(215) 597-7668
	Jim Suhrer	Office of Technical and Scientific Assistance	(415) 974-8192		Christopher Pilla	Environmental Services	(215) 597-4651
U.S. EPA, Region X 1200 6th Avenue Seattle, WA 98101	Charles W. Rice	Waste Management Branch	(206) 442-2728		Michael Vaccaro	Regional Council	(215) 597-9477
	Roger Fuentes Regional PCB Coordinator	Waste Management Branch	(206) 442-1254	U.S. EPA, Region IV 345 Courtland, Northeast Atlanta, GA 30365	K. K. Wu	Environmental Services	(215) 597-7683
	Jim Everts Regional Toxic Coordinator	Permits and Compliance Branch	(206) 442-1090		Ralph Jennings Regional Toxics & PCB Coordinator	Air and Waste Management	(404) 881-3864
					Don Hunter	Air and Waste Management	(404) 881-3933
U.S. EPA, Region V 230 S. Dearborn Street Chicago, IL 60604					Howard Zeller	Enforcement	(404) 881-2211
					Constance Allison	Air and Waste Management	(404) 881-3864
					James Finger	Surveillance and Analysis	(404) 546-3136
					Francis Redman	Public Awareness	(404) 881-3004
					Y. J. Kim	Waste Management	(312) 353-1428
					Bill Muno	Waste Management	(312) 886-6136

For technical assistance and review of disposal technology please contact:

U.S. EPA, Region I-V

GCA Corporation

Bedford, MA

Bob McInnes (617) 275-5444 Ext. 4206

U.S. EPA, Region VI-X

TRW Environmental Operations

Research Triangle Park, NC

Red Adams (919) 541-9100

*The first contact listed for each Region is the primary contact for information contained in this report.

REGIONAL SUMMARIES: REGIONS VI - X

Region VI - Jim Sales

PPG incineration trial burn results were received and are being reviewed. The incinerator is located in Lake Charles, Louisiana and tests were on the destruction of a process waste stream.

Los Alamos Scientific Laboratories conducted a test burn in June 1982 to destroy PCB contaminated transformer fluid. The results are still under review at the Region.

Huber Corporation at Borger, Texas has conducted a research test for disposing of PCBs in contaminated soil by pyrolysis in a carbon black furnace. The Region has received the test results and they are being reviewed.

Biotechnology, Inc. at Houston, Texas is conducting research on a disposal method employing biodegradation. A demonstration test is expected to be completed by the end of November.

San Angelo Electric of San Angelo, Texas has cancelled plans to conduct a demonstration test for the chemical dechlorination of 900 ppm PCB in mineral oil.

Region VII - Steve Busch

Rose Chemical Company at Holden, Missouri submitted a request during the third quarter, 1983 to modify their permit to include the disposal of PCB contaminated natural gas condensate. The present permit is for chemical dechlorination of PCB contaminated mineral oils. The Region has requested further information about disposal of the natural gas condensate. Rose Chemical also received final approval for the shredding and rinsing of PCB contaminated capacitors. The permit is effective October 15, 1983 to October 15, 1986.

PPM Incorporated at Kansas City, Missouri submitted a request in January 1983 for research and development for the solvent cleaning of transformers and capacitors. The application is still under review at the Region.

PCB Treatment Incorporated at Kansas City, Missouri had their approval extended to September 15, 1986 for the chemical dechlorination of PCB liquids.

PCB Disposal Systems, Inc. at Kansas City, Missouri has requested a permit for a demonstration test for the chemical dechlorination of mineral oil dielectric fluid. The request is being reviewed at the Region. They have also requested a demonstration test for the mechanical shredding and rinsing of capacitors. The request is under review at the Region.

Environmental International Electrical Services conducted a demonstration test on October 7, 1983 for the mechanical separation and cleanup of PCB contaminated transformers. Metals are to be salvaged. EPA observed the demonstration test. Analytical results have not been received.

Region VIII - Steve Farrow

Otter Tail Power Company at the Big Stone power station, Big Stone, South Dakota plans to destroy mineral oil dielectric fluid in a high efficiency boiler. The power station is owned by Otter Tail, Montana - Dakota Utilities and Northwest Public Service. The utility may proceed after they install a CO monitor. The company has agreed to purchase this monitor.

Region IX - Raymond Seid

The Approval to Operate for Chemical Waste Management at Kettleman Hills, California was amended on November 14, 1983. The amendment approves design modifications to increase the capacity of Burial Cell B-14 of the landfill. The permit for Burial Cell B-14 is one of two permits that Chemical Waste Management has at Kettleman Hills. It was issued June 29, 1981.

Region X - Charles Rice

Aqua-Tech at Hillsboro, Oregon has conducted research tests for the biodegradation of PCBs. The Region expects no further action by this company.

The municipal utilities department of Anchorage, Alaska has postponed a research test to determine destruction of low concentration PCBs (<500 ppm) in oil.

The municipality has yielded to considerable public pressure to hold off. No further action is expected until Spring 1984.

APPENDIX C

INFORMATION ON PCB DISPOSAL ACTIVITIES -
THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION
(EPA REGIONS I-V)

TABLES C-1 THROUGH C-5, ABBREVIATIONS, DEFINITIONS

M.O.D.F.:	Mineral Oil Dielectric Fluid
THF:	Tetrahydrofuran
DEGM:	Diethylene Glycol, Di-methyl Ether
R&D:	Research and Development Project
N/A:	Not Applicable
CBI:	Data are cited by firm as confidential business information
MT:	Metric Tons
D.E.:	Destruction Efficiency
STD. Conditions:	Regional office approval includes several standard conditions concerning reporting requirements, system operation, record keeping, etc.
Semi-continuous:	Process is used regularly in region, duration of individual decontamination runs may last from several days to several months.
Never utilized:	Process has been approved by EPA but has not yet been utilized for PCB disposal.

TABLE C-1. INFORMATION OF PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION I

Company:	Public Service Company of New Hampshire	New England Power Company	Northeast Utilities
Application Date:	2-6-80	10-14-80	9-4-80
Site Location:	Merrimac Station, N.H.	Salem Harbor Station, Mass.	Middletown Station, Conn. Unit No. 3
Type of Waste:	M.O.D.F.	M.O.D.F.	M.O.D.F.
Process Utilized:	Boiler	Boiler	Boiler
Permit Status			
Approval Date:	3-3-80	12-80	9-4-80
Approval Conditions:	STD. Conditions	STD. Conditions	STD. Conditions
Expiration Date:	None	None	None
Technical Considerations			
Number of Units:	1	1	1
Concentration Limit of Feed (ppm):	500 ppm	500 ppm	500 ppm
Capacity of Process or Unit:	Boiler size unknown	Boiler size unknown	2.19 x 10 ⁹ Btu/hr
% Capacity Presently Available:	N/A	N/A	100
Frequency of Operation:	Never utilized	Never utilized	4 times/yr
Test Results (Limits as defined by test burn or test run):	No test conducted	No test conducted	D.E. >99.98%
Commercial Availability:	Never utilized	Never utilized	Available

(continued)

TABLE C-1. (continued)

Company:	General Electric	Pyro Magnetic	Sunohio
Application Date:	4-80	12-81	3-81
Site Location:	Pittsfield, Mass.	Mobile	Mobile
Type of Waste:	All PCB fluids	Waste oil	M.O.D.F.
Process Utilized:	Annex I liquid injection incinerator	Mobile Annex I incinerator	Chemical dechlorination
Permit Status			
Approval Date:	3-4-82	7-9-82	6-81
Approval Conditions:	30 STD. Conditions	Concept app'd, but site specific approval req'd.	M.O.D.F. only, STD. Conditions
Expiration Date:	3-4-87	None	None
Technical Considerations			
Number of Units:	1	1	5 (Nationwide)
Concentration Limit of Feed (ppm):	No limit	No limit	No limit
Capacity of Process or Unit:	132 gal/hr <i>~200 4 PCB/min</i>	5,940 lb/hr	600 gal/hr
% Capacity Presently Available:	100	N/A	100
Frequency of Operation:	Continuous	Never utilized	Semi-continuous
Test Results (Limits as defined by test burn or test run):	20% PCB feed, D.E. >99.9%	D.E. >99.9999%	Outlet <2 ppm
Commercial Availability:	Available	Never utilized	Available

(continued)

TABLE C-1. (continued)

Company:	Acurex	PPM, Inc.	Transformer consultants
Application Date:	1-81	12-14-81	4-5-82
Site Location:	Mobile	Mobile	Mobile
Type of Waste:	M.O.D.F.	M.O.D.F.	M.O.D.F., PCB liquids
Process Utilized:	Chemical dechlorination	Chemical dechlorination	Chemical dechlorination
Permit Status			
Approval Date:	2-1-82	3-26-82	11-29-82
Approval Conditions:	M.O.D.F. only, STD. Conditions	M.O.D.F. only, STD. Conditions	5,000 gal. max per batch STD. Conditions
Expiration Date:	None	None	None
35 Technical Considerations			
Number of Units:	1 (Nationwide)	4 (Nationwide)	2 (Nationwide)
Concentration Limit of Feed (ppm):	No limit	10,000 ppm	M.O.D.F. - 5,000 ppm Other PCB liquids - 3,000 ppm
Capacity of Process or Unit:	4 - 6,000 gal/day	5 - 10,000 gal/day	7 - 9,000 gal/day
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Semi-continuous	Semi-continuous	Semi-continuous
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Outlet <2 ppm	Outlet <2 ppm
Commercial Availability:	Available	Available	Available

TABLE C-2. INFORMATION OF PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION II

Company:	General Electric	U.S. EPA	Sunohio
Application Date:	Original-1978, Reauth-1982	10-81	7-81
Site Location:	Waterford, NY	Mobile (Edison, N.J.)	Mobile
Type of Waste:	Waste Oil	Waste Oil	Waste Oil
Process Utilized:	Annex I Liquid Injection Incinerator	Rotary Kiln Incinerator	Chemical Dechlorination
Permit Status			
Approval Date:	3-31-82	12/21/83	11/9/82
Approval Conditions:	STD. Conditions	STD. Conditions	STD. Conditions
Expiration Date:	3-31-87	None	None
54 Technical Considerations			
Number of Units:	1	1	5 (Nationwide)
Concentration Limit of Feed (ppm):	25%	None	2,500 ppm
Capacity of Process or Unit:	CBI	6 x 10 ⁶ Btu/hr	600 gal/hr
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Continuous	Never utilized	Semi-continuous
Test Results (Limits as defined by test burn or test run):	D.E. >99.99%	D.E. >99.999.9	Outlet <2 ppm
Commercial Availability:	Not Available (G.E. Wastes Only)	Available	Available

(continued)

TABLE C-2. (continued)

Company:	Acurex	PPM, Inc.	Transformer Consultants
Application Date:	8-81	12-81	4-82
Site Location:	Mobile	Mobile	Mobile
Type of Waste:	Waste Oil	Waste Oil	M.O.D.F.
Process Utilized:	Chemical Dechlorination	Chemical Dechlorination	Chemical Dechlorination
Permit Status			
Approval Date:	1-83	4-26-83	4-26-83
Approval Conditions:	Conc. Limit, STD. Conditions	Conc. Limit, STD. Conditions	Conc. Limit, STD. Conditions
Expiration Date:	None	None	None
5 Technical Considerations			
Number of Units:	1 (Nationwide)	4 (Nationwide)	2 (Nationwide)
Concentration Limit of Feed (ppm):	7,500 ppm	1,100 ppm	Batch - 3,000 ppm
Capacity of Process or Unit:	4-6,000 gal/day	5 - 10,000 gal/day	7 - 9,000 gal/day
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Semi-Continuous	Semi-continuous	Semi-continuous
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Outlet <2 ppm	Outlet <2 ppm
Commercial Availability:	Available	Available	Available

(continued)

TABLE C-2. (continued)

56	Company:	Bengart & Memel	Galson Technical Services	Niagara Mohawk
	Application Date:	2-82	2-4-82	2-10-82
	Site Location:	South Buffalo, NY	East Syracuse, NY	Syracuse, NY
	Type of Waste:	PCB Contaminated Soil	PCB Contaminated Soil	Transformer Fluids
	Process Utilized:	Non-Thermal, In Situ Dechlorination (R&D)	Chemical Dechlorination (R&D)	Non-Thermal (R&D)
	Permit Status			
	Approval Date:	8-15-83	3-10-83	6-20-83
	Approval Conditions:	STD. Conditions	STD. Conditions	STD. Conditions
	Expiration Date:	8-15-84	None	None
	Technical Considerations			
	Number of Units:	1	1	1
	Concentration Limit of Feed (ppm):	Unknown	Unknown	5,000 ppm
	Capacity of Process or Unit:	10 cu. yrds. of soil	165 lbs/yr of soil	3,000 gal. @ <500 ppm 250 gal. @ 500-5,000 ppm
	% Capacity Presently Available:	N/A	N/A	N/A
	Frequency of Operation:	N/A	N/A	N/A
	Test Results (Limits as defined by test burn or test run):	Data not yet available	No data	No data
	Commercial Availability:	Not Available (R&D Study)	Not Available (Bench Scale R&D Study)	Not Available (Pilot Plant R&D Study)

(continued)

TABLE C-2. (continued)

Company:	Marcus Sittenfield Assoc.
Application Date:	4-28-83
Site Location:	Farmingdale, NY
Type of Waste:	PCB Liquids
Process Utilized:	Chemical Dechlorination (R&D)

Permit Status

Approval Date:	8-10-83
Approval Conditions:	STD. Conditions
Expiration Date:	None

57 Technical Considerations

Number of Units:	1
Concentration Limit of Feed (ppm):	500 ppm
Capacity of Process or Unit:	25 gallons
% Capacity Presently Available:	N/A
Frequency of Operation:	N/A
Test Results (Limits as defined by test burn or test run):	No data available

Commercial Availability:	Not Available (Pilot Scale R&D Study)
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TABLE C-3. INFORMATION OF PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION III

Company:	Potomac Electric & Power	Baltimore Gas & Electric	Acurex
Application Date:	10-9-79	12-21-79	1-29-81
Site Location:	Morgantown Station, MD	Crane Station, Chase, MD	Mobile
Type of Waste:	Waste Oil	Waste Oil	M.O.D.F.
Process Utilized:	Boiler	Boiler	Chemical Dechlorination
Permit Status			
Approval Date:	11-79	1-80	11-9-82
Approval Conditions:	STD. Conditions	STD. Conditions	Conc. limit, STD. conditions
Expiration Date:	None	None	None
58 Technical Considerations			
Number of Units:	1	1	1 (Nationwide)
Concentration Limit of Feed (ppm):	500 ppm	500 ppm	7,500
Capacity of Process or Unit:	Boiler size unknown	Boiler size unknown	4-6,000 gal/day
% Capacity Presently Available:	100	100	100
Frequency of Operation:	No data	No data	Semi-continuous
Test Results (Limits as defined by test burn or test run):	No test conducted	No test conducted	Outlet <2 ppm
Commercial Availability:	Available	Available	Available

(continued)

TABLE C-3. (continued)

Company:	Sunohio	Franklin Institutes	General Electric
Application Date:	9-11-81	3-28-81	5-29-81
Site Location:	Mobile	Philadelphia, PA	Philadelphia, PA
Type of Waste:	M.O.D.F.	M.O.D.F.	M.O.D.F.
Process Utilized:	Chemical Dechlorination	Chemical Dechlorination	Chemical Dechlorination
Permit Status			
Approval Date:	9-9-82	9-28-82	9-28-82
Approval Conditions:	Conc. Limit, STD. Conditions	Conc. Limit, STD. Conditions	Conc. Limit, STD. Conditions
Expiration Date:	None	None	None
5 Technical Considerations			
Number of Units:	5 (Nationwide)	1	1
Concentration Limit of Feed (ppm):	2,500 ppm	7,406 ppm	1,050 ppm
Capacity of Process or Unit:	600 gal/day	250 gal/batch	210 gal/batch
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Semi-Continuous	Never utilized	Never utilized
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Outlet <2 ppm	Outlet <2 ppm
Commercial Availability:	Available	Available	Available

(continued)

TABLE C-3. (continued)

8	Company:	PPM, Inc.	Transformer Consultants	Sunohio
	Application Date:	12-14-81	4-5-82	7-23-82
	Site Location:	Mobile	Mobile	Jeannette, PA
	Type of Waste:	Waste oil	M.O.D.F.	Therminol-55 heat Transfer fluid/M.O.D.F.
	Process Utilized:	Chemical Dechlorination	Chemical Dechlorination	Chemical Dechlorination
	Permit Status			
	Approval Date:	4-28-83	5-26-83	3-21-83
	Approval Conditions:	Conc. limit, STD conditions	Conc. limit, STD conditions	Conc. limit, STD conditions
	Expiration Date:	None	None	None
	Technical Considerations			
	Number of Units:	4 (Nationwide)	2 (Nationwide)	1
	Concentration Limit of Feed (ppm):	1,100 ppm	Batch - 3,000 ppm Continuous - 2,100 ppm	4,500 ppm
	Capacity of Process or Unit:	5 - 10,000 gal/day	7 - 9,000 gal/day	CBI
	% Capacity Presently Available:	100	100	100
	Frequency of Operation:	Semi-continuous	Semi-continuous	No data
	Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Outlet <2 ppm	Outlet <2 ppm
	Commercial Availability:	Available	Available	Unavailable (Pilot Plant R&D Study)

(continued)

TABLE C-3. (continued)

Company:	Chemical Decontamination Corp.	Atlantic Research Corp.
Application Date:	8-20-83	9-9-83
Site Location:	Mobile	Alexandria, VA
Type of Waste:	M.O.D.F.	PCB waste (unspecified)
Process Utilized:	Chemical Dechlorination (R&D)	CBI
Permit Status		
Approval Date:	9-23-82	11-30-83
Approval Conditions:	Conc. limit, STD conditions	STD. conditions
Expiration Date:	None	None
Technical Considerations		
Number of Units:	1	1
Concentration Limit of Feed (ppm):	4,179 ppm	CBI
Capacity of Process or Unit:	CBI	CBI
% Capacity Presently Available:	N/A	N/A
Frequency of Operation:	N/A	N/A
Test Results (Limits as defined by test burn or test run):	Outlet < 2 ppm	No test conducted
Commercial Availability:	Unavailable (Research & Development Pilot Study)	Unavailable (Research & Development Study)

TABLE C-4. INFORMATION OF PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION IV

Company:	Tennessee Eastman Co.	Duke Power Co.	Tennessee Valley Authority
Application Date:	3-79	5-81	6-10-81
Site Location:	Kingsport, TN	Riverbend Station Unit, Unit No. 4	Widow's Creek Station, Unit No. 1, Bridgeport, AL
Type of Waste:	Waste Oil	M.O.D.F.	Waste oil
Process Utilized:	Boiler	Boiler	Boiler
Permit Status			
Approval Date:	4-79	6-81	7-81
Approval Conditions:	STD. Conditions	STD. Conditions	STD. Conditions conditions
Expiration Date:	None	None	None
Technical Considerations			
Number of Units:	1	1	1
Concentration Limit of Feed (ppm):	500 ppm	500 ppm	500 ppm
Capacity of Process or Unit:	Unknown	977 x 10 ⁶ Btu/hr	1,290 x 10 ⁶ Btu/hr
% Capacity Presently Available:	100	100	100
Frequency of Operation:	3-4/yr	No data	No data
Test Results (Limits as defined by test burn or test run):	D.E. >99.7%	D.E. >99.92%	D.E. >99.95%
Commercial Availability:	Available	Available	Available

(continued)

TABLE C-4. (continued)

Company:	Louisville Gas & Electric Carolina Power & Light Co.	
Application Date:	8-81	11-12-82
Site Location:	Cane Run Station, Units 4,5,6, Louisville, KY	Cape Fear Station, Unit No. 5, Moncure, NC
Type of Waste:	M.O.D.F.	M.O.D.F.
Process Utilized:	Boiler	Boiler
Permit Status		
Approval Date:	8-81	12-82
Approval Conditions:	STD. Conditions	STD. Conditions
Expiration Date:	None	None
Technical Considerations		
Number of Units:	1	1
Concentration Limit of Feed (ppm):	500 ppm	500 ppm
Capacity of Process or Unit:	Unit 4 - $1,801 \times 10^6$ Btu/hr, Unit 5 - $1,822 \times$ 10^6 Btu/hr, Unit 6 - $2,759 \times 10^6$ Btu/hr	$1,200 \times 10^6$ Btu/hr
% Capacity Presently Available:	100	100
Frequency of Operation:	5-6/yr	3-4/yr
Test Results (Limits as defined by test burn or test run):	Unknown	Unknown
Commercial Availability:	Available	Available

(continued)

TABLE C-4. (continued)

Company:	Sunohio	Acurex	PPM, Inc.
Application Date:	3-81	7-81	12-14-81
Site Location:	Mobile	Mobile	Atlanta, GA
Type of Waste:	Waste oil	Waste oil	Waste oil
Process Utilized:	Chemical Dechlorination	Chemical Dechlorination	Chemical Dechlorination
Permit Status			
Approval Date:	4-81	6-4-82	3-1-82
Approval Conditions:	None	None	None
Expiration Date:	None	None	None
Technical Considerations			
Number of Units:	5 (Nationwide)	1 (Nationwide)	4 (Nationwide)
Concentration Limit of Feed (ppm):	No limit	No limit	No limit
Capacity of Process or Unit:	608 gal/hr	4 - 6,000 gal/day	5 - 10,000 gal/day
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Semi-continuous	Never utilized	Semi-continuous
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Outlet <2 ppm	Outlet <2 ppm
Commercial Availability:	Available	Available	Available

(continued)

TABLE C-4. (continued)

Company:	Transformer Consultants	S.E.D., Inc.	Chemical Waste Management
Application Date:	5-7-82	4-26-82	N/A
Site Location:	Mobile	Greensboro, NC	M.T. Vulcanus (offshore) Mobile, AL (port)
Type of Waste:	M.O.D.F.	Capacitors	Waste oil
Process Utilized:	Chemical Dechlorination	Shredding with solvent extraction	Liquid injection incinerator
Permit Status			
Approval Date:	11-23-82	6-29-82	N/A
Approval Conditions:	STD. Conditions	Process specific common	N/A
Expiration Date:	None	None	
Technical Considerations			
Number of Units:	2 (Nationwide)	1	2
Concentration Limit of Feed (ppm):	No limit	No limit	No limit
Capacity of Process or Unit:	7 - 9,000 gal/day	CBI	25 MT/hr
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Semi-continuous	Continuous	1-2/yr
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Not tested	D.E. >99.995%
Commercial Availability:	Available	Available	Continuous burn permit not yet granted

TABLE C-5. INFORMATION OF PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION V

Company:	Illinois Power Company	General Motors Corp.	Otter Tail Power Company
Application Date:	6-18-80	5-1-81	10-1-81
Site Location:	Baldwin Station, Unit 3 Baldwin, IL	Chevrolet Division, Boiler No. 3, Bay City, MI	Hoot Lake Plant, Unit 3 Fergus Falls, MN
Type of Waste:	M.O.D.F.	Waste oil	M.O.D.F.
Process Utilized:	Boiler	Boiler	Boiler
Permit Status			
Approval Date:	7-80	7-10-81	11-4-81
Approval Conditions:	STD. Conditions	STD. Conditions	STD. Conditions
Expiration Date:	None	None	None
Technical Considerations			
Number of Units:	1	1	1
Concentration Limit of Feed (ppm):	500 ppm	500 ppm	500 ppm
Capacity of Process or Unit:	6,000 x 10 ⁶ Btu/hr	70 x 10 ⁶ Btu/hr	660 x 10 ⁶ Btu/hr
% Capacity Presently Available:	100	100	100
Frequency of Operation:	No data	No data	Never utilized
Test Results (Limits as defined by test burn or test run):	No test conducted	D.E. >99.99%	No test conducted
Commercial Availability:	Available	Available	Never utilized

(continued)

TABLE C-5. (continued)

Company:	Northern States Power Co.	Housier Energy, Inc.	SCA Chemical Services
Application Date:	12-18-81	10-13-82	9-2-82
Site Location:	High Bridge Plant, Unit 12, Minneapolis, MN	Frank E. Ratts Station, Units 1 & 2, Bloomington, IN	Chicago, IL
Type of Waste:	M.O.D.F.	M.O.D.F.	PCB Liquids
Process Utilized:	Boiler	Boiler	Annex I rotary kiln incinerator
Permit Status			
Approval Date:	1-8-82	12-7-82	9-26-83
Approval Conditions:	STD. Conditions	STD. Conditions	STD. Conditions
Expiration Date:	None	None	None
Technical Considerations			
Number of Units:	1	1	1
Concentration Limit of Feed (ppm):	500 ppm	500 ppm	25%
Capacity of Process or unit:	1,630 x 10 ⁶ Btu/hr	2,332 x 10 ⁶ Btu/hr	6,012 lb/hr
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Never utilized	No data	Continuous
Test Results (Limits as defined by test burn or test run):	No test conducted	No test conducted	D.E. >99.99%
Commercial Availability:	Never utilized	Available	Available

(continued)

TABLE C-5. (continued)

Company:	SCA Chemical Services	Pyro-Magnetics, Corp.	Sunohio
Application Date:	9-2-82	11-3-81	5-16-80
Site Location:	Chicago	Mobile (La Porte, IN)	Mobile (Canton, OH)
Type of Waste:	PCB solids	Waste oil	M.O.D.F., petroleum or synthetic hydrocarbons
Process Utilized:	Annex I rotary kiln incinerator	Rotary kiln incinerator	Chemical Dechlorination
Permit Status			
Approval Date:	9-26-83	12-17-82	5-6-83
Approval Conditions:	STD. Conditions	STD. Conditions	Conc. limit, STD. Conditions
Expiration Date:	None	None	None
Technical Considerations			
Number of Units:	1	1	5 (Nationwide)
Concentration Limit of Feed (ppm):	28.5%	No limit	4,500 ppm
Capacity of Process or Unit:	2,910 lb/hr	5,940 lb/hr	1,608 gal/hr
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Continuous	Not utilized	Semi-continuous
Test Results (Limits as defined by test burn or test run):	D.E. >99.99%	D.E. >99.9999%	Outlet <2 ppm
Commercial Availability:	Available	Available	Available

(continued)

TABLE C-5. (continued)

Company:	Acurex	Transformer Consultants	Dowzer Electric Co.
Application Date:	2-6-81	10-15-81	1-7-82
Site Location:	Mobile (Cincinnati, OH)	Akron, OH	Mt. Vernon, IL
Type of Waste:	Waste oil	Waste oil	Waste oil
Process Utilized:	Chemical Dechlorination	Chemical Dechlorination	Chemical Dechlorination
Permit Status			
Approval Date:	5-6-83	11-29-82	7-7-83
Approval Conditions:	Conc. limit, STD. Conditions	Conc. limit, STD. Conditions	Conc. limit, STD Conditions
Expiration Date:	None	None	None
3 Technical Considerations			
Number of Units:	1 (Nationwide)	2 (Nationwide)	1
Concentration Limit of Feed (ppm):	7,500 ppm w/THF 1,600 ppm w/DEGD	Batch - 3,000 ppm Continuous - 2,100 ppm	450 ppm
Capacity of Process or Unit:	4 - 6,000 gal/day	7 - 9,000 gal/day	200 gal/batch
% Capacity Presently Available:	100	100	100
Frequency of Operation:	Never utilized	Semi-continuous	Semi-continuous
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Outlet <2 ppm	Outlet <2 ppm
Commercial Availability:	Available	Available	Available

(continued)

TABLE C-5. (continued)

Company:	PPM-PCB Management	Sunohio	Acurex "B"
Application Date:	1-11-82	3-29-82	8-1-81
Site Location:	Mobile (Kansas City, MO)	Mobile	Cincinnati, OH
Type of Waste:	Waste oil	Waste oil	Capacitors
Process Utilized:	Chemical Dechlorination	Chemical Dechlorination (R&D)	CBI (R&D)
Permit Status			
Approval Date:	2-18-83	10-3-83	12-30-81
Approval Conditions:	Conc. limit, STD. Conditions	STD. conditions, max Conc., Qty., Submit R&D Report	STD. Conditions, Max, Conc., Qty., Submit R&D Report
Expiration Date:	None	4-3-84	6-30-82
Technical Considerations			
Number of Units:	4 (Nationwide)	1	1
Concentration Limit of Feed (ppm):	1,100 ppm	CBI	CBI
Capacity of Process or Unit:	5 - 10,000 gal/day	160 gal. reactor	CBI
% Capacity Presently Available:	100	N/A	N/A
Frequency of Operation:	Never utilized	N/A	N/A
Test Results (Limits as defined by test burn or test run):	Unknown	No test conducted	No test conducted
Commercial Availability:	Available	Unavailable (R&D Study)	Unavailable (R&D Study)

(continued)

TABLE C-5. (continued)

71	Company:	Acurex "C"	Acurex "D"	Acurex "E"
	Application Date:	11-22-82	12-13-82	12-13-82
	Site Location:	Mobile	Cincinnati, OH	Kingsbury, IN
	Type of Waste:	Waste oil	Contaminated soils	Proprietary solvent
	Process Utilized:	Chemical Dechlorination (R&D process optimization)	Chemical Dechlorination (bench scale R&D)	Chemical Dechlorination (R&D)
	Approval Date:	1-13-83	3-8-83	3-9-83
	Approval Conditions:	STD. Conditions, Max Conc., Qty., Submit R&D Report	STD. Conditions, Max Conc., Qty., Submit R&D Report	STD. Conditions, Max Conc., Qty., Submit R&D Report
	Expiration Date:	7-13-83	9-8-83	9-9-83
	Technical Considerations			
	Number of Units:	1	1	1
	Concentration Limit of Feed (ppm):	CBI	CBI	CBI
	Capacity of Process or Unit:	CBI	CBI	CBI
	% Capacity Presently Available:	N/A	N/A	N/A
	Frequency of Operation:	N/A	N/A	N/A
	Test Results (Limits as defined by test burn or test run):	Unknown	Unknown	Unknown
	Commercial Availability:	Unavailable (R&D Study)	Unavailable (R&D Study)	Unavailable (R&D Study)

(continued)

TABLE C-5. (continued)

Company:	Goodyear	Transformer Consultants	Polygone Corp.
Application Date:	10-13-81	10-9-82	10-28-81
Site Location:	Akron, OH	Akron, OH	Warrenville, IL
Type of Waste:	Waste oil	Waste oil	Waste oil
Process Utilized:	Chemical Dechlorination (R&D)	Chemical Dechlorination (R&D Process optimization)	Chemical Dechlorination (Bench scale R&D)
Permit Status			
Approval Date:	10-30-81	6-29-83	11-24-81
Approval Conditions:	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max. conc. Qty., Submit R&D Report
Expiration Date:	4-30-82	12-29-83	5-24-82
Technical Considerations			
Number of Units:	1	1	1
Concentration Limit of Feed (ppm):	CBI	CBI	CBI
Capacity of Process or Unit:	240 gal/hr	CBI	CBI
% Capacity Presently Available:	N/A	N/A	N/A
Frequency of Operation:	N/A	N/A	N/A
Test Results (Limits as defined by test burn or test run):	Unknown	Unknown	Unknown
Commercial Availability:	Unavailable (R&D Study)	Unavailable (R&D Study)	Unavailable (R&D Study)

(continued)

TABLE C-5. (continued)

Company:	Polygone Corp. "B"	Transformer Service, Inc.	Chem. Oil Corp.
Application Date:	12-13-82	5-17-82	6-17-82
Site Location:	Kingsbury, IN	Akron, OH	Warren, OH
Type of Waste:	Hydraulic fluids	M.O.D.F.	M.O.D.F.
Process Utilized:	Solvent extraction (R&D)	Chemical Dechlorination (Bench scale R&D)	Chemical Dechlorination (R&D)
Permit Status			
Approval Date:	7-25-83	4-14-83	10-24-83
Approval Conditions:	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max Conc. Qty., Submit (R&D report)
Expiration Date:	1-25-84	10-14-83	4-24-84
Technical Considerations			
Number of Units:	1	1	1
Concentration Limit of Feed (ppm):	CBI	CBI	CBI
Capacity of Process or unit:	CBI	CBI	CBI
% Capacity Presently Available:	N/A	N/A	N/A
Frequency of Operation:	N/A	N/A	N/A
Test Results (Limits as defined by test burn or test run):	Unknown	Unknown	Unknown
Commercial Availability:	Unavailable (R&D Study)	Unavailable (R&D Study)	Unavailable (R&D Study)

(continued)

TABLE C-5. (continued)

Company:	RTE Corp.	Midland-Ross	Transformer Recovery
Application Date:	6-21-82	6-28-82	8-2-82
Site Location:	Waukesha, WI	Toledo, OH	Brighton, MI
Type of Waste:	M.O.D.F.	Contaminated soils	Capacitors
Process Utilized:	Chemical Dechlorination (R&D)	Thermal-pyrolysis (R&D)	Chemical Dechlorination (R&D)
Permit Status			
Approval Date:	6-28-82	7-16-82	7-19-83
Approval Conditions:	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max. Conc. Qty., Submit R&D Report
74 Expiration Date:	12-28-82	1-16-83	1-19-84
Technical Considerations			
Number of Units:	1	1	1
Concentration Limit of Feed (ppm):	CBI	CBI	CBI
Capacity of Process or Unit:	CBI	CBI	CBI
% Capacity Presently Available:	N/A	N/A	N/A
Frequency of Operation:	N/A	N/A	N/A
Test Results (Limits as defined by test burn or test run):	Unknown	Unknown	Unknown
Commercial Availability:	Unavailable (R&D Study)	Unavailable (R&D Study)	Unavailable (R&D Study)

(continued)

TABLE C-5. (continued)

Company:	U.S. Transformer	Pollution Science Intl.	Excell, Inc.
Application Date:	8-2-82	9-15-82	11-10-82
Site Location:	Jordan, MN	Glen Coe, IL	Cincinnati, OH
Type of Waste:	M.O.D.F.	Contaminated sediments	Waste oil
Process Utilized:	Chemical Dechlorination (R&D)	Thermal stripping (R&D)	Thermal-molten salt (R&D)
Permit Status			
Approval Date:	9-1-82	6-24-83	9-14-83
Approval Conditions:	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max. Conc. Qty., Submit R&D Report
Expiration Date:	3-1-82	10-24-83	3-14-84
Technical Considerations			
Number of Units:	1	1	1
Concentration Limit of Feed (ppm):	CBI	CBI	CBI
Capacity of Process or Unit:	CBI	CBI	CBI
% Capacity Presently Available:	N/A	N/A	N/A
Frequency of Operation:	N/A	N/A	N/A
Test Results (Limits as defined by test burn or test run):	No work done	Unknown	Unknown
Commercial Availability:	Unavailable (R&D Study)	Unavailable (R&D Study)	Unavailable (R&D Study)

(continued)

TABLE C-5. (continued)

Company:	Dow Corning Corp.	Energystics, Inc.
Application Date:	11-12-82	7-15-83
Site Location:	Midland, MI	Toledo, OH
Type of Waste:	Contaminated silicon fluids	Waste oil
Process Utilized:	Physical absorption (Bench scale R&D)	Thermal-plasma jet incineratin (R&D)
Permit Status		
Approval Date:	8-22-83	9-14-83
Approval Conditions:	STD. Conditions, Max. Conc., Qty., Submit R&D Report	STD. Conditions, Max. Conc., Qty., Submit R&D Report
Expiration Date:	2-22-84	3-14-84
Technical Considerations		
Number of Units:	1	1
Concentration Limit of Feed (ppm):	CBI	CBI
Capacity of Process or Unit:	CBI	CBI
% Capacity Presently Available:	N/A	N/A
Frequency of Operation:	N/A	N/A
Test Results (Limits as defined by test burn or test run):	Unknown	Unknown
Commercial Availability:	Unavailable (R&D Study)	Unavailable (R&D Study)

(continued)

APPENDIX D

INFORMATION ON PCB DISPOSAL ACTIVITIES - THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION (EPA REGIONS VI-X)

TABLES D-1 THROUGH D-5, ABBREVIATIONS, DEFINITIONS

M.O.D.F.:	Mineral Oil Dielectric Fluid
THF:	Tetrahydrofuran
DEGM:	Diethylene Glycol, Di-methyl Ether
R&D:	Research and Development Project
N/A:	Not Applicable
CBI:	Data are cited by firm as confidential business information
MT:	Metric Tons
D.E.:	Destruction Efficiency
STD. Conditions:	Regional office approval includes several standard conditions concerning reporting requirements, system operation, record keeping, etc.
Semi-continuous:	Process is used regularly in region, duration of individual decontamination runs may last from several days to several months.
Never utilized:	Process has been approved by EPA but has not yet been utilized for PCB disposal.

TABLE D-1. INFORMATION ON PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION VI

Company:	Energy Systems Company (ENSCO)	Dow Chemical	Dow Chemical	Dow Chemical
Application Date:	March 1978	September 1979	September 1979	September 1979
Site Location:	El Dorado, AR	Freeport, TX	Plaquemine, LA	Oster Creek, TX
Type of Waste:	Solid waste	Vinyl chloride	Vinyl chloride	Vinyl chloride
Process Utilized:	Annex I rotary kiln	Annex I liquid injection incinerator	Annex I liquid injection incinerator	Annex I liquid injection incinerator
Permit Status				
Approval Date:	June 3, 1983	April 1982	June 1982	June 1982
Approval Conditions:	Standard conditions	Waiver - Residence time	Waiver - Residence time, feed measurement every 15 minutes, combustion efficiency during feed switching	Standard conditions
Expiration Date:	None	None	None	None
Technical Considerations				
Number of Units:	1	1	1	1
Concentration Limit of Feed (ppm):	None	None	None	None
Capacity of Process or Unit:	3,700 lb/h	48.6 lb/h PCBs	2.3 lb/h PCBs	3.4 lb/h PCBs
% Capacity Presently Available:	Not available	Not available	Not available	Not available
Frequency of Operation:	Continuous	Continuous	Continuous	Continuous
Test Results (Limits as defined by test burn or test run):	D.E. = 99.999997%	D.E. = >99.99999%	D.E. = >99.9971%	D.E. = >99.999998%
Commercial Availability:	Available	Not available	Not available	Not available

(continued)

TABLE D-1. (continued)

Company:	Vulcan Materials	Rollins Environmental Services	LaPort Chemical Corp.	PPG
Application Date:	January 1980	April 1980	July 1980	1980
Site Location:	Geismar, LA	Deer Park, TX	Pasadena, TX	Lake Charles, LA
Type of Waste:	Vinyl chloride	Solid waste	Vinyl chloride	Process waste
Process Utilized:	Incinerator	Rotary kiln	Incinerator	Incinerator
Permit Status				
Approval Date:	May 3, 1983	January 1983	January 1983	Proposed March 22, 1984
Approval Conditions:	Waiver - Temperature automatic cutoff	Annex I	Annex I	Waiver - Residence time
Expiration Date:	None	None	None	None
Technical Considerations				
Number of Units:	1	1	1	3
Concentration Limit of Feed (ppm):	None	None	None	None
Capacity of Process or Unit:	12.95 lb/h	2,439 lb/h PCBs	13.2 lb/h	No. 1 & 2 - 1.9 lb/h No. 3 - 2.7 lb/h
% Capacity Presently Available:	N/A	N/A	N/A	N/A
Frequency of Operation:	Continuous	Continuous	Not operating	Continuous
Test Results (Limits as defined by test burn or test run):	D.E. = >99.99998%	D.E. = >99.99999%	D.E. = >99.99999%	D.E., No. 1&2 = 99.99997% D.E., No. 3 = 99.99998%
Commercial Availability:	Not available	Available	Not available	Not available

(continued)

TABLE D-1. (continued)

Company:	SunOhio	ENSCO (formerly Pyro-Magnetics)	Acurex	PPM, Inc.
Application Date:	September 1981	November 1981	November 1981	December 1981
Site Location:	Mobile	Mobile	Mobile	Mobile
Type of Waste:	MODF	Waste oil	MODF	MODF
Process Utilized:	Chemical dechlorination	Annex I liquid injection	Chemical dechlorination	Chemical dechlorination
Permit Status				
Approval Date:	October 21, 1982	June 13, 1983	May 3, 1982	March 7, 1983
Approval Conditions:	Alternate	Annex I	Alternate	Alternate
Expiration Date:	None	None	None	None
Technical Considerations				
Number of Units:	5 (nationwide)	1	1	4 (nationwide)
Concentration Limit of Feed (ppm):	<2500	None	<7500	<1100
Capacity of Process or Unit:	N/A	217.56 lb/h	No limit	No limit
% Capacity Presently Available:	Not available	100%	Not available	Not available
Frequency of Operation:	Semi-continuous	Not in use	Semi-continuous	Semi-continuous
Test Results (Limits as defined by test burn or test run):	<2 ppm PCB	D.E. = 99.999943%	<2 ppm PCB	<2 ppm PCB
Commercial Availability:	Available	Available	Available	Available

(continued)

TABLE D-1. (continued)

Company:	Los Alamos Scientific	Transformer Consultants	General Electric	Franklin Institute Research Laboratory
Application Date:	February 1982	May 1982	August 1982	October 1982
Site Location:	Los Alamos, NM	Mobile	Mobile	Mobile
Type of Waste:	MODF	MODF	MODF	MODF
Process Utilized:	Incinerator	Chemical dechlorination	Chemical dechlorination	Chemical dechlorination
Permit Status				
Approval Date:	Proposed March 22, 1984	March 7, 1983	March 7, 1983	March 7, 1983
Approval Conditions:	Standard conditions	Alternate technology	Alternate technology	Alternate
Expiration Date:	None	None	None	None
Technical Considerations				
Number of Units:	1	2 (nationwide)	1	1
Concentration Limit of Feed (ppm):	None	<3,000 batch	<1,050	7,400
Capacity of Process or Unit:	26.5 lb/h	No limit	No limit	No limit
% Capacity Presently Available:	100	100	N/A	100
Frequency of Operation:	Not operating	Semi-continuous	Semi-continuous	Semi-continuous
Test Results (Limits as defined by test burn or test run):	D.E. = 99.99998%	<2 ppm PCBs	<2 ppm PCBs	<2 ppm PCBs
Commercial Availability:	Not available	Available	Available	Available

(continued)

TABLE D-1. (continued)

Company:	Huber, Corp.	Detox, Inc.
Application Date:	December 1982	January 1983
Site Location:	Borger, TX	Houston, TX
Type of Waste:	Contaminated soil	Contaminated soil, sludges
Process Utilized:	Pyrolysis	Biodegradation
Permit Status		
Approval Date:	Proposed - March 22, 1984	Proposed - pending
Approval Conditions:	Alternate	Alternate
Expiration Date:	None	None
Technical Considerations		
Number of Units:	1	Not applicable
Concentration Limit of Feed (ppm):	None	None
Capacity of Process or Unit:	2.8 lb/h	N/A
% Capacity Presently Available:	100	100
Frequency of Operation:	N/A	N/A
Test Results (Limits as defined by test burn or test run):	D.E. = >99.999997%	<1 ppm PCBs
Commercial Availability:	Available	Available

TABLE D-2. INFORMATION ON PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION VII

Company:	SunOhio	Energy Recovery Corp. (formerly PCB Destruction)	Acurex	Chemical Waste Management (formerly Environmental International)
Application Date:	October 1980	May 1981	May 1981	May 1981
Site Location:	Mobile	Mobile	Mobile	Kansas City, MO
Type of Waste:	M.O.D.F.	M.O.D.F.	M.O.D.F.	Capacitors
Process Utilized:	Chemical dechlorination	Chemical dechlorination	Chemical dechlorination	Mechanical shredding and rinsing
Permit Status				
Approval Date:	November 1981	October 1, 1983	September 15, 1982	April 4, 1983
Approval Conditions:	Concentration	Concentration	Concentration	CBI
Expiration Date:	November 17, 1984	April 1, 1984	September 15, 1983	March 16, 1985
Technical Considerations				
Number of Units:	5 (nationwide)	CBI	CBI	CBI
Concentration Limit of Feed (ppm):	10,000	10,000	10,000	CBI
Capacity of Process or Unit:	CBI	CBI	CBI	CBI
% Capacity Presently Available:	CBI	CBI	CBI	CBI
Frequency of Operation:	CBI	CBI	CBI	CBI
Test Results (Limits as defined by test burn or test run):	CBI	CBI	CBI	CBI
Commercial Availability:	Available	Not available	Available	Available

(continued)

TABLE D-2. (continued)

Company:	Alcoa	Rose Chemical Company	PPM Inc.	Pyro-Magnetics
Application Date:	June 1981	June 1981	October 1981	November 1981
Site Location:	Davenport, IA	Holden, MO	Mobile	Mobile
Type of Waste:	Contaminated fuel oil	M.O.D.F.	M.O.D.F., contaminated kerosene and heat transfer fluids	Contaminated waste oil
Process Utilized:	Incineration	Dechlorination	Dechlorination	Incineration
Permit Status				
Approval Date:	December 1981	March 1983	August 1982	September 1, 1982
Approval Conditions:	2.5 million gallons onsite	Concentration	Concentration	Interim
Expiration Date:	None	March 15, 1986	August 1, 1985	None
Technical Considerations				
Number of Units:	1	CBI	CBI	CBI
Concentration Limit of Feed (ppm):	500	10,000	10,000	500,000
Capacity of Process or Unit:	CBI	CBI	CBI	1.45 gal/min
% Capacity Presently Available:	CBI	CBI	CBI	CBI
Frequency of Operation:	CBI	CBI	CBI	CBI
Test Results (Limits as defined by test burn or test run):	CBI	CBI	CBI	CBI
Commercial Availability:	Not available	Available	Available	Available

(continued)

TABLE D-2. (continued)

Company:	Chemical Waste Management (formerly Environmental International)	Union Electric Company	Transformer Consultants, Div. of S.D. Meyers	PCB Treatment Inc.
Application Date:	January 1982	April 1982	June 1982	August 1982
Site Location:	Mobile	St. Louis, MO	Mobile	Kansas City, MO
Type of Waste:	Contaminated waste oil	M.O.D.F.	PCB liquids	PCB liquids
Process Utilized:	Chemical dechlorination	High efficiency boiler	Chemical dechlorination	Chemical dechlorination
Permit Status				
Approval Date:	November 5, 1982	January 1983	October 1, 1982	September 15, 1983
Approval Conditions:	Concentration	Site generated only	Concentration	Concentration
Expiration Date:	September 17, 1985	None	April 1, 1986	September 15, 1986
Technical Considerations				
Number of Units:	CBI	1	CBI	CBI
Concentration Limit of Feed (ppm):	570,000	50,000 \pm 10,000	10,000	10,000
Capacity of Process or Unit:	CBI	750 \pm 75 gal/hr	CBI	CBI
% Capacity Presently Available:	CBI	CBI	CBI	CBI
Frequency of Operation:	CBI	CBI	CBI	CBI
Test Results (Limits as defined by test burn or test run):	CBI	CBI	CBI	CBI
Commercial Availability:	Available	Not available	Available	Available

(continued)

TABLE D-2. (continued)

Company:	Franklin Institute Research Laboratory	General Electric	Rose Chemical Company	SED Inc.
Application Date:	October 1982	October 1982	November 1982	November 1982
Site Location:	Mobile	Mobile	Holden, MO	Mobile
Type of Waste:	M.O.D.F.	M.O.D.F.	Capacitors	Capacitors
Process Utilized:	Dechlorination	Dechlorination	Mechanical shredding and rinsing	Mechanical shredding and rinsing
Permit Status				
Approval Date:	Permit request	March 1983	November 7, 1983	Permit request
Approval Conditions:	Sent to headquarters	Concentration	Effective October 15, 1983	Sent to headquarters
Expiration Date:	-	October 1, 1983 - not renewed	October 15, 1986	-
Technical Considerations				
Number of Units:	-	CBI	CBI	-
Concentration Limit of Feed (ppm):	-	10,000	CBI	-
Capacity of Process or Unit:	-	CBI	CBI	-
% Capacity Presently Available:	-	CBI	CBI	-
Frequency of Operation:	-	CBI	CBI	-
Test Results (Limits as defined by test burn or test run):	-	CBI	CBI	-
Commercial Availability:	-	Available	Available	-

(continued)

TABLE D-2. (continued)

Company:	PPM Inc.	PCB Treatment Inc.	PCB Specialist	PCB Disposal Systems, Inc.
Application Date:	January 1983	January 1983	Informal letter of intent, October 21, 1982	October 1983
Site Location:	Kansas City, MO	Kansas City, MO	Kansas City, MO	Kansas City, MO
Type of Waste:	Transformer and capacitors	Capacitors	M.O.D.F.	M.O.D.F.
Process Utilized:	Solvent cleaning	Mechanical shredding and rinsing	Dechlorination	Dechlorination
Permit Status				
Approval Date:	Permit request	July 5, 1983	Application not received or expected	Permit request
Approval Conditions:	-	Interim	-	-
Expiration Date:	-	February 1, 1984	-	-
Technical Considerations				
Number of Units:	-	CBI	-	-
Concentration Limit of Feed (ppm):	-	CBI	-	-
Capacity of Process or Unit:	-	CBI	-	-
% Capacity Presently Available:	-	CBI	-	-
Frequency of Operation:	-	CBI	-	-
Test Results (Limits as defined by test burn or test run):	-	CBI	-	-
Commercial Availability:	-	Available	-	-

(continued)

TABLE D-2. (continued)

Company:	PCB Disposal Systems, Inc.	Environmental International Electrical Services
Application Date:	October 1983	August 1983
Site Location:	Kansas City, MO	Kansas City, KS
Type of Waste:	Capacitors and transformers	Transformers
Process Utilized:	Capacitors: mechanical shredding and rinsing Transformers: mechanical separations, cleanup and salvage of metals	Mechanical separations, cleanup and salvage of metals
Permit Status		
Approval Date:	December 15, 1983	Not approved
Approval Conditions:	R&D for transformers only	-
Expiration Date:	June 15, 1984	-
Technical Considerations		
Number of Units:	CBI	-
Concentration Limit of Feed (ppm):	CBI	-
Capacity of Process or Unit:	CBI	-
% Capacity Presently Available:	CBI	-
Frequency of Operation:	CBI	-
Test Results (Limits as defined by test burn or test run):	CBI	-
Commercial Availability:	CBI	-

TABLE D-3. INFORMATION ON PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION VIII

Company:	Rockwell International/DOE	Acurex	T & R Electric	PCB Eliminator, Inc.
Application Date:	March 1980	March 1981	June 1981	September 1981
Site Location:	Mobile	Mobile	Coleman, SD	Mobile
Type of Waste:	Contaminated liquids	Contaminated liquids	Contaminated liquids	Contaminated liquids
Process Utilized:	Fluidized bed incineration	Chemical dechlorination	Chemical dechlorination	-
Permit Status				
Approval Date:	May 1981 (test date)	September 15, 1982	September 1, 1982	Withdrew request
Approval Conditions:	Single test	Concentration	-	-
Expiration Date:	None	None	None	-
Technical Considerations				
Number of Units:	1	1	1	-
Concentration Limit of Feed (ppm):	N/A	<7500	500 ppm	-
Capacity of Process or Unit:	1 gal	4,000 - 6,000 gal/day	500 gal batches	-
% Capacity Presently Available:	N/A	100	100	-
Frequency of Operation:	Not operating	Semi-continuous	Semi-continuous	-
Test Results (Limits as defined by test burn or test run):	DE = 99.9999%	N/A	N/A	-
Commercial Availability:	Not available - R&D	Available	Available	-

(continued)

TABLE D-3. (continued)

Company:	SunOhio	Pyro-Magnetics	PPM Inc.	PCB Destruction Company
Application Date:	October 1981	November 1981	December 1981	December 1981 (requested)
Site Location:	Mobile	Mobile	Mobile	Mobile
Type of Waste:	Contaminated liquids	Contaminated liquids	Contaminated waste oil	Contaminated liquids
Process Utilized: {	Chemical dechlorination	Annex I liquid injection	Chemical dechlorination	Chemical dechlorination
Permit Status				
Approval Date:	September 1982	September 12, 1982	March 25, 1982	Never applied
Approval Conditions:	Concentration	Excess oxygen volume	Concentration	-
Expiration Date:	None	None	None	-
Technical Considerations				
Number of Units:	5 (nationwide)	1	4 (nationwide)	-
Concentration Limit of Feed (ppm):	<2,500 PCBs	410,000 ppm	<2,500	-
Capacity of Process or Unit:	600 gal/hr	1/gal/min 520 lb/hr	5,000 - 10,000 gal/day	-
% Capacity Presently Available:	100	100	100	-
Frequency of Operation:	Semi-continuous	Semi-continuous	Semi-continuous	-
Test Results (Limits as defined by test burn or test run):	N/A	C.E. = 99.95 D.E. = 99.99992	N/A	-
Commercial Availability:	Available	Available	Available	-

(continued)

TABLE D-3. (continued)

Company:	Chemical Waste Management (formerly Environmental Intl.)	Transformer Consultants	PCB Specialist	Franklin Institute Research Laboratory
Application Date:	January 1982	April 1982	October 1982	October 1982
Site Location:	Mobile	Akron, OH - Mobile	Mobile	Mobile
Type of Waste:	Contaminated liquids	Contaminated waste oil	M.O.D.F.	M.O.D.F.
Process Utilized: f	Chemical dechlorination	Chemical dechlorination	Chemical dechlorination	Chemical dechlorination
Permit Status				
Approval Date:	March 25, 1982	July 30, 1982	No action	February 1983
Approval Conditions:	Concentration	Concentration, Standard conditions	-	-
Expiration Date:	None	None	-	None
Technical Considerations				
Number of Units:	N/A	2 (nationwide)	-	1
Concentration Limit of Feed (ppm):	≤1000	2000	-	7500
Capacity of Process or Unit:	N/A	4000 - 6000 gal/day	-	250 gal/batch
% Capacity Presently Available:	N/A	100	-	100
Frequency of Operation:	N/A	Semi-continuous	-	Semi-continuous
Test Results (Limits as defined by test burn or test run):	N/A	Outlet <2 ppm	-	Outlet <2 ppm
Commercial Availability:	Available	Available	-	Available

(continued)

TABLE D-3. (continued)

Company:	General Electric	Otter Tail Power Company
Application Date:	November 1982	January 1983
Site Location:	Mobile	Big Stone, SD
Type of Waste:	M.O.D.F.	M.O.D.F.
Process Utilized:	Chemical dechlorination	High efficiency boiler
Permit Status		
Approval Date:	February 1983	November 1983
Approval Conditions:	Concentration	Standard for H.E. boiler
Expiration Date:	None	None
Technical Considerations		
Number of Units:	1	1
Concentration Limit of Feed (ppm):	1000	500
Capacity of Process or Unit:	210 gal/batch	25 gal/min
% Capacity Presently Available:	100	N/A
Frequency of Operation:	Semi-continuous	N/A
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	no test
Commercial Availability:	Available	Not available

TABLE D-4. INFORMATION ON PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION IX

Company:	SunOhio	Dow Chemical	Thagard Research Corp.	Rockwell International
Application Date:	June 1980	September 1980	July 1981	October 1981
Site Location:	Mobile	Pittsburg, CA	Irvine, CA	Ventura County, CA
Type of Waste:	M.O.D.F.	Contaminated process waste	Contaminated solids	Contaminated oils
Process Utilized:	Chemical dechlorination	Thermal oxidizer	High temperature fluid volume reactor	Molten salt reactor
Permit Status				
Approval Date:	December 1981	Not issued	June 7, 1982	January 26, 1982
Approval Conditions:	Standard conditions	N/A	R&D for contaminated soil	R&D report
Expiration Date:	None	N/A	None	None
Technical Considerations				
Number of Units:	5 (nationwide)	1	1	1
Concentration Limit of Feed (ppm):	No limit	N/A	10,000	30 lb. of 70% PCB
Capacity of Process or Unit:	600 gal/hr	Not available	100 gm/min.	Not available
% Capacity Presently Available:	100	Not available	R&D	Not available
Frequency of Operation:	Semi-continuous	Not available	Once	Once
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Not available	99.9997%	Not available
Commercial Availability:	Available	Not available	Not available - R&D study	Not available - R&D study

(continued)

TABLE D-4. (continued)

Company:	Pyro-Magnitics Corp.	Exceltech (licensed by Acurex)	Transformer Consultants	Baird Corporation
Application Date:	November 1981	November 19, 1982 (transferred)	April 1982	May 1982
Site Location:	Mobile	Mobile	Mobile	Irvine, CA
Type of Waste:	Contaminated waste oils	M.O.D.F.	M.O.D.F.	Contaminated solids
Process Utilized:	Annex I incinerator	Chemical dechlorination	Chemical dechlorination	High temperature fluid volume reactor (Thagard unit)
Permit Status				
Approval Date:	May 25, 1983	August 22, 1982	Not issued	June 21, 1982
Approval Conditions:	Standard conditions	Concentration	N/A	R&D for sediment concentration
Expiration Date:	None	None	N/A	None
Technical Considerations				
Number of Units:	1	1	2 (nationwide)	1
Concentration Limit of Feed (ppm):	No limit	7,500	N/A	10,000
Capacity of Process or Unit:	5,940 lb/hr	4,000-6,000 gal/day	7,000-9,000 gal/day	100 gm/min
% Capacity Presently Available:	N/A	N/A	N/A	R&D
Frequency of Operation:	Semi-continuous	Semi-continuous	Semi-continuous	Once
Test Results (Limits as defined by test burn or test run):	D.E. >99.9999%	Outlet <2 ppm	Outlet <2 ppm	D.E. 99.9997%
Commercial Availability:	Available	Available	Not available	Not available - R&D study

(continued)

TABLE D-4. (continued)

Company:	Franklin Institute Research Laboratory	General Electric
Application Date:	October 1982	October 1982
Site Location:	Mobile	Mobile
Type of Waste:	M.O.D.F.	M.O.D.F.
Process Utilized:	Chemical dechlorination	Chemical dechlorination
Permit Status		
Approval Date:	Not issued	Not issued
Approval Conditions:	-	-
Expiration Date:	-	-
Technical Considerations		
Number of Units:	1	1
Concentration Limit of Feed (ppm):	N/A	N/A
Capacity of Process or Unit:	250 gal/batch	210 gal/batch
% Capacity Presently Available:	100	100
Frequency of Operation:	Semi-continuous	Semi-continuous
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	Outlet <2 ppm
Commercial Availability:	Available	Available

TABLE D-5. INFORMATION ON PCB DISPOSAL ACTIVITIES--THERMAL DESTRUCTION/NONTHERMAL DESTRUCTION,
REGION X

Company:	SunOhio	Washington Water and Power Company	Acurex	Environmental International, Inc.
Application Date:	August 1980	October 1980	January 1981	September 1981
Site Location:	Mobile	Spokane, WA	Mobile	Mobile
Type of Waste:	M.O.D.F.	M.O.D.F.	M.O.D.F.	Capacitors
Process Utilized:	Chemical dechlorination	High efficiency boiler	Chemical dechlorination	Decontamination process
Permit Status				
Approval Date:	January 21, 1983	December 1, 1981	April 1982	December 3, 1982
Approval Conditions:	Concentration	Standard for H.E. boiler	Concentration	Concentration
Expiration Date:	January 1, 1984	None	January 1, 1984	January 1, 1985
Technical Considerations				
Number of Units:	5 (nationwide)	1	1 (nationwide)	1
Concentration Limit of Feed (ppm):	2,500	500	7,500	Outlet <2 ppm
Capacity of Process or Unit:	600 gal/hr	N/A	4,000 - 6,000 gal/day	N/A
% Capacity Presently Available:	100	N/A	100	N/A
Frequency of Operation:	Semi-continuous	N/A	Semi-continuous	Semi-continuous
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	N/A	Outlet <2 ppm	N/A
Commercial Availability:	Available	Not available - used once	Available	Available

(continued)

TABLE D-5. (continued)

Company:	PPM Inc.	Pyro-Magnetics	PCB Destruction Company	Environmental Inter-national, Inc.
Application Date:	September 1981	November 1981	December 1981	February 1982
Site Location:	Mobile	Mobile	Mobile	Mobile
Type of Waste:	M.O.D.F. and kerosene	Contaminated waste oil	Contaminated waste oil	Contaminated waste oil
Process Utilized:	Chemical dechlorination	Annex I liquid injection	Chemical dechlorination	Chemical dechlorination
Permit Status				
Approval Date:	November 1982	Not approved	Not approved	Not approved
Approval Conditions:	Concentration	-	-	-
Expiration Date:	January 1, 1985	-	-	-
Technical Considerations				
Number of Units:	4 (nationwide)	1	1	-
Concentration Limit of Feed (ppm):	1,500	-	-	-
Capacity of Process or Unit:	5,000 - 10,000 gal/day	-	-	-
% Capacity Presently Available:	100	-	-	-
Frequency of Operation:	Semi-continuous	-	-	-
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	-	-	-
Commercial Availability:	Available	-	-	-

(continued)

TABLE D-5. (continued)

Company:	Transformer Consultants	Franklin Institute Research Laboratory	General Electric	Aqua-Tech
Application Date:	April 1982	October 1982	October 1982	October 1982
Site Location:	Mobile	Mobile	Mobile	Hillsboro, OR
Type of Waste:	M.O.D.F.	M.O.D.F.	M.O.D.F.	Contaminated oil waste
Process Utilized: {	Chemical dechlorination	Chemical dechlorination	Chemical dechlorination	Biodegradation
Permit Status				
Approval Date:	December 8, 1982	Not approved	Not approved	Research project letter of permission issued November 8, 1982
Approval Conditions:	Concentration	-	-	-
Expiration Date:	January 1, 1985	-	-	October 1, 1983
Technical Considerations				
Number of Units:	2 (nationwide)	1	1	1
Concentration Limit of Feed (ppm):	2,100	-	-	100
Capacity of Process or Unit:	CBI	-	-	N/A
% Capacity Presently Available:	100	-	-	N/A
Frequency of Operation:	Semi-continuous	-	-	N/A
Test Results (Limits as defined by test burn or test run):	Outlet <2 ppm	-	-	N/A
Commercial Availability:	Available	-	-	Not available - R&D study

(continued)

TABLE D-5. (continued)

Company:	SED Inc.	PCB Specialist	Anchorage Utilities
Application Date:	November 1982	Letter of intent - March 1983	Letter of intent
Site Location:	Mobile	Mobile	Anchorage, AK
Type of Waste:	Capacitors	M.O.D.F.	M.O.D.F.
Process Utilized:	Mechanical shredding and rinsing	Chemical dechlorination	Multiple hearth sludge incinerator
Permit Status			
Approval Date:	Not approved	Not approved	Withdrawn
Approval Conditions:	-	-	-
Expiration Date:	-	-	-
Technical Considerations			
Number of Units:	-	-	1
Concentration Limit of Feed (ppm):	-	-	50 ppm
Capacity of Process or Unit:	-	-	-
% Capacity Presently Available:	-	-	-
Frequency of Operation:	-	-	-
Test Results (Limits as defined by test burn or test run):	-	-	-
Commercial Availability:	-	-	Not available

APPENDIX E

SAMPLING AND ANALYSIS OF THE NEW BEDFORD, MASSACHUSETTS MULTIPLE HEARTH SEWAGE SLUDGE INCINERATOR

SAMPLING AND ANALYSIS OF THE NEW BEDFORD, MASSACHUSETTS,
MULTIPLE HEARTH SEWAGE SLUDGE INCINERATOR

One principal technical assistance task conducted under this work assignment was a PCB destruction efficiency test of the New Bedford municipal sewage sludge incinerator. This sampling and analysis effort was undertaken by GCA/Technology Division at the request of EPA Region I personnel to quantify environmental releases of PCBs and potential incomplete combustion by-products that result from incineration of PCB containing sewage sludge. The results of this testing will be reported in a separate report. The following discussion presents the highlights of this program.

Due to widespread PCB contamination resulting primarily from the manufacture of PCB capacitors, the entire New Bedford Harbor area has been classified as a national priority list site under Superfund. Significant quantities of PCBs presently reside in the city's municipal sewage system and hence represent a potential source of PCBs to the city's sewage treatment plant. These PCBs are concentrated in the treatment facility and are potentially released during sludge incineration. A PCB destruction efficiency test conducted during 1976 indicated an incinerator PCB destruction efficiency of between 46 and 77 percent. However, these results were considered inconclusive due to problems encountered with background interferences. Under a previous PCB technical assistance effort (Contract 68-02-3168, Work Assignment 58), a Stack Test Plan, and a Quality Assurance Project Plan were written for the New Bedford sludge incinerator. However, this test series was not conducted until the present due to equipment problems at the facility.

The New Bedford Municipal Wastewater Treatment Plant is a 30 million gallon per day primary treatment facility designed to handle both municipal and industrial wastewater. The onsite sludge incinerator at the plant is a multiple hearth unit with seven hearths. The incinerator has a rated capacity

of 1,500 pounds per hour of dry sludge feed. A precooler and an impingement scrubber are installed downstream of the unit to control particulate and gaseous emissions.

Region I PCB program personnel requested that a stack test be conducted on this unit for four principal reasons. These include:

1. To establish the PCB destruction efficiency of a conventional multiple hearth sewage sludge incinerator while burning contaminated sludge under actual operating conditions. The New Bedford situation is unique in that the incinerator regularly burns sludge contaminated with PCBs. No additional PCB spiking is required. A test of this incinerator, under standard operating conditions, will therefore serve to define the typical performance characteristics of multiple hearth incinerator when burning difficult to incinerate hazardous wastes such as PCBs. Little research and emission testing has been conducted to date on the capabilities of multiple hearth incinerators, and this testing will provide useful information in this area.
2. Define the historical impact of the incinerator on New Bedford ambient air quality. Region I is requiring a capacitor manufacturing company to clean PCB contaminated sewer lines. Once this activity is completed, the largest known sources of PCBs into the municipal treatment plant will have been eliminated. Before this process is completed, a stack test is essential to define what the historical long-term impact of PCB contaminated sludge incineration may have had on ambient air quality in the New Bedford region.
3. Emissions data on combustion by-products (i.e., PCDDs, PCDFs) potentially formed during the incineration process do not presently exist in the unit. In fact, the PCDD/PCDF data base on municipal sludge incineration in general is somewhat limited at this time and this test series may provide valuable data in this area as well.
4. A valid sampling and analysis test plan and a quality assurance protocol of these tests has been completed and are in place. Only slight modifications are needed to adapt these plans to reflect existing agency policy on sampling and analytical approaches when conducting PCB destruction efficiency burns.

To address these concerns, GCA designed a sampling approach that will:

- Quantify PCB levels in raw sewage into the facility, incinerator sludge feed, incinerator ash, precooler/scrubber outlet water and flue gas emissions.

- Quantify polychlorinated dibenzo-p-dioxin (PCDD) and polychlorinated dibenzofuran (PCDF) levels in the incinerator sludge feed, incinerator ash, and flue gas emissions.
- Obtain sufficient operating data on the sludge, ash, water and flue gas feed rates to permit calculation of a PCB materials balance of the sewage sludge incinerator.
- Conduct all sampling and analysis in accordance with recommended protocols, including Quality Assurance/Quality Control criteria.

Testing of the New Bedford incinerator was conducted in February 1984. Results of this effort will be compiled in a separate report which will be available in late spring 1984.

APPENDIX F

PLANNING FOR THE SAMPLING AND ANALYSIS OF THE ANCHORAGE, ALASKA MULTIPLE HEARTH SEWAGE SLUDGE INCINERATOR

Section No. 1
Revision No. 2
Date: November 14, 1983
Page 1 of 1

QUALITY ASSURANCE PROJECT PLAN:
SAMPLING AND ANALYSES OF PCB
CONTAMINATED WASTE OIL INCINERATION
FROM A MULTIPLE HEARTH
INCINERATOR AT THE ANCHORAGE WATER AND
WASTEWATER UTILITY -
POINT WORONZOF SEWAGE TREATMENT PLANT

TRW Incorporated
Environmental Operations
Research Triangle Park, North Carolina 27709

Contract No. 68-02-3174
Work Assignment No. 115

November 14, 1983

Approved by:

TRW Project Manager:	<u>R. C. Adams</u>	(R. Adams)
TRW QA Officer:	<u>Spencer McAllister</u>	(R. McAllister)
EPA Project Officer:	_____	(D. Sanchez)
EPA QA Officer:	_____	(G. Johnson)

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List of Copy Holders

1. D. Sanchez, EPA Task Officer
2. G. Johnson, EPA QA Officer
3. R. Hutson, AWWU
4. R. Adams, TRW
5. R. McAllister, TRW
6. R. Jongleux, TRW
7. J. McGaughey, TRW
8. D. Wagoner, TRW

3. PROJECT DESCRIPTION

Anchorage Water and Wastewater Utility (AWWU) operates a multiple hearth incinerator at their Point Woronzof sewage treatment plant located in Anchorage, Alaska. The utility has tentatively agreed to test the performance of this incinerator for the destruction of PCB contaminated waste oil.

The EPA is interested in verifying the efficiency of PCB destruction by this common and readily available disposal means via the multiple hearth incinerator. This need is significant in light of the fact that (1) previous destruction tests have reported variable destruction performance and are therefore inconclusive, (2) alternative thermal destruction systems with proven destruction performance (high efficiency power boilers >99.9 percent and rotary kiln or liquid injection incinerators >99.9999 percent) are available and (3) savings derived from using municipal incinerators for disposal of trace or low level PCB contaminated materials may be substantial.

The results of the investigation at Point Woronzof will be used to establish the destruction and removal performance of a typical multiple hearth sewage sludge incinerator. The implications of the results, which go beyond establishing PCB destruction efficiency and quantitation of possible incineration by-products such as dibenzofurans and/or dioxins, will establish a basis for comparison with other alternative disposal means and also establish a basis for an environmental assessment and/or risk assessment of the Point Woronzof incinerator.

Primary focus is on the performance of the multiple hearth incinerator for destroying PCB's and on the fate of any PCB's, dibenzofurans and dioxins either not destroyed or produced as a result of combustion. The test has been designed to clearly identify destruction/removal efficiencies (DRE) of PCB's as high as 99.9 percent. PCB's are a class

of compounds that include 209 different isomers. Gas chromatograph/mass spectrometry (GC/MS) methods that will be employed to detect and quantify PCB's will allow the summation of the quantities of individual isomers if present in detectable amounts. Thus quality assurance criteria requires that a sufficient volume of sample be collected to assure the presence of quantities of each isomer well above its detectable limit. In order to achieve this, it will be necessary to feed PCB laced oil in concentrations between 450 and 500 ppm, as Aroclor.

The sampling will include three replications of the simultaneous collection of six samples:

1. PCB contaminated oil feed,
2. sludge feed,
3. ash discharge,
4. flue gas exiting the scrubber,
5. scrubber influent water, and
6. scrubber effluent water.

Two sets of replications will be analyzed and one set held in reserve in case of results anomalies. Material balances for PCB's, dibenzofurans and dioxins will be used to determine DRE and the fate of these compounds. Applicable quality control and quality assurance procedures will be used in the sampling and analysis of all samples collected.

3.1 ENGINEERING ASSESSMENT

The Anchorage multiple hearth incinerator is described in a facility evaluation and in a pretest site visit report (Appendix A and Appendix B). This section sets forth the feed conditions and operating conditions requested of AWWU. Anchorage Municipal Power and Light (MPL) will provide the PCB contaminated waste oil in sufficient amounts for testing.

3.1.1 Waste Feed

Scum, consisting primarily of an oil phase skimmed from the surface of the primary sewage treatment clarifiers, is typically fed into the third hearth of the incinerator at rates up to one gallon per minute. Observation by AWWU indicates, however, that stable operation cannot be maintained above about 0.5 gpm. For test purposes, waste oil containing 400-500 ppm PCB will be fed at 0.5 gpm. Discharge of scum to the

third hearth is through an open two inch pipe ending at the wall of the furnace. The original intent was to feed the oil through this pipe. However, better distribution of oil into the combustion space will be attained with the use of a conventional oil burner. An oil burner port is available on the fourth hearth and AWWU will install a burner correctly sized for oil feed rates to one gallon per minute. Thus, waste oil will now be fed to the fourth rather than the third hearth. A feed system will have to be installed similar to the one shown in Figure 3-1. Samples will be collected at the beginning and end of each test and at 15 minute intervals during a test and composited proportionally to feed rate to make up one sample per test. Flow rate will be measured by calibrated flowmeter.

Sludge and PCB oil feed to the incinerator will be sampled and analyzed for PCB's, dioxins and furans. In addition, the sample will undergo a proximate/ultimate analysis as well as density, ash content, and BTU determinations. AWWU should provide these analyses. Waste oil feed and sludge feed sampling will be on the same schedule. AWWU is requested to determine the sludge feed rate for the period of each test by their established method as well as the dry solids and volatiles content of the dewatered sludge sample collected for feed rate determination.

3.1.2 Incinerator Operating Conditions

AWWU is requested to operate the incinerator normally and at steady state conditions during the period of each test. A possible exception to "normal" operation is maximum operating temperature. It is understood that damage may result from operating temperatures as high as 2,000°F and that sustained operation is possible at 1,700°F ± 100°F. Operation within the latter range is requested.

AWWU will determine the optimum operating settings during a pretest trial. Uncontaminated transformer oil will be fed to the incinerator. A feed rate will be established for stable operation at maximum temperature and minimum stack opacity. To verify 99.9% destruction of PCB's, waste oil should be fed at the maximum rate consistent with stable incinerator operation and should not be less than 0.5 gpm.

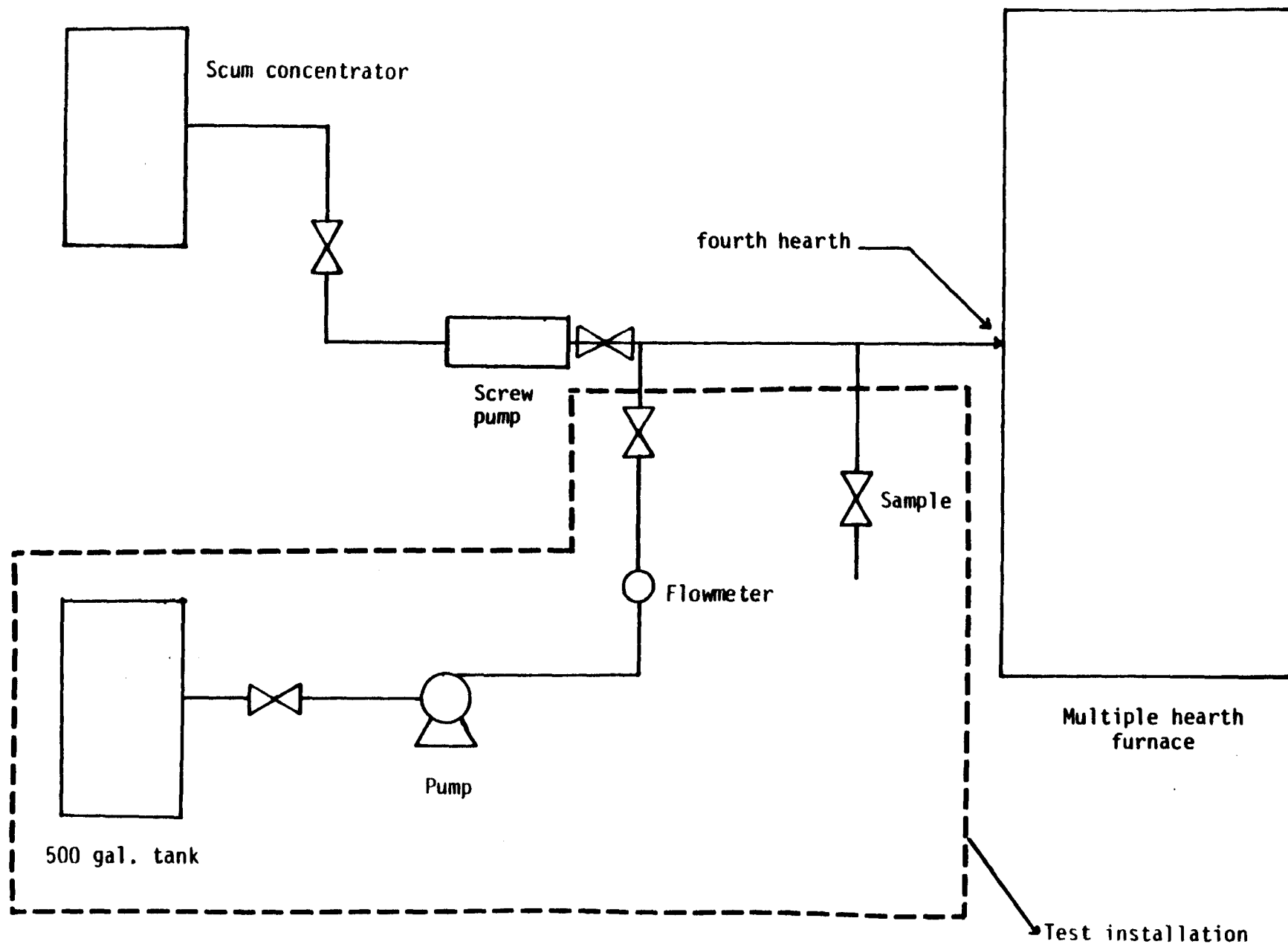


Figure 3-1. Waste oil feed system.

Excess oxygen levels should be established during the pretest trial with the AWWU oxygen analyzer. Knowing the excess oxygen, limits can then be established for the test. Operation outside of these limits will halt the test until stable operation is reestablished.

Stable operating temperature limits on the third and fourth hearth will also be established during the pretest trial. Sustained operation outside of these limits will halt the tests until stable operation is reestablished. Normal operation will therefore be defined as follows:

temperature: $1700^{\circ}\text{F} \pm 100^{\circ}\text{F}$

oil feed rate: 0.5 gpm minimum to a maximum rate determined from pretest trial

sludge feed rate: repeat rate of pretest trial

scrubber water rate: repeat rate of pretest trial

excess oxygen: range determined from pretest trial.

Short term excursions of temperature and oil feed rate outside the specified limits will be tolerated. However, the test will be halted when sustained temperature excursion occur. The magnitude of a sustained temperature excursion will be defined from examination of the temperature strip charts of the pretest trial. Sustained operation at oil feed rates below 0.5 gpm will hamper or prevent verification of DRE's of 99.9%.

3.2 TEST DESIGN

A series of three tests will be conducted. Sampling for each test is expected to take a minimum of seven hours. Sampling time is fixed by the amount of sample required to verify destruction efficiencies of 99.9%. Calculations are shown in Appendix D. Increase of the original sampling time from six to seven hours reflects a decrease in feed rate from one gpm to 0.5 gpm partially offset by elimination of one factor of safety. Test results to be reported and the specific data and analytical requirements to obtain those results are listed in Table 3-1. Detailed descriptions of the sampling and analytical procedures are given in Sections 6 and 9.

Test has been postponed due to unavailability of process unit. No new date has been selected but will probably be after March 1984.

Table 3-1. TEST RESULTS AND REQUIREMENTS

Test results	Data/analysis requirements
a. PCB, dibenzofuran, dioxin isomers of waste oil; weight/time	GC/FID and/or GC/ECD GC/MS waste oil flow rate, volumetric* waste oil density
b. PCB, dibenzofuran, dioxin isomers of sludge feed; weight/time	GC/FID and/or GC/ECD GC/MS sludge feed rate, weight of dry solids*
c. PCB content of flue gas, weight/time	GC/FID and/or GC/ECD GC/MS flue gas flow rate, volumetric flue gas density
d. PCB, dibenzofuran, dioxin of scrubber influent water; weight/time	GC/FID and/or GC/ECD GC/MS feed rate, volumetric* influent water density
e. PCB, dibenzofuran, dioxin of scrubber effluent water; weight/time	GC/FID and/or GC/ECD GC/MS effluent rate, volumetric* effluent water density

(continued)

Table 3-1. Concluded

Test results	Data/analysis requirements
f. PCB, dibenzofuran, dioxin content of incinerator ash; weight/time	GC/FID and/or GC/ECD GC/MS ash content
g. PCB destruction/removal efficiency, weight %	a, b, c, d, e, f above
h. Dibenzofuran, dioxin content of flue gas, weight/time	GC/FID and/or GC/ECD GC/MS flue gas flow rate, volumetric flue gas density
i. Fuel gas consumption, volume/time	fuel gas meter*
j. Incinerator temperature profile, °C for all hearths, inlet scrubber	AWWU control room readings*
k. Combustion efficiency, %	CO, CO ₂ in undiluted flue gas
l. Excess oxygen in flue gas, volume % dry	O ₂ in undiluted flue gas

*Collected by AWWU.

4. PROJECT ORGANIZATION AND RESPONSIBILITY

The primary responsibilities and supporting roles of each member of the project team are summarized in Figure 4-1. Project Manager, Mr. R. C. Adams, has the ultimate responsibility and authority for the entire project. He will provide overall technical and administrative supervision of all project aspects, and will be assisted by the appropriate personnel who will perform administrative tasks such as cost performance and scheduling. He will be the principal point of contact with EPA and Anchorage Water and Wastewater Utilities (AWWU).

Frequent contacts as needed between Mr. Adams and the EPA, supplemented with monthly technical progress reports, will provide EPA personnel with ongoing current information regarding the progress and anticipated problems. Mr. Adams will notify the EPA project officer if a significant problem is anticipated (a significant problem is one which may affect technical performance, schedule, or cost, either short-term or long-term).

The program's QA activities will be directed by the QA Officer, Dr. R. A. McAllister. Dr. McAllister will report directly to the Project Manager as shown in the project organization chart, Figure 4-1. He will select quality monitors for different aspects of the project. He will have full authority to coordinate, direct, and administer all QA activities as depicted in Figure 4-2. This is a functional diagram for QA, and will cover all project activities and serve as a master planning and control document. He will also serve as a technical advisor to give solicited and unsolicited advice, and will make recommendations to the Project Manager.

The QA Officer will coordinate the activities of the Quality Control and Technical Advisory Group (QC/TA). The purpose of this group will be to review test plans for sampling and analysis, make recommendations for

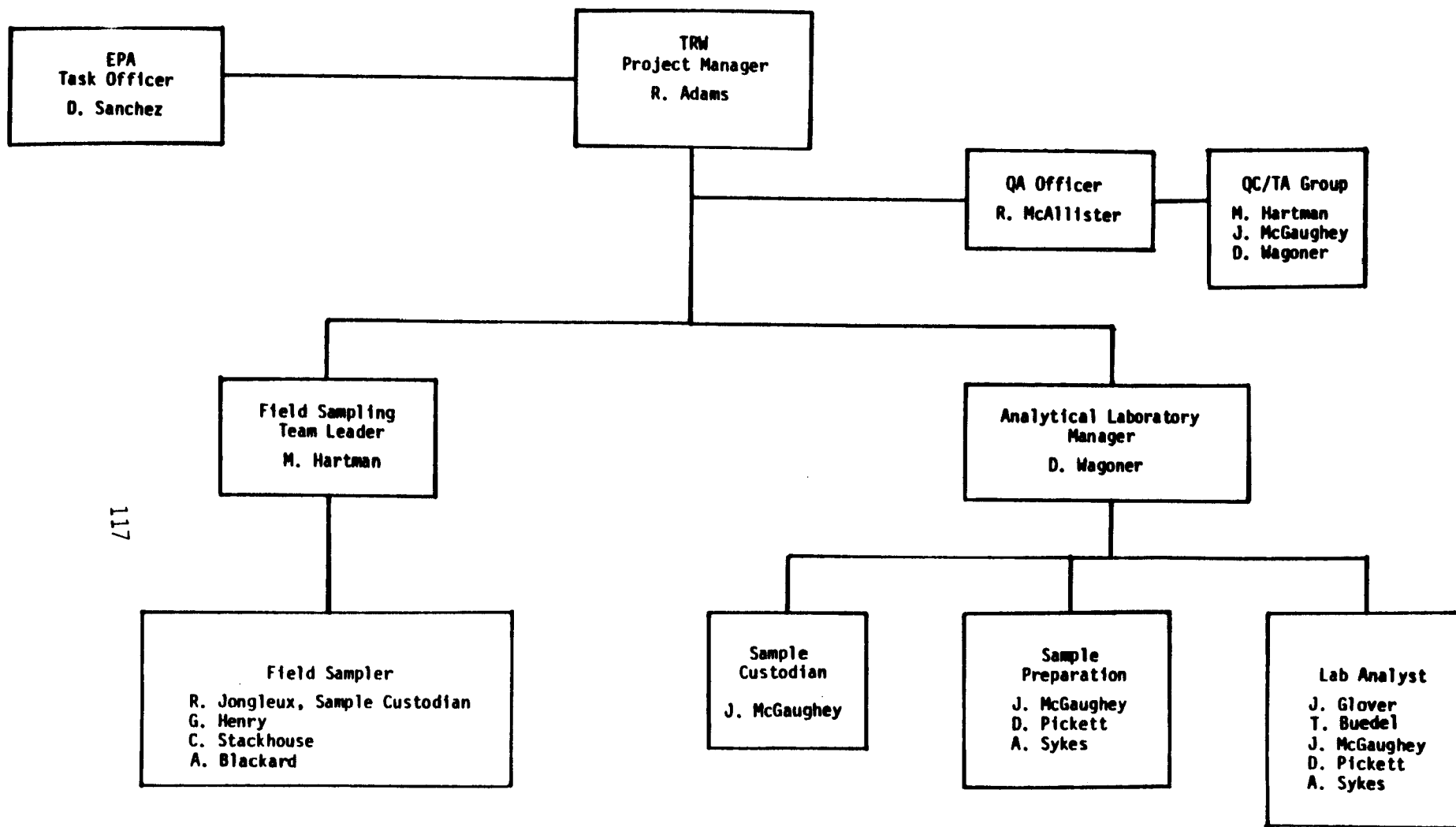


Figure 4-1. TRW project organization.

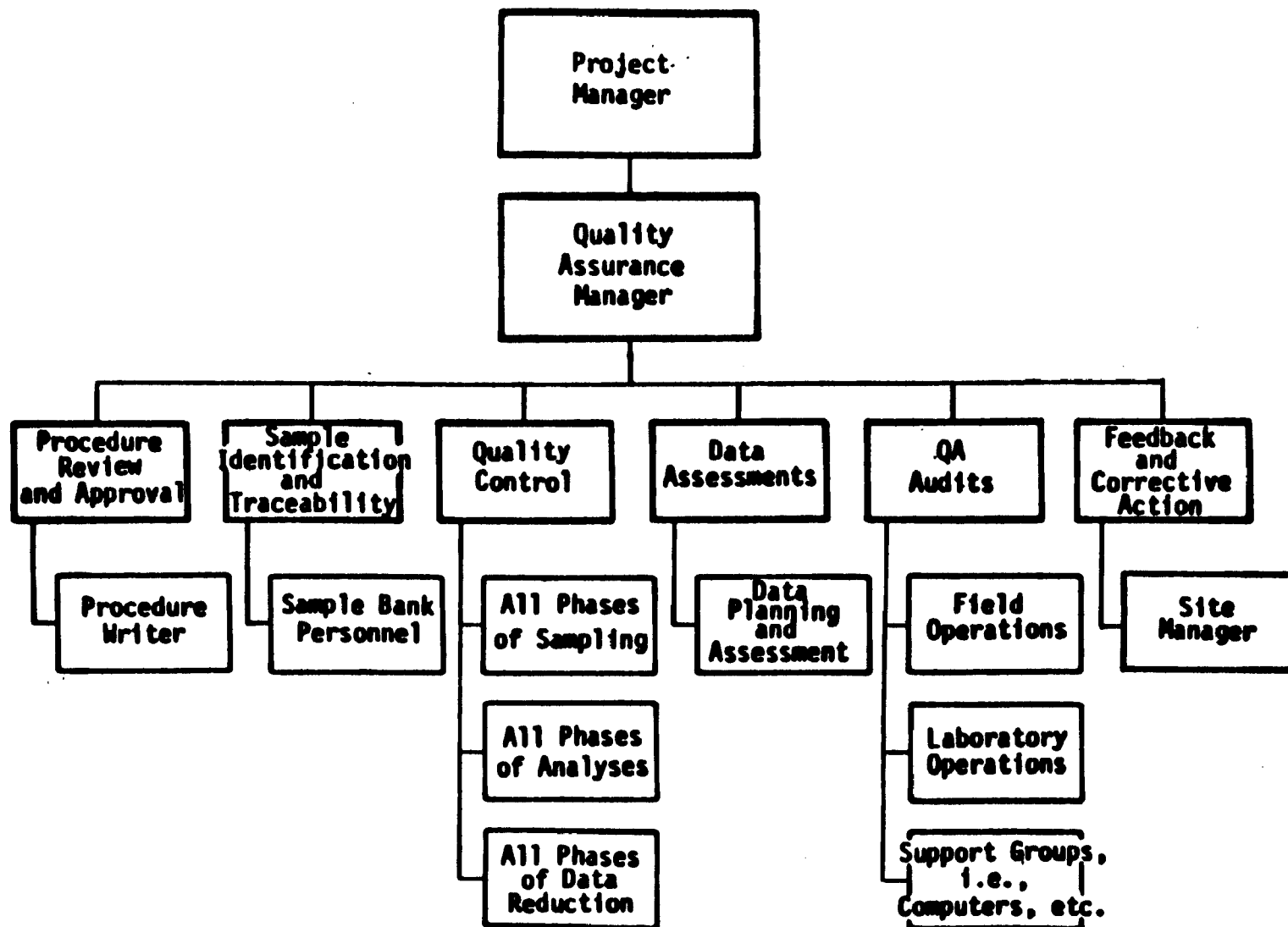


Figure 4-2. Functional diagram for quality assurance.

alternate test approaches, assist in resolving problems, review and carry out QA plans, and review collected data.

The Field Sampling Team Leader has the responsibility to ensure that the test procedures are conducted in a timely and accurate manner. His responsibility is to be sure that the tests are performed according to the procedures specified. The Field Sampling Team Leader reports daily to the Project Manager and relays to him on a timely basis the overall progress and/or problems or potential problems.

The Sample Custodian is responsible for keeping a log of all the samples taken each day. He makes sure each sample is properly labeled, identified, and packed for shipment to the TRW Research Triangle Park analytical laboratory. A Sample Custodian will be appointed in the laboratory to handle incoming samples from the field activities.

A quality control monitor will be selected for each set of activities and identified in the daily log of the Project Manager. The role primarily addresses internal audits of sampling and analysis procedures. A description of the tasks to be done and the responsibilities of the quality control monitor are detailed in Section 12.

The TRW laboratory facilities, located at Research Triangle Park, North Carolina, will be responsible for performing the sophisticated analyses that are provided below. The preparation and/or dispensing of audit materials will be conducted through the Research Triangle Park laboratory under the direction of the QA Officer.

The lines of communication between management, the QC/TA group, the technical staff, and within the technical staff are established and will allow for mandatory discussions of resulting problems, potential problems, preventive actions, and corrective procedures.

The major quality control responsibilities and quality assurance review functions are summarized below:

<u>Performance</u>	<u>Major Quality Control Responsibility</u>	<u>Primary Quality Assurance Review</u>
1. Project Manager	● Procedure Change Approval	QA Office
	● Response to Compliance Failures	QA Office
	● Information Completeness Check	QA Office
	● Information Validity Review	QA Office

<u>Performance</u>	<u>Major Quality Control Responsibility</u>	<u>Primary Quality Assurance Review</u>
2. Quality Assurance Officer	<ul style="list-style-type: none"> ● Procedure Approval ● Test Plan Approval ● Quality Anomaly Recommendations ● Quality Reports 	Project Manager Project Manager Project Manager Project Manager
3. Field Sampling Manager or Laboratory Manager	<ul style="list-style-type: none"> ● Equipment Downtime Record ● Information Validity Review ● Information Completeness Check ● Procedure Currentness ● Response to Completeness Check Failures 	QA Office Quality Monitor Quality Monitor Quality Monitor QA Office
4. Field Sampling Team Leader	<ul style="list-style-type: none"> ● Preventive Maintenance ● Documentation ● Sample Integrity ● Calibration and Procedures 	Project Manager Project Manager Quality Monitor Quality Monitor
5. Sample Custodian	<ul style="list-style-type: none"> ● Information Completeness Count ● Documentation ● Sample Integrity ● Inventory Crosscheck 	Quality Monitor Field Sampling Team Leader Quality Monitor Field Sampling Team Leader
6. Sample Preparation	<ul style="list-style-type: none"> ● Information Completeness Count ● Sample Integrity ● Documentation ● Procedures ● Test Blanks 	Quality Monitor Quality Monitor Field Sampling Team Leader Quality Monitor Field Sampling Team Leader
7. Quality Monitor	<ul style="list-style-type: none"> ● Performance Audit 	Quality Assurance Officer

5. QUALITY OBJECTIVES

The major quality objective of this project plan is to provide a practical means to implement quality assurance techniques into a program involving the destruction and removal efficiency of PCB waste in a municipal sewage sludge incinerator. An objective of this program is to devise and select testing procedures that are simple and direct, but that measure the destruction and removal efficiency for the components of interest when the waste is incinerated.

In order to facilitate the following discussion, it is useful to define the following three terms; namely data quality, quality control, and quality assurance.

1. **Data Quality:** The totality of features and characteristics of a product (measurement data) that bears on its ability to satisfy a given purpose. These characteristics are defined as follows:

- **Accuracy** – The degree of agreement of a measurement (or an average of measurements of the same thing), X , with an accepted reference or true value, T , usually expressed as the difference between two values, $X-T$, or the difference as a percentage of the reference or true value, $100 (X-T)/T$, and sometimes expressed as a ratio, X/T . Accuracy is a measure of the bias in a system.
- **Precision** – A measure of mutual agreement among individual measurements of the same property, usually under prescribed similar conditions. Precision is best expressed in terms of the standard deviation (or the relative standard deviation). Various measures of precision exist depending upon the "prescribed conditions."
- **Completeness** – A measure of the amount of valid data obtained from a measurement system compared to the amount that was expected to be obtained under correct normal conditions.
- **Representativeness** – The degree to which data accurately and precisely represent a characteristic of a population, parameter variations at a sampling point, or an environmental condition.

- Comparability - A measure of the confidence with which one data set can be compared to another.

2. **Quality Control:** The overall system of activities whose purpose is to provide a quality product or service; for example, the routine application of procedures for obtaining prescribed standards of performance in the monitoring and measurement process.

3. **Quality Assurance:** A system of activities whose purpose is to provide assurance that the overall quality control is in fact being done effectively.

- The total integrated program for assuring the reliability of monitoring and measurement data.
- A system for integrating the quality planning, quality assessment, and quality improvement efforts of various groups in an organization to enable operations to meet user requirements at an economical level. In pollution measurement systems, quality assurance is concerned with the activities that have an important effect on the quality of the pollutant measurements, as well as the establishment of methods and techniques to measure the quality of the pollution measurements. The more authoritative usages differentiate between "quality assurance" and "quality control," where quality assurance is the "system of activities to provide assurance that the quality control system is performing adequately."

In summation, the purpose of QA is to assess independently the overall QC program. This assessment of QC is done in two ways. Reviews and performance audits are conducted by the QC organization itself (in internal assessment program), and in additional periodic assessments by an independent outside organization.

It is required for a thorough data quality program to delineate the quality elements for the organization and the required measurement program. This quality assurance plan will include provisions for the following elements:

1. the use of validated, well conceived analytical test methods and well constructed, equipped, and maintained laboratory facilities;
2. collection of representative samples;
3. use of high quality glassware, solvents, and other testing materials;

4. scheduled, periodic calibration, adjustment, and maintenance of equipment;
5. use of control samples and standards;
6. strict adherence to analytical procedures;
7. internal and external review of methods and results;
8. internal and external proficiency testing;
9. use of replicate samples;
10. open lines of communications between management and test personnel;
11. data validation and review;
12. data storage and retrieval;
13. up-to-date sample log and instrument maintenance and calibration records; and
14. periodic review of current, pertinent literature.

5.1 PRECISION, ACCURACY, AND COMPLETENESS OBJECTIVES

Quantitative guidelines for precision, accuracy, and completeness objectives have not been established for trial burns. Composition measurements from continuous monitors can be made with precisions of $\pm 5\%$ and accuracies of $\pm 10\%$ according to 40 CFR 60 Appendix A. Directed GC/MS measurements in general can be made with precisions and accuracies of $\pm 30\%$. How these GC/MS accuracies relate to trial burns in boilers and incinerator has not been established.

Completeness objectives of all measurements can be set at 90%.

Process measurements will be made by AWWU. TRW will estimate instrument precisions based on the specifications of these devices. These include incinerator temperature and waste oil flow and scrubber water flow sensors. AWWU is requested to calibrate the temperature transmitters and flow meters just prior to testing and to supply TRW with the calibration records. The method for determining sludge feed rate and weight of dry solids have no quantitative guidelines for precision, accuracy, and completeness objectives. AWWU will minimize measurement error to the extent possible by following these procedures:

1. Verify filter speed of revolution by manual observation.
2. Describe in detail the procedure for sampling each filter cake. Report dimensions of sample to the nearest 0.1 inch and weight of sample in grams to one decimal place.
3. Describe in detail the analytical procedure. Provide detailed calculations for determining sludge feed rate.
4. Report all information to TRW.

Ultimate/proximate analyses will utilize ASTM Methods D2015, D3173, and D3176. Precision guidelines are inherent in these methods. TRW will review the results from the analysis of sludge for completeness and for compliance with precision requirements.

6. SAMPLING PROCEDURES

The test on the Point Woronzof sewage treatment plant will consist of the following sample runs:

<u>Flue Gas</u>			
3	PCB runs	7 hours	Isokinetic ⁽¹⁾
3	TCDD/TCDF runs	7 hours	Isokinetic ⁽¹⁾
3	Integrated bag samples	1 hour	Integrated ⁽¹⁾
3	CO, CO ₂ , O ₂	7 hours	Continuous ⁽²⁾
<u>Feed</u>			
3	PCB-waste oil	Every 15 minutes	Composited
3	Sludge	Every 2 hours	Composited
<u>Residue</u>			
3	Ash	Every 2 hours	Composited
<u>Control Equipment</u>			
3	Scrubber influent	Every 2 hours	Composited
3	Scrubber effluent	Every 2 hours	Composited

A single test run is scheduled for each of 3 test days. The sampling duration of seven (7) hours was determined by the calculation of the minimum sampling volume necessary to verify a DRE of 99.9%. (See Appendix D for assumptions and calculations.)

In order to obtain sufficient samples for PCB and TCDD/TCDF analysis, the flue gas samples will be collected with two identically constructed sampling trains operating simultaneously. Identical but separate sampling

(1) Sampled downstream of cooling air discharge to stack.

(2) Sampled upstream of cooling air discharge to stack.

trains will be operated simultaneously; Train A for PCB's and Train B for dioxins and furans. All samples from Train B will be shipped directly from the field to the mass spectrometry center at the University of Nebraska for analysis. The preparation, description, and operation of the sample train(s) is covered in the following section.

Flue gas samples are obtained from an 18 inch diameter duct. The downstream sampling position is located in a vertical stack and is five feet (3+ diameters) from the top of the stack and 14 feet 8 inches (9+ diameters) of the sampling position is a side connection in the duct for bypass air that is located approximately ten feet (6+ diameters) upstream of the sampling position. The upstream sampling position (before the ID fan) for gas sampling only will be located about five feet from the ID fan in a horizontal section of duct.

6.1 PRINCIPLE AND APPLICABILITY OF A SOURCE PCB, TCDD, AND TCDF SAMPLING TRAIN

6.1.1 Principle

Gaseous and particulate Polychlorinated Biphenyls (PCB's) are withdrawn from the source using a sampling train. The PCB's are collected in the Florisil[®] adsorbent tube and in the impingers in front of the adsorbent. The Florisil[®] is followed by an XAD-2[®] trap and two basic impingers. The total PCB's in the train are determined by solvent extraction followed by Gas Chromatography/Electron Capture Detection (GC/ECD) and/or Gas Chromatography/Mass Spectroscopy (GC/MS). Total TCDD's, TCDF's and the corresponding 2,378 isomers are determined by solvent extraction followed by gas chromatography/high resolution mass spectrometric detection.

6.1.2 Applicability

This method is applicable for the determination of vaporous and particulate matter emissions from a multiple hearth furnace.

6.2 RANGE AND MINIMUM DETECTABLE LIMIT (MDL)

The range of the analytical method may be expanded considerably through concentration and/or dilution. The total method sensitivity is also highly dependent on the volume of gases sampled. The MDL of the GC/ECD method is about 50 pg of Aroclor per 1 µL injection. Both dioxin and furan can be detected at the 10-50 ppb range (10-50 pg per µL injection)(6).

6.3 INTERFERENCES

Organochlorine compounds other than PCB, Tetrachlorodibenzofuran (TCDF) or Tetrachlorodibenzodioxin (TCDD) found in the raw waste may interfere with the analyses. Appropriate sample clean-up steps shall be performed.

Throughout all stages of sample handling and analysis, care should be taken to avoid contact of samples and extracts with synthetic organic materials other than TFE[®] (polytetrafluoroethylene). Adhesives should not be used to hold TFE[®] liners on lids, (but, if necessary, appropriate blanks must be run), and lubricating and sealing greases must not be used on the sampling train.

6.4 PRECISION AND ACCURACY

Recovery efficiencies on source samples spiked with PCB's, dioxins, and furans ranged from 85 to 95% (1,6).

6.5 APPARATUS

6.5.1 Sampling Train

The train consists of a series of six impingers with two solid adsorbent traps between the third and fourth impingers (Figure 6-1). The first trap contains Florisil[®] and the second one contains XAD-2[®]. The train may be constructed by adaptation of an EPA Method 5 train. Descriptions of the train components are contained in the following subsections.

6.5.1.1 Probe. The probe should be stainless steel with a borosilicate or quartz glass liner. The glass liner provides an inert surface for the sample gas. The glass liner extends past the retaining nut into the stack. Since some of the compounds of interest are in both the particulate and vapor phases at the point of collection, isokinetic sampling is a requirement. Therefore, an S-type probe must be utilized. The glass liner shall be equipped with a glass ball connecting joint fitting that is capable of forming a leak-free, vacuum tight connection without sealing greases. A stainless steel nozzle (precleaned) is sized in order to maintain an isokinetic sampling rate.

6.5.1.2 Filter. A standard glass Method 5 filter holder will be utilized to collect the constituents of interest that are condensed into

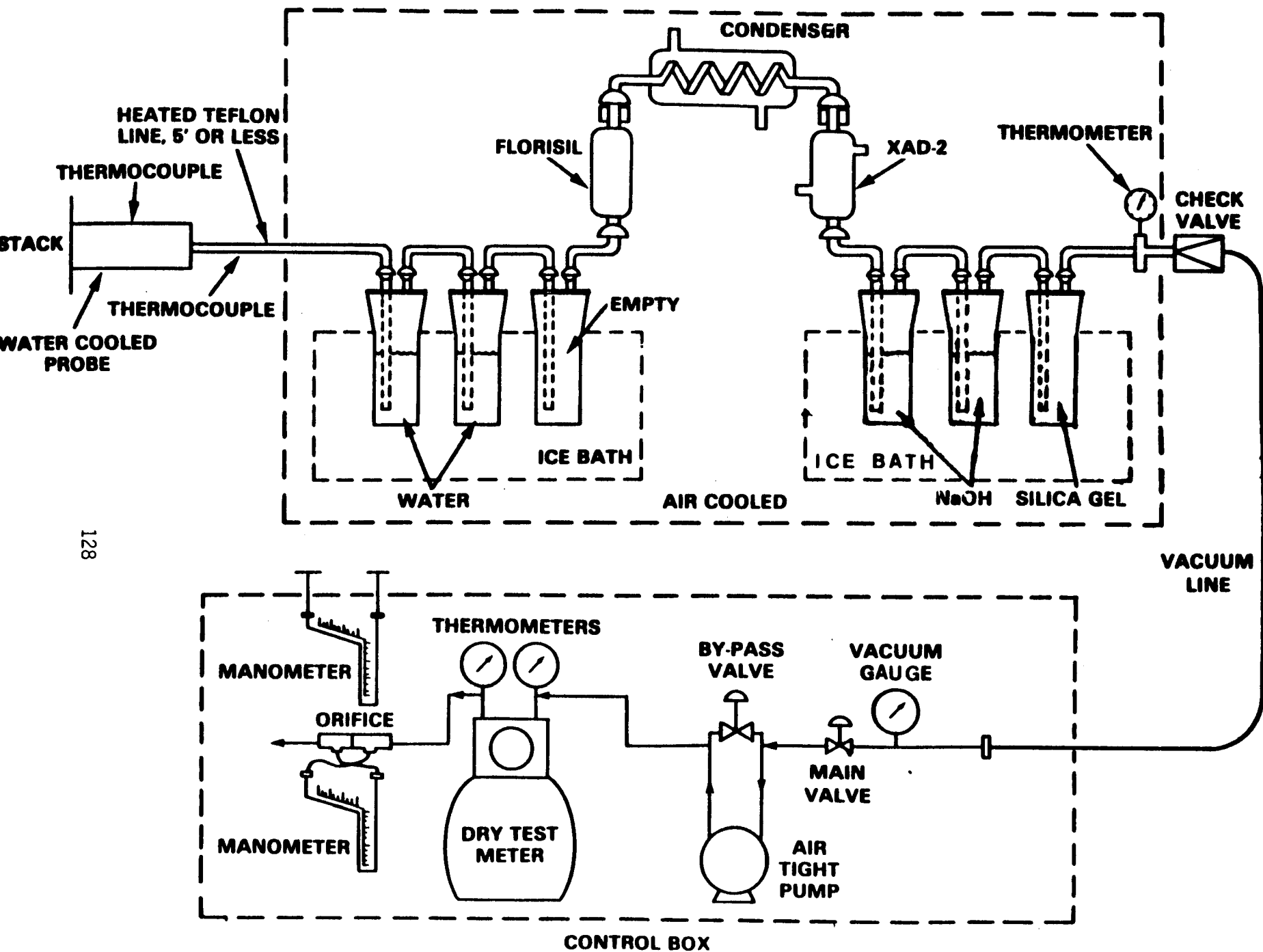


Figure 6-1. Sample train.

the particulate matter fraction. The glass filter holder will be precleaned to remove any interfering organic residues. The filter material will be binder free glass-fiber. The filter shall exhibit at least 95 percent efficiency (≤ 5 percent penetration) of 0.3 micrometer dioctyl phthalate smoke particles. The filter efficiency test shall be conducted in accordance with ASTM Standard Method D2986-71. Test data from the supplier's quality control program are sufficient demonstration of filter performance.

The filters will be shipped to and from the sampling site in precleaned glass petri dishes. Representative filters will be screened for the components of interest to determine the background or blank values.

The filters will be maintained at a temperature of $248^{\circ}\text{F} \pm 25^{\circ}\text{F}$ during the sampling run in accordance with standard particulate matter sampling.

6.5.1.3 Impingers. Six impingers with connecting fittings able to form leak-free, vacuum tight seals without sealant greases when connected together as shown in Figure 6-1 shall be used. All impingers are of the Greenburg-Smith design modified by replacing the tip with a 1.3-cm (1/2-in.) ID glass tube extending to 1.3 cm (1/2 in.) from the bottom of the flask.

6.5.1.4 Solid Adsorbent Tubes. Both the Florisil[®] and XAD-2[®] traps shall be made of glass with connecting fittings which are able to form leak-free, vacuum tight seals without sealant greases (Figures 6-2 and 6-3). Exclusive of connectors, the Florisil[®] tube has a 2.2-cm inner diameter, is at least 10 cm long, and has four deep indentations on the outlet end to aid in retaining the adsorbent. Glass wool plugs are used in both ends of the tube. The XAD-2[®] tube is about 10 cm long and 4 cm in diameter. The resin is surrounded by a water jacket preceded with a condenser coil. The gas entering the XAD-2[®] trap must be maintained at or below 20°C . Ground glass caps (or equivalent) must be provided to seal the adsorbent-filled tube both prior to and following sampling. All adsorbent tubes must be maintained in the vertical position during sampling.

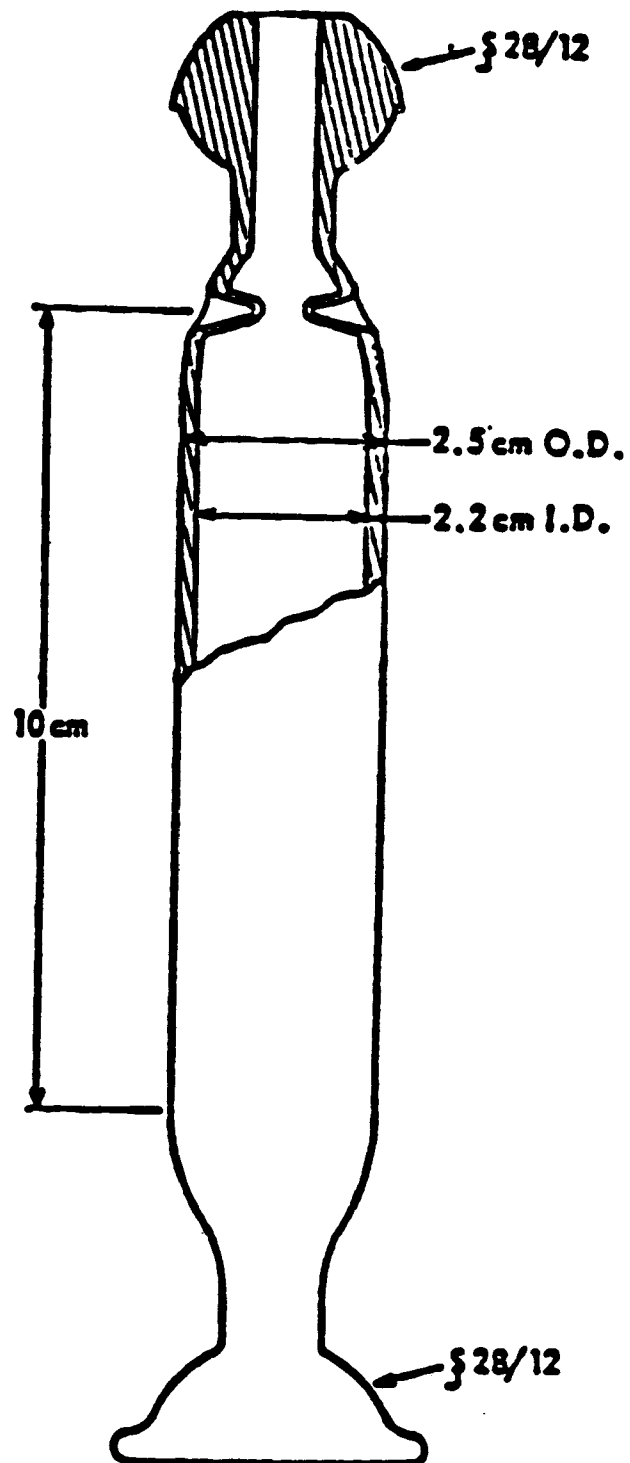


Figure 6-2. Florisil[®] adsorbent tube.

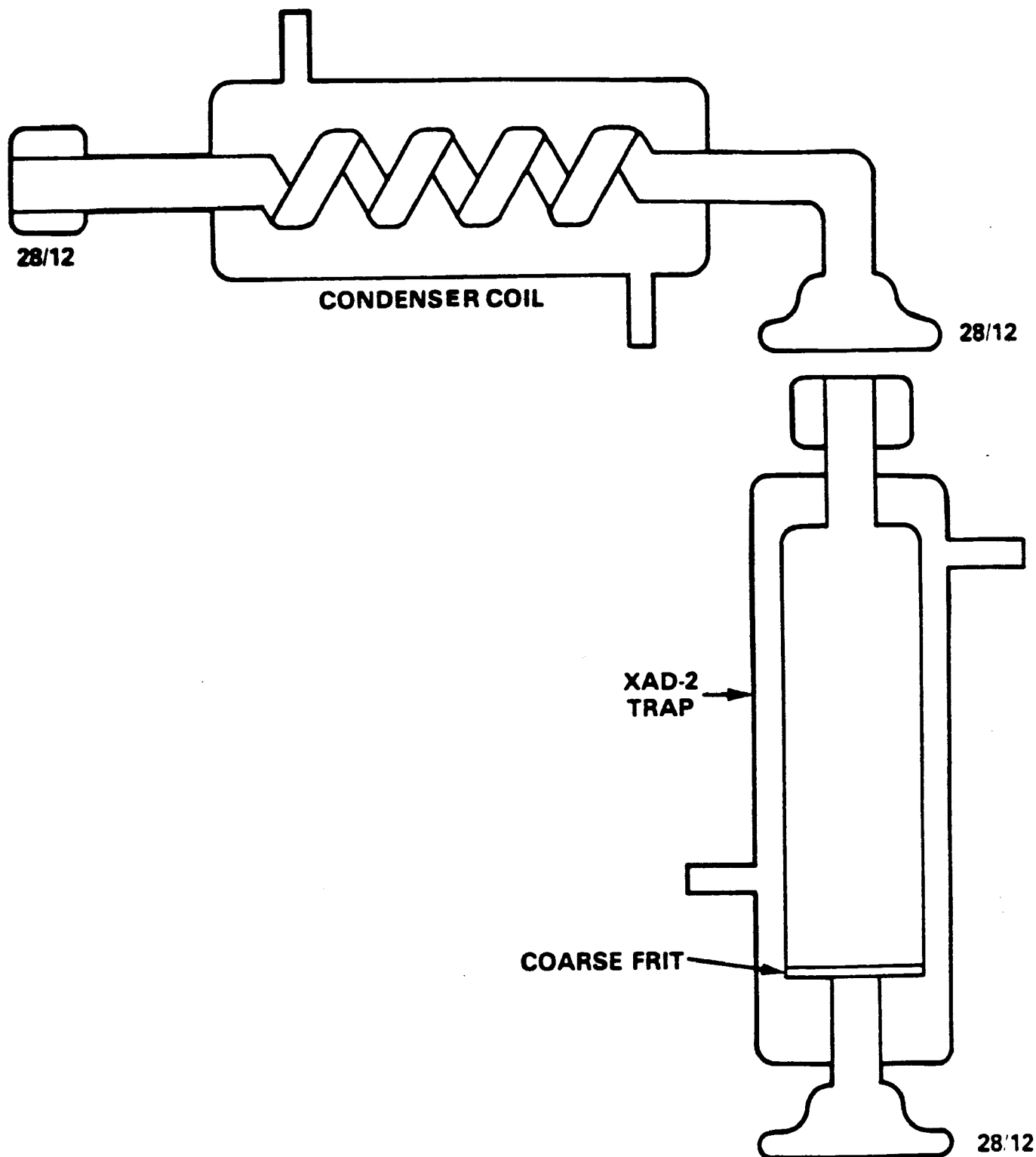


Figure 6-3. XAD-2[®] trap and condenser coil.

6.5.1.5 Sample Transfer Line. If a sample transfer line is required, it shall be heat traced Teflon[®] with connecting fittings that are capable of forming leak free, vacuum tight connection without using sealing greases. The line, (equal to or less than 5' in length) must be maintained at 120°C.

6.5.1.6 Metering System. The metering system shall consist of a vacuum gauge, a leak-free pump, thermometers capable of measuring temperature to within 3°C (~5°F), a dry gas meter with 2% accuracy at the required sampling rate, and related equipment, or equivalent.

6.5.1.7 Barometer. Mercury, aneroid, or other barometers capable of measuring atmospheric pressure to within 2.5 mm Hg (0.1 in. Hg) shall be used.

6.5.2 Sample Recovery, Supplies, and Equipment

6.5.2.1 Ground Glass Caps. To cap off adsorbent tube and the other sample exposed portions of the train.

6.5.2.2 Teflon FEP[®] Wash Bottle. Two, 500 ml, Nalgene No. 0023A59 or equivalent.

6.5.2.3 Sample Storage Containers. Amber glass bottles (or wrapped in opaque material), 1 liter, with TFE[®]-lined screw caps.

6.5.2.4 Balance. Triple beam, Ohaus Model 7505 or equivalent.

6.5.2.5 Aluminum Foil. Heavy duty, hexane rinsed.

6.5.2.6 Metal Can. To recover used silica gel.

6.5.2.7 250 mL and 500 mL Graduated Cylinder.

6.5.3 Analysis

6.6 REAGENTS

6.6.1 Sampling

6.6.1.1 Florisil-Floridin Co., 30/60 Mesh, Grade A. The Florisil[®] is cleaned by 8 hr Soxhlet extraction with hexane and then by drying for 8 hr in an oven at 110°C and is activated by heating to 650°C for 2 hr (not to exceed 3 hr) in a muffle furnace. After allowing to cool to near 110°C, the clean, active Florisil[®] is transferred to a clean, hexane-washed glass jar and sealed with a TFE[®]-lined lid. The Florisil[®] should be stored at 110°C until taken to the field for use. Florisil[®] that has been stored more than 1 month must be reactivated before use. A sample of the Florisil[®] must be carried through the extraction, clean-up, and analytical finish steps to assure proper blank values before use.

6.6.1.2 XAD-2[®] Resin - Supelco, Inc. The clean-up procedure may be carried out in a giant Soxhlet extractor, which will contain enough XAD-2[®] for several sampling traps. An all-glass thimble (55- to 90-mm OD x 150-mm deep [top to frit]) containing an extra-coarse frit is used for extraction of XAD-2[®]. The frit is recessed 10 to 15 mm above a crenulated ring at the bottom of the thimble to facilitate drainage. The resin must be carefully retained in the extractor cup with a glass wool plug and stainless steel screen since it floats on methylene chloride. This process involves sequential extraction in the following order.

<u>Solvent</u>	<u>Procedure</u>
Water	Initial rinse with 1 L H ₂ O for 1 cycle, then discard H ₂ O
Water	Extract with H ₂ O for 8 hours
Methyl alcohol	Extract for 22 hours
Methylene chloride	Extract for 22 hours
Hexane	Extract for 22 hours

The XAD-2[®] resin must be dried by one of the following techniques.

(a) After evaluation of several methods of removing residual solvent, a fluidized-bed technique has proven to be the fastest and most reliable drying method.

A simple column with suitable retainers as shown in Figure 6-4 will serve as a satisfactory column. A 10.2-cm (4-in.) Pyrex[®] pipe 0.6 m (2 ft.) long will hold all of the XAD-2[®] from the Soxhlet extractor, with sufficient space for fluidizing the bed while generating a minimum resin load at the exit of the column.

The gas used to remove the solvent is the key to preserving the cleanliness of the XAD-2[®]. Liquid nitrogen from a regular commercial liquid nitrogen cylinder has routinely proven to be a reliable source of large volumes of gas free from organic contaminants. The liquid nitrogen cylinder is connected to the column by a length of precleaned 0.95-cm (3/8-in.) copper tubing, coiled to pass through a heat source. As nitrogen is bled from the cylinder, it is vaporized in the heat source and passes through the column. A convenient heat source is a water bath

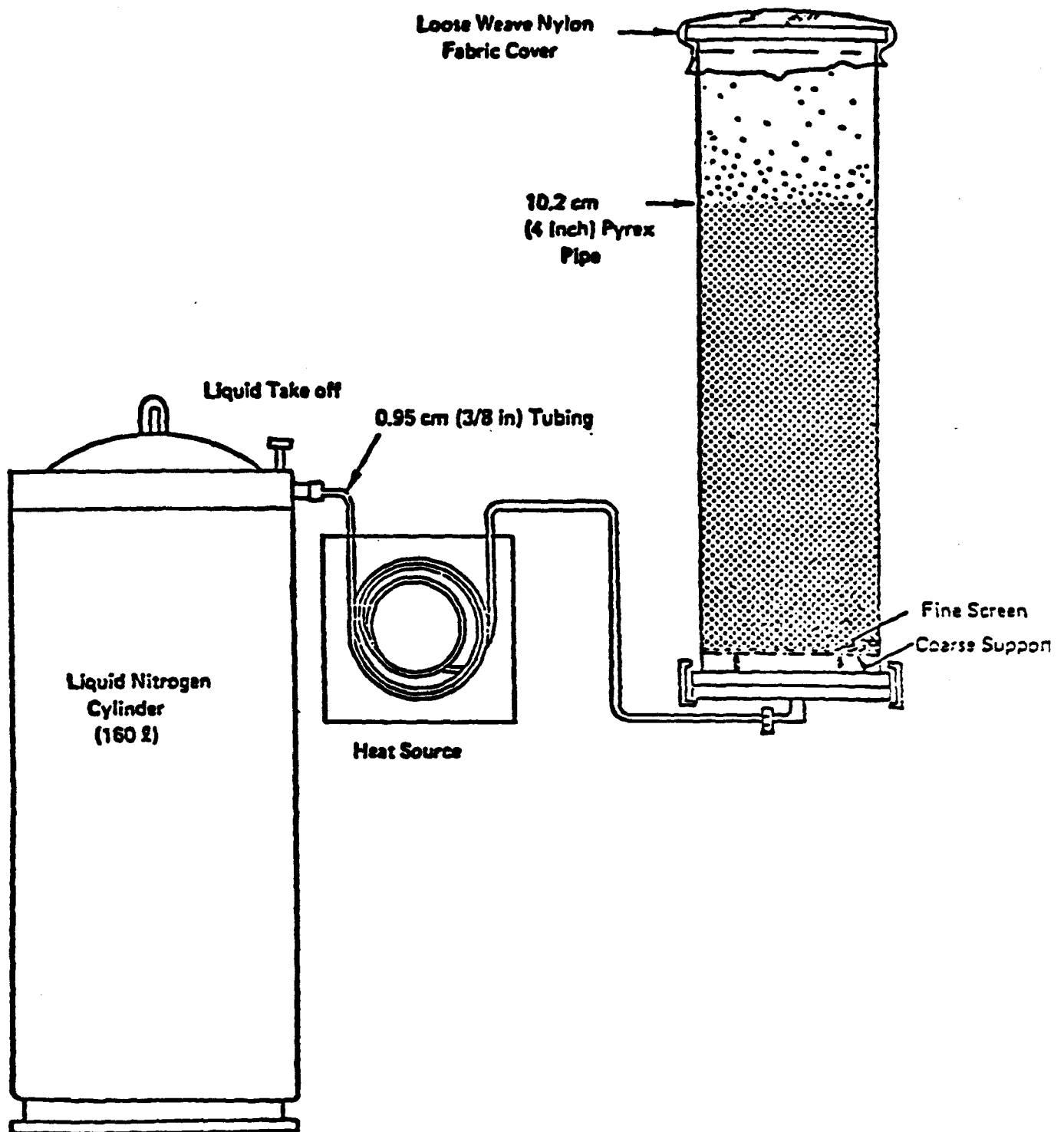


Table 6-4. XAD-2[®] fluidized-bed drying apparatus.

heated from a steam line. The final nitrogen temperature should only be warm to the touch and not over 40°C. Experience has shown that about 500 g of XAD-2® may be dried overnight consuming a full 160-L cylinder of liquid nitrogen.

As a second choice, high purity tank nitrogen may be used to dry the XAD-2®. The high purity nitrogen must first be passed through a bed of activated charcoal approximately 150 mL in volume. With either type of drying method, the rate of flow should gently agitate the bed. Excessive fluidization may cause the particles to break up.

(b) As an alternate if the nitrogen process is not available, the XAD-2® resin may be dried in a vacuum oven, if the temperature never exceeds 20°C.

The resin must be checked for both methylene chloride and hexane residuals, plus normal blanks before use.

6.6.1.3 Glass Wool. Cleaned by thorough rinsing with hexane, dried in a 110°C oven, and stored in a hexane-washed glass jar with TFE®-lined screw cap.

6.6.1.4 Water. Deionized, then glass-distilled, and stored in hexane-rinsed glass containers with TFE®-lined screw caps.

6.6.1.5 Silica Gel. Indicating type, 6 to 16 mesh. If previously used, dry at 175°C for 2 hr. New silica gel may be used as received.

6.6.1.6 Crushed Ice.

6.6.1.7 Sodium Hydroxide. ACS reagent grade.

6.6.2 Sample Recovery Reagents

6.6.2.1 Acetone. Pesticide quality, Burdick and Jackson "Distilled in Glass" or equivalent, stored in original containers. A blank must be screened by the analytical detection method.

6.6.2.2 Hexane. Pesticide quality, Burdick and Jackson "Distilled in Glass" or equivalent, stored in original containers and used as received. A blank must be screened by the analytical detection method.

6.7 PROCEDURE

Caution: Section 6.7.1.1 should be done in the laboratory.

6.7.1 Sampling

The sampling shall be conducted by competent personnel experienced with this test procedure and cognizant of intricacies of the operation

of prescribed sampling train and the constraints of the analytical techniques for PCB's, particularly contamination problems.

6.7.1.1 Pretest Preparation. All train components shall be maintained and calibrated according to the procedure described in APTD-0576 (2), unless otherwise specified herein. Flow rates will be calibrated using an EPA supplied standard orifice.

6.7.1.1.1 Cleaning glassware. All glass parts of the train upstream of and including the adsorbent tube, should be cleaned as described in Appendix C. Special care should be devoted to the removal of residual silicone grease sealants on ground glass connections of used glassware. These grease residues should be removed by soaking several hours in a chromic acid cleaning solution prior to routine cleaning as described above.

6.7.1.1.2 Florisil[®] tube. Weigh 7.5 g of Florisil[®], activated within the last 30 days and still warm from storage in a 110°C oven, into the adsorbent tube (prerinsed with hexane) with a glass wool plug in the downstream end. Place a second glass wool plug in the tube to hold the sorbent in the tube. Cap both ends of the tube with ground glass caps. These caps should not be removed until the tube is fitted to the train immediately prior to sampling. Store the prepared tubes at ambient temperature.

6.7.1.1.3 XAD-2[®] sorbent tube. Weigh a sufficient amount of cleaned resin into the glass adsorbent trap which has been thoroughly cleaned as prescribed and rinsed with hexane. Follow the resin with hexane rinsed glass wool and cap both ends. These caps should not be removed until the trap is fitted into the train.

6.7.1.1.4 Silica gel. The silica gel for each run must be prepared in the laboratory prior to shipping to the site. Sufficient silica gel is weighed in a tared, sealable, and marked container. The container used is recorded with the other run data. Upon completion of the test, the silica is carefully returned to the same container and sealed within. The container may be weighed at the originating laboratory to determine the moisture captured if desired at the preference of the tester.

6.7.1.2 Preliminary Determinations. At the selected sampling site, determine the flow rate in the incinerator from the burner combustion

calculations and data from previous operations, if available. Determine the preliminary velocity and sampling point selection according to EPA Reference Methods 1 and 2. Determine the stack gas moisture using EPA Method 4 or previous data. Select a sampling time appropriate for total method sensitivity and the PCB concentration anticipated (see Appendix D). Sampling times will vary based on the relative amount of spiked waste added to the feed.

6.7.1.3 Preparation of Collection Train. During preparation and assembly of the sampling train, keep all train openings where contamination can enter covered until just prior to assembly or until sampling is about to begin. Immediately prior to assembly, rinse all parts of the train upstream of the adsorbent tube with hexane. CAUTION: Do not use sealant greases in assembling the train. Mark the probe with heat resistant tape or by some other method at a point indicating the proper distance into the stack for sampling.

Place 200 mL of water in each of the first two impingers with a graduated cylinder, and leave the third impinger empty. Place 200 mL of concentrated sodium hydroxide in the fourth and fifth impinger. The total concentration of NaOH should be at least the theoretical amount needed to neutralize the expected hydrochloric acid. Place approximately 200 to 300 g or more, if necessary, of silica gel in the last impinger. Weigh each impinger (stem included) and record the weights on the impingers and on the data sheet, or determine volumetrically (tester option). If no balance is available, use a preweighed container of silica gel and record the container number.

Assemble the train as shown in Figure 6-1. Before a leak check as specified below, place crushed ice in the water bath around the impingers.

6.7.1.4 Leak Check Procedure. The probe will be leak checked prior to being inserted into the stack after the sampling train has been assembled. Turn on and set (if applicable) the heating/cooling system(s) as necessary to avoid condensation in the probe and filter holder (approximately 120°C). Allow time for the temperature to stabilize. Leak check the train at the sampling site by plugging the nozzle and pulling a 380 mm Hg (12 in. Hg) vacuum. A leakage rate in excess of 4% of the average sampling rate or 0.0057 m³/min (0.02 cfm) whichever is less, is unacceptable.

The following leak check instruction for the sampling train described in APTD-0576 (2) and APTD-0581 (4) may be helpful. Start the pump with bypass valve fully open and coarse adjust valve completely closed. Partially open the coarse adjust valve and slowly close the bypass valve until 380 mm Hg (12 in. Hg) vacuum is reached. Do not reverse direction of bypass valve. This will cause water to back up into the probe. If 380 mm Hg (12 in. Hg) is exceeded, either leak check at this higher vacuum or end the leak check as described below and start over.

The final leak check will be first performed at the highest vacuum achieved during the sampling run and again at the initial leak check pressure. If the first leak check fails (at highest vacuum achieved during the sampling run) invalidate the run. If leak check fails at initial leak check pressure then determine the leak rate.

When the leak check is completed, first slowly remove the plug from the inlet to the probe then immediately turn off the vacuum pump. This prevents the water in the impingers from being forced backward into the probe.

Leak checks shall be conducted as described above prior to and after each test run. If leaks are found to be in excess of the acceptable rate prior to the test, the source of leakage shall be located and corrected. Failure of this test after a run shall invalidate that run.

6.7.1.5 Train Operation. During the sampling run, a sampling rate within 10% of the selected sampling rate or as specified by the Administrator, shall be maintained.

For each run, record the data required on the data sheets. An example is shown in Figure 6-5. Be sure to record the initial dry gas meter reading. Record the dry gas meter readings at the beginning and end of each sampling time increment and when sampling is halted.

To begin sampling, remove the nozzle cap, verify (if applicable) that the probe temperature control system is working and at temperature and that the probe is properly positioned at required sampling point. Immediately start the pump and adjust the flow rate.

If the stack is under significant negative pressure (height of impinger stem), take care to close the coarse adjust valve before inserting the probe into the stack to avoid water backing into the probe. If

```

PROBE LENGTH AND TYPE _____
NOZZLE I.D. _____ MA _____
ASSUMED MOISTURE % _____
SAMPLE BOX NUMBER _____
METER BOX NUMBER _____
METER  $\Delta H$  @ _____
C FACTOR _____
PROBE HEATER SETTING _____
HEATER BOX SETTING _____
REFERENCE  $\Delta p$  _____

```

SCHEMATIC OF TRAVERSE POINT LAYOUT

READ AND RECORD ALL DATA EVERY MINUTES

[illegible]

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Figure 6-5. Field data sheet.

necessary, the pump may be turned on with the coarse adjust valve closed.

During the test run, make periodic adjustments to keep the probe temperature at the proper value. Add more ice and, if necessary, salt to the ice bath. Also, periodically check the level and zero of the manometer and maintain the temperature of XAD-2[®] module at or slightly less than 20°C.

If the pressure drop across the train becomes high enough to make the sampling rate difficult to maintain, the filters should be terminated. Extra care must be taken to prevent contamination during particulate filter changes. All sampling components should be capped off using precleaned caps, plugs, and hexane rinsed aluminum foil. All caps should be properly stored in a precleaned container prior to usage.

At the end of the sample run, turn off the pump, remove the probe and nozzle from the stack, and record the final dry gas meter reading. Perform a leak check.*

6.7.1.6 Blank Train. For each series of test runs, set up a blank train in a manner identical to that described above, but with the probe inlet capped with aluminum foil and the exit end of the last impinger capped with a ground glass cap. Allow the train to remain assembled for a period equivalent to one test run. Recover the blank sample as described in Section 6.7.2.

6.7.2 Sample Recovery

Proper cleanup procedure begins as soon as the probe is removed from the stack at the end of the sampling period.

When the probe can be safely handled, wipe off all external particulate matter near the tip of the probe. Remove the probe from the train and close off both ends with aluminum foil. Cap off the inlet to the train with a ground glass cap.

Transfer the probe and impinger assembly to the cleanup area. This area should be clean and protected from the wind so that the chances of contaminating or losing the sample will be minimized.

Inspect the train prior to and during disassembly and note any abnormal conditions. Treat the samples as follows:

*With acceptability of the test run to be based on the same criterion as in 6.7.1.4.

6.7.2.1 Adsorbent Tubes. Remove both the Florisil[®] tube and the XAD-2[®] trap and condenser from the train and cap them off with ground glass caps and wrap in aluminum foil. Clearly identify each adsorbent tube by run number.

6.7.2.2 Sample Container No. 1. Remove the first three impingers. Wipe off the outside of each impinger to remove excessive water and other material, weigh (stem included), and record the weight on data sheet. Pour the contents directly into container No. 1 and seal. Alternatively, measure volume of each impinger before and after sampling.

6.7.2.3 Sample Container No. 2. Rinse each of the first three impingers sequentially first with acetone and then with hexane, and put the rinses into container No. 2. Quantitatively recover material deposited in the probe and filter housing using acetone and then hexane and add these rinses to container No. 2 and seal.

6.7.2.4 Sample Container No. 3. Empty the fourth and fifth impingers into container No. 3. Rinse each with distilled D.I. water and add the rinses to container No. 3.

6.7.2.5 Filter Container No. 4. Recover the particulate matter filter into the original glass petri dish with Teflon[®]-coated tweezers. Label appropriately.

6.7.2.6 Silica Gel Container. Remove the last impinger, wipe the outside to remove excessive water and other debris, weigh (stem included), and record weight on data sheet. Transfer the contents to the used silica gel can. If preweighed batches of silica gel are used, return the silica gel to the appropriate container and seal.

6.8 CALCULATIONS

Carry out calculations, retaining at least one extra decimal figure beyond that of the acquired data. Round off figures after final calculations.

6.8.1 Nomenclature

G_s = Total weight of PCB's in stack gas sample, μg .

C_s = Concentration of PCB's in stack gas, $\mu\text{g}/\text{m}^3$, corrected to standard conditions of 20°C, 760 mm Hg (68°F, 29.92 in. Hg) on dry basis.

- A_n = Cross-sectional area of nozzle, m^2 (ft^2).
- B_{ws} = Water vapor in the gas stream, proportion by volume.
- M_w = Molecular weight of water, 18 g/g-mole (18 lb/lb-mole).
- P_{bar} = Barometric pressure at the sampling site, mm Hg (in. Hg).
- P_s = Absolute stack gas pressure, mm Hg (in. Hg).
- P_{std} = Standard absolute pressure, 760 mm Hg (29.92 in Hg).
- R = Ideal gas constant, 0.06236 mm Hg- m^3 /°K-g-mole (21.83 in. Hg-ft /°R-lb-mole).
- T_m = Absolute average dry gas meter temperature °K (°R).
- T_s = Absolute average stack gas temperature °K (°R).
- T_{std} = Standard absolute temperature, 293°K (528°R).
- V_{lc} = Total volume of liquid collected in impingers and silica gel, mL. volume of water collected equals the weight increase in grams times 1 mL/gram
- V_m = Volume of gas sample as measured by dry gas meter, dcm (dcf).
- $V_{m(std)}$ = Volume of gas sample measured by the dry gas meter corrected to standard conditions, dscm (dscf).
- $V_{w(std)}$ = Volume of water vapor in the gas sample corrected to standard conditions, scm (scf).
- V_t = Total volume of sample, mL.
- V_s = Stack gas velocity, calculated by combustion calculation, m/sec (ft/sec).
- ΔH = Average pressure differential across the orifice meter, mm H₂O (in. H₂O).
- ρ_w = Density of water, 1 g/mL.
- θ = Total sampling time, min.
- 13.6 = Specific gravity of mercury.
- 60 = Sec/min.
- 100 = Conversion to percent.

6.8.2 Average Dry Gas Meter Temperature and Average Orifice Pressure Drop

See data sheet (Figure 6-5).

6.8.3 Dry Gas Volume

Correct the sample volume measured by the dry gas meter to standard conditions [20°C, 760 mm Hg (68°F, 29.92 in. Hg)] by using Equation 6-1.

$$V_{m(std)} = V_m \frac{T_{std}}{T_m} \frac{P_{bar} + \frac{\Delta H}{13.6}}{P_{std}} = K V_m \frac{P_{bar} + \frac{\Delta H}{13.6}}{T_m}$$

Equation 6-1

where $K = 0.3855 \text{ } ^\circ\text{K/mm Hg}$ for metric units
 $= 17.65 \text{ } ^\circ\text{R/in. Hg}$ for English units

6.8.4 Volume of Water Vapor

$$V_{w(std)} = V_{lc} \frac{P_w}{M_w} \frac{RT_{std}}{P_{std}} = K V_{lc}$$

Equation 6-2

where $K = 0.00134 \text{ m}^3/\text{mL}$ for metric units
 $= 0.0472 \text{ ft}^3/\text{mL}$ for English units

6.8.5 Moisture Content

$$B_{ws} = \frac{V_{w(std)}}{V_{m(std)} + V_{w(std)}}$$

Equation 6-3

If the liquid droplets are present in the gas stream assume the stream to be saturated and use a psychrometric chart to obtain an approximation of the moisture percentage.

6.8.6 Concentration of PCB's in Stack Gas

Determine the concentration of PCB's in the stack gas according to Equation 6-5.

$$C_s = K \frac{G_s}{V_{m(std)}}$$

Equation 6-5

where $K = 35.31 \text{ ft}^3/\text{m}^3$

Calculation of destruction removal efficiencies are discussed in Section 9.7.3.2.5.

6.9 SPECIAL CASES

6.9.1 Sampling Moisture Saturated or Supersaturated Stack Gases

One or two additional modified Greenburg-Smith impingers may be added to the train between the third impinger and the Florisil[®] tube to accommodate additional water collection when sampling high moisture gases. Throughout the preparation, operation, and sample recovery from the train, these additional impingers should be treated exactly like the third impinger.

6.10 INTEGRATED BAG SAMPLE

An integrated bag sample will be collected during each PCB run. EPA Reference Method 3 (Gas Analysis, for Carbon Dioxide, Oxygen, Excess Air, and Dry Molecular Weight, Federal Register 42 FR 41768) will be utilized to characterize the stationary gas analysis. As permitted under Section 1.2, paragraph 2 of the reference document, a modification to the sampling procedures and use of an alternative analytical procedure will be implemented. A single point integrated sample is anticipated. In lieu of an Orsat analyzer, a gas chromatograph with a thermal conductivity detector (GC/TCD) will be utilized to measure the concentrations of oxygen (O₂), carbon dioxide (CO₂), nitrogen (N₂), and carbon monoxide (CO) in the integrated bag sample. Previous test programs have demonstrated the acceptability of this substitution. This alternative analytical method offers acceptable accuracy and a permanent hard copy record of the analysis. The data will be reported in units of percent by volume for O₂, CO₂, N₂, and CO. Dry molecular weight will be calculated by Equation 3-2 of the EPA reference method.

6.11 WASTE SAMPLING

During the incineration sample run, one liter aliquots of the waste being burned must be taken. A minimum of one aliquot every 30 minutes is required. The sample shall be taken from the waste feed line to the incinerator as near to the incinerator as possible. If the sample tap line has a residual volume it must be discarded before collection of the sample. The sample shall be collected in cleaned amber glass bottles or jars, with TFE[®]-lined screw caps.

Composite samples of the waste feed shall be made by combining individual samples taken at frequent intervals or by means of an automatic sampler. At the end of each test period (6 hour nominally), mix the composite sample thoroughly so that a portion of the composite sample will represent the average for the sample constituents within the sampled stream. The composite sample should be placed into two duplicate 500 mL bottles for shipment to the laboratory. Record all pertinent data or sampling data on a field sheet or notebook. The data points required from the sampler are:

- temperature;
- sample point location;
- sample volume;
- sampling methods used;
- observations (sample is cloudy, has odor, etc.); and
- specific gravity.

To acquire the tap sample of the feed material, the valve or stopcock used for sample removal must be fitted with a length of precleaned Teflon[®] tubing long enough to reach the bottom of the sample container. Because of the wide diversity in valve and stopcock nozzle sizes, a full range of male-to-female and female-to-male Teflon[®] tubing of sufficient length to reach to the bottom of the sample container is coupled to the appropriate male or female adapter. The adapter is then coupled to the valve or stopcock.

The sample is removed by a stopcock or valve by inserting a clean Teflon[®] line into the sampling bottle so that it touches the bottom. The sample bottle should be thoroughly rinsed with sample prior to filling. The sample line flow must be regulated so it does not exceed 500 mL/min after the sample line has been flushed at a rate high enough to remove all sediment and gas pockets. The apparatus used for tap sampling is illustrated in Figure 6-6. If sampling valves or stopcocks are not available, samples may be taken from water-level or gauge-glass drain lines or petcocks.

6.12 FILTER CAKE SLUDGE

A representative sample of filter cake sludge will be taken by TRW or plant personnel every 2 hours and composited over a 6 hour period.

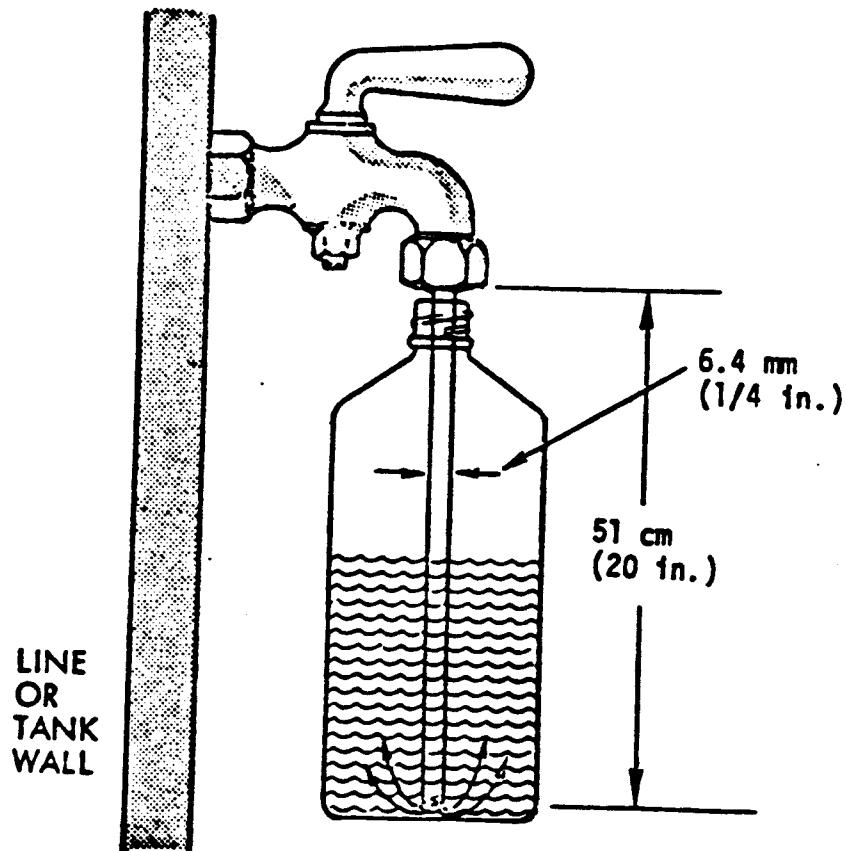


Figure 6-6. Assembly for tap sampling.

The sample will be collected from the sludge feed belt with a precleaned scoop and composited into precleaned containers.

6.13 ASH

The ash will be sampled every 2 hours during each sampling run. The sample will be collected with a long handled shovel and allowed to cool before compositing using standard ASTM cone and quarter techniques.

6.14 SCRUBBER INFLUENT AND EFFLUENT

A liquid sample of the scrubber influent and effluent will be taken every 2 hours and composited during each test run. A standard tap sample will be collected after sufficiently purging the sampling line to ensure a representative sample.

6.15 CONTINUOUS MONITORING SAMPLING SYSTEM

The extractive-type gas monitors and gas chromatograph to be employed for analyzing stack gas composition will be supplied with sample gas from a common manifold. Sample gas will be removed from the stack through an in-stack particulate filter using "heat-traced" line to maintain the sample at about 121°C to prevent condensation of water vapor in the sample line. Since the water vapor content of the sample gas will be above the practical limits for some of the continuous gas monitors, a commercial sample gas conditioner will be utilized to condense and remove the moisture and thus provide a dry gas stream for the CO, O₂, and CO₂ gas monitors.

The sample gas will be pumped into a glass sample manifold at a flow rate which exceeds the total sample requirements of the individual gas monitors. The common sampling manifold will, therefore, offer slipstream sample flows to each monitor. Maintaining excess sample flow ensures that there are no measurement errors due to back dilution from ambient air. Also, since the sampling manifold is exhausted to ambient pressure the manifold itself remains at ambient pressure and eliminates measurement errors which could arise from varying stack pressures and pressure effects which could be caused by interaction between the gas monitors individual sample pumps.

To ensure representative measurements, all gases for calibration will be introduced through the heated sampling line such that it follows

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the same flow path as actual sample gas. The heat-traced sample line will be attached in such a manner that it can be removed to introduce calibration gases.

7. SAMPLE CUSTODY

This section provides the quality control requirements associated with custody of samples taken in this project, including both field custody and subsequent laboratory custody actions. A set of general QC requirements is also presented for use by all sample custodians. For the purposes of these requirements, a custodian is considered any person designated to provide receiving inspection, physical acceptance of a group of samples intended for subsequent treatment or analysis, analysis tracking, or sample repository operation. An important QC activity performed by the custodian is completeness checking of records, data, identities etc., of the samples, primarily with respect to a preplanned sample inventory.

7.1 GENERAL REQUIREMENTS

All custodians in this program are required to present plans for maintaining custody, sample integrity, and adequate records of all test samples. A plan will identify:

- Name of sample custodian(s)
- Laboratory tracking report sheets to be used which identify
 - Sample code number, reserve sample, quantity, aliquot for each test, responsible person, date received, date completed
 - Storage facility for reserve samples
 - Method for using hard-bound workbooks in conjunction with lab tracking report sheets to note unusual events
 - Quality control inspection results on incoming samples
 - Method of identifying sample at any stage of testing, using existing laboratory practices
- Use of the completeness check as described in Section 7.4.

7.2 FIELD CUSTODY

To ensure the integrity of collected samples, and to maintain a timely and traceable transfer of samples, an established and proven chain of custody or possession is mandatory. It is imperative that accurate records be maintained whenever samples are collected, transferred, stored, analyzed, or destroyed.

The primary objective of these procedures is to create an accurate written record that can be used to trace the possession of the sample from the moment of its collection through the reporting of the final results. A sample is in custody if it is in any one of the following states:

- a. In actual physical possession
- b. In view, after being in physical possession
- c. In physical possession and locked up so that no one can tamper with it
- d. In a secured area, restricted to authorized personnel.

Personnel will receive copies of study plans prior to the study. Prestudy briefings should then be held to apprise participants of the objectives, sample locations, and chain-of-custody procedures to be followed. After the chain-of-custody samples are collected, a debriefing is held in the field to verify the adherence to the chain-of-custody procedures and to determine whether additional samples are required.

The personnel involved with the sampling and analyses effort will be briefed by the Project Manager in regard to the following rules.

- a. Involve a minimum number of trained persons in sample collection and handling.
- b. Establish guidelines for particular procedures to be used for each type of sample collection, preservation, and handling.
- c. Minimum handling of samples.
- d. Obtain samples using the appropriate sampling techniques.
- e. Attach sample tag or label securely (see Figure 7-1) to the sample container at the time the sample is collected. The label will contain the following items as a minimum: the station number and location, the date and time taken, the type

TRW ENVIRONMENTAL
ENGINEERING
DIVISION

DATE _____

SAMPLE NUMBER _____

TYPE SAMPLE _____

FRACTION _____

COMMENTS _____

COLLECTED BY _____

SOURCE I.D. _____

Figure 7-1. Example of sample label.

- of sample, the sequence number (e.g., first sample of the day-sequence No. 1), the preservative used (if any) and the name of the sample collector. Labels will be completed legibly in waterproof ink. The samples will be sealed to preserve the integrity of the sample from the time it is collected until it is opened in the laboratory.
- f. Use bound field notebooks to record field measurements and other pertinent information necessary to reconstruct the sample collection processes for future reference. Maintain a separate set of field notebooks for each study and store them in a safe place where they can be protected and accounted for at all times. Establish a sample log sheet with a standard format to minimize field entries and include the serial number of the sheet, the date, time, survey, type of samples taken, volume of each sample, type of analyses, unique sample numbers, sampling location, field measurements and any other pertinent information or observation. The QA Manager will be responsible for the preparation of the necessary sample log sheets, etc., and the periodic review of all notebooks during and after the study. The Project Manager will be responsible for the safe keeping of all notebooks at completion of the project. The entries should be signed by the sample collector.
 - g. The sample collector is responsible for the care and custody of the samples until the samples are properly dispatched to the receiving laboratory or given to an assigned custodian. The sample collector will insure that each container is in his physical possession or in his view at all times, or stored in a locked place where no one can tamper with it.

In the transfer-of-custody procedures, each custodian or sampler will sign, record, and date the transfer. Sample transfer can be a sample-by-sample basis or on a bulk basis. The following protocol will be followed for all samples as they are collected and prepared for distribution.

- a. Samples will be accompanied by a chain-of-custody record (Figure 7-2) that includes the name of the study, collectors' signatures, station number, station location, date, time, type of sample, sequence number, number of containers, and analyses required. When turning over possession of samples, the transferor and transferee will sign, date, and time the record sheet. This record sheet allows transfer of custody of a group of samples in the field to the mobile laboratory or to the central laboratory.
- b. If the custodian has not been assigned, the field custodian or field sampler has the responsibility of packaging and dispatching samples to the laboratory for analysis. The appropriate chain-of-custody record must be filled out, dated, signed, and included with the sample. A copy will remain with the custodian.
- c. To avoid breakage, samples will be carefully packed in shipment containers such as ice chests. The shipping containers will be sealed for shipment to the receiving laboratory.
- d. Packages must be accompanied by the chain-of-custody record showing identification of the contents. The original must accompany the shipment. A copy is retained by the Field Sampling Team Leader.
- e. If sent by mail, register the package with return receipt requested. If sent by common carrier, a bill of lading should be obtained. Receipts from post offices and bills of lading will be retained as part of the permanent chain-of-custody documentation.
- f. If delivered to the laboratory when appropriate personnel are not there to receive them, the samples must be locked in a designated area within the laboratory or must be placed in a secure area, so that no one can tamper with them. The recipient must return to the laboratory, unlock the samples, and deliver custody to the appropriate custodian.

Collector's Sample No. _____

CHAIN OF CUSTODY RECORD

Location of Sampling: _____ Producer _____ Hauler _____ Disposal Site
_____ Other: _____

Sample

Shipper Name: _____

Address: _____
number street city state zip

Collector's Name _____ Telephone: (____) _____
signature

Date Sampled _____ Time Sampled _____ hours _____

Type of Process Producing Waste _____

Field Information _____

Sample Receiver:

1. _____
name and address of organization receiving sample

2. _____

3. _____

Chain of Possession:

1. _____
signature title inclusive dates

2. _____
signature title inclusive dates

Figure 7-2. Example of chain-of-custody record.

7.3 LABORATORY CUSTODY

The following protocol will be followed for all samples received at the TRW laboratories.

- a. The laboratory has designated Jim McGaughey as sample custodian. The laboratory will set aside a sample storage security area. This will be a clean, dry, isolated room with sufficient refrigerator space that can be securely locked from the outside.
- b. Samples will be handled by the minimum possible number of persons.
- c. Incoming samples, along with the sample analysis request form (Figure 7-3), will be received only by the custodian, who will indicate receipt by signing the chain-of-custody record and sample analysis request sheets accompanying the samples, and retaining the sheets as a permanent record. Couriers picking up samples at the airport or post office shall sign jointly with the laboratory custodian.
- d. Immediately upon receipt, the custodian places the samples in the sample room, which will be locked at all times except when samples are removed or replaced by the custodian. The samples are then cross checked with the enclosed chain-of-custody record to ensure that the proper number of samples were received and that they correspond to the appropriate sample descriptions. Samples are also checked for damage and/or leaks. All abnormalities will be documented.
- e. The custodian will ensure that the samples are logged into the laboratory "master" sample log immediately upon receipt.
- f. Only the custodian will distribute samples to personnel who are to perform tests.
- g. The analyst will record in his laboratory notebook or analytical worksheet, identifying information describing the sample, the procedures performed, and the results of the testing. The notes will be dated, will indicate who performed the tests, and will include any abnormalities that occurred during the

SAMPLE ANALYSIS REQUEST

Part I: FIELD SECTION

Collector _____ Date Sampled _____ Time _____ hours

Affiliation of Sampler _____

Address _____
number street city state zip

Telephone (____) _____ Company Contact _____

Laboratory Sample Number	Collector's Sample No.	Type of Sample ^a	Field Information ^b
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Analysis Requested _____

Special Handling and/or Storage _____

Part II: LABORATORY SECTION^b

Received by _____ Title _____ Date _____

Analysis Required _____

^aIndicate whether sample is water, soil, sludge, etc.

^bUse back of page for additional information relative to sample location.

Figure 7-3. Sample analysis request.

testing procedure. The notes will be retained as a permanent record in the laboratory.

- h. Laboratory personnel are responsible for the care and custody of a sample once it is handed to them and should be in their possession and view or secured in the laboratory at all times from the moment it was received from the custodian until the tests were run. Sample preparation forms will be drafted for each sample and include provisions for conducting and reporting:
 - 1. blank determinations for all reagents which become an integral part of the sample
 - 2. clean-up reagent blank determination
 - 3. glassware blank determination.All samples will be refrigerated prior to analysis to ensure adequate sample preservation.
- i. The laboratory area shall be maintained as a secured area and shall be restricted to authorized personnel.
- j. Once the sample analyses are completed, the unused portion of the sample, together with identifying labels and other documentation, must be returned to the custodian. The returned, tagged sample should be retained in the custody room until permission to destroy the sample is received by the custodian.
- k. Samples should be destroyed only upon the order of the Program Manager when it is certain that the information is no longer required, or that the samples have deteriorated.
- l. Figure 7-4 presents the complete chain-of-custody flow of samples from initial sampling to the reporting of results.

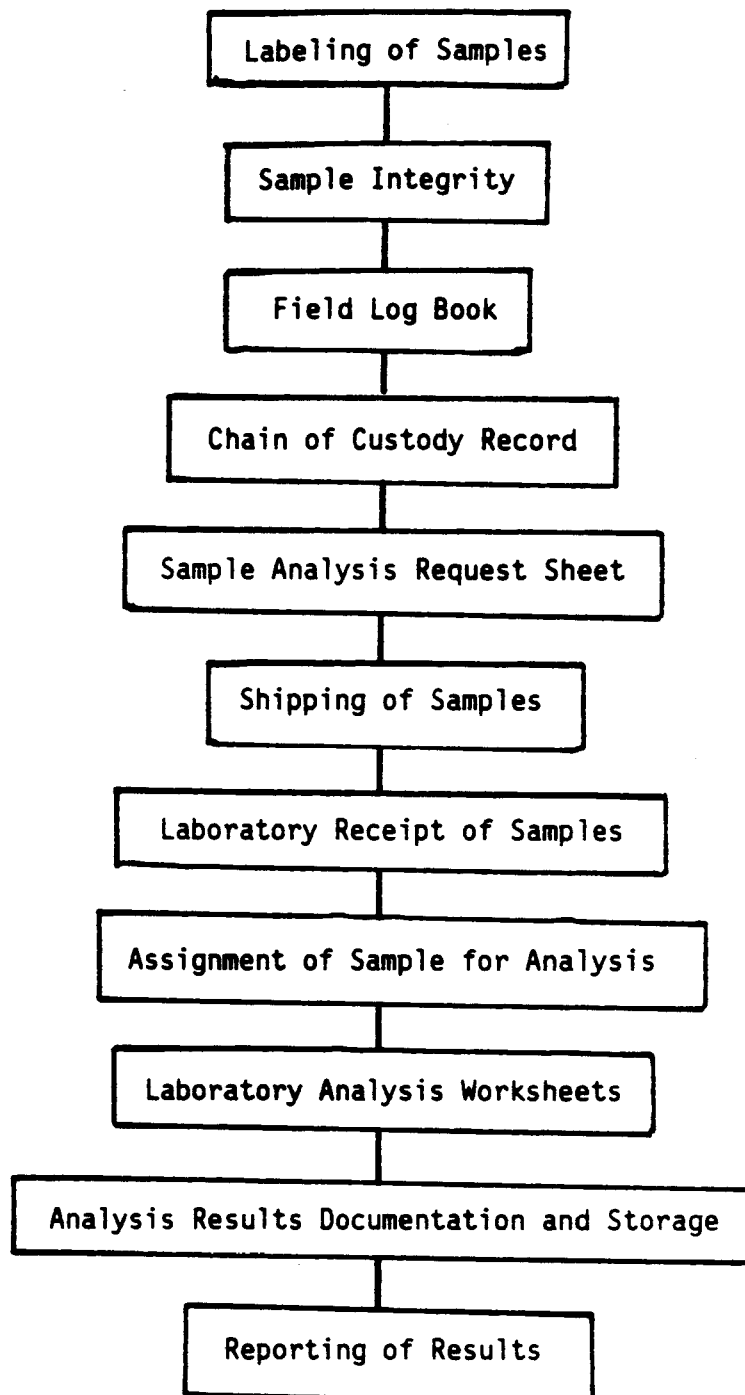


Figure 7-4. Chain of custody.

8. CALIBRATION PROCEDURES AND FREQUENCY

Calibration procedures for laboratory instrumentation will be performed on a daily basis to establish linearity of parameters being measured and determine response factors. This is the general approach that will be used throughout the project for each measured parameter. Analytical standard materials to be utilized will come from existing stocks or will be purchased from Ultra Scientific. Lot numbers will be documented for each standard along with date of receipt, date of initial use, expiration date, purity, and persons handling standards.

Complete traceability of each standard used for calibrations will continue by documenting all preparation steps from primary to working standards. A separate standard preparation quality control log book will be kept which will include weight measured, dilution volumes, calculations, solvents, solvent brands and lot numbers, and persons performing these procedures.

For each day that analyses are done, a calibration curve or checks (GC/MS and/or GC/ECD) will be prepared each morning. Thereafter throughout the day a calibration check will be done with a standard solution after every five analyses.

The calibration curve is assumed to be linear. If the regression coefficient is less than 0.900, the calibration curve is not considered to be valid and the calibration is repeated with new standards.

Any failure of the analysis internal standard checks, or any failure of the calibration check causes the analyses to stop for that day until a new acceptable calibration curve is established.

8.1 CALIBRATION REQUIREMENTS FOR LABORATORY EQUIPMENT

Table 8-1 presents calibration requirements for laboratory equipment.

Table 8-1. CALIBRATION REQUIREMENTS FOR LABORATORY EQUIPMENT

Item	Calibration method	Frequency of calibration	Calibration recommendation reference	Reference standard used
Analytical Balances	Standard weights	Monthly	(5)	NBS Class S weight
Microbalances	Standard weights	Each use	(5)	NBS Class J or Class N weights
Thermometers	Water bath check vs. standard	3 months	(6)	Certified NBS thermometer
Gas chromatography	Retention time/detection response check	Each use-day	(4)	Reference mixture
	Response curve check	Each use-day	(6)	Reference mixtures
	Oven temperature check	Monthly	(4)	Reference pyrometer, thermocouple, or thermometer
GC/MS	MS tuning	Daily	(7)	DFTPP, BFD, or BFB
	Calibration check	Each 8 hours of analysis	(8)	See Table 3.1 of of Reference (8)

(4) EPA 600/4-78-043, August 1978, pp. 39-44.

(5) QA practices for Health Laboratories, S.L. Inhorn, APHA, (1978).

(6) TRW practice.

(7) EPA Method 624.

(8) "Development of Acceptance Criteria for the Determination of Organic Pollutant at Medium Concentrations in Soil, Sediment, and Water Samples, Systems, Science and Software #R-81-4819, April 1981. See also R-81-5042, June 1981 and #R-81-5043, June 1981.

8.2 CALIBRATION STANDARDS

Specific chemical or physical species are available as standard reference materials or commercially available secondary standards. A list of these is provided in Table 3, page 29 of EPA-600/7-78-201, dated October 1978. In addition, certain "quality control" standards are available to check performance after calibrations for some tests. (See EPA QA Newsletter, dated February 1980, Volume 3, No. 1.) The use of these standards is to be specified in the procedure, and will include the frequency of calibration and limits of permissible deviation.

8.3 CALIBRATION RECORDS AND SUPPORT

Maintenance of calibration records will be required to provide assurance that required calibrations of measurement systems are occurring at specified intervals. A dated tag will be attached to the measurement system indicating expiration date of the calibration and type of standard. Tagged equipment will include:

- Balances
- Gas chromatographs
- Gas chromatograph/mass spectrometer system
- IR, UV, IC instruments.

Calibrations which are part of the measurement system preparation procedure (such as GC/MS, GC, IC, etc.) will be recorded in an instrument log book to be kept adjacent to the instrument. The log book will record the date, concentration versus response data, graphs, equations, preventive maintenance, parts replaced, etc.

8.4 CALIBRATIONS REQUIREMENTS FOR FIELD EQUIPMENT

The Method 5 dry gas meters in the control boxes will be calibrated before and after testing against a wet test meter standardized through the EPA Method 5 external national audit program.

All temperature measuring devices will be calibrated against an NBS thermometer.

9. ANALYTICAL PROCEDURES

9.1 PRINCIPLE AND APPLICABILITY

9.1.1 Principle

Gaseous and particulate Polychlorinated Biphenyls (PCB's and/or dioxins and furans) are withdrawn from the source using a sampling train. The compounds of interest are collected in the Florisil[®] adsorbent tube and in the impingers in front of the adsorbent. The Florisil[®] is followed by an XAD-2[®] trap and two basic impingers. The total PCB's, dioxins and furans in the train are determined by solvent extraction followed by Gas Chromatography/Electron Capture Detection (GC/ECD) and/or Gas Chromatography/Mass Spectroscopy (GC/MS). Identical but separate sampling trains will be operated simultaneously; Train A for PCB's and Train B for dioxins and furans. All samples from Train B will be shipped to the mass spectrometry center at the University of Nebraska for analysis. The analytical procedures are found in Appendix H of reference 6.

9.1.2 Applicability

This method is applicable to the determination of vaporous emissions from municipal sewage sludge incinerators. The analysis of the samples should be conducted by personnel trained in chemical analysis and experienced in determinations of trace organics utilizing sophisticated, instrumental techniques. All extract transfers should be made quantitatively by rinsing the apparatus at least three times with the appropriate solvent and adding the rinses to the receiving container. A pre-extracted boiling stone should be used in all evaporative steps to control "bumping."

9.2 RANGE AND MINIMUM DETECTABLE LIMIT (MDL)

The range of the analytical method may be expanded considerably through concentration and/or dilution. The total method sensitivity is also highly dependent on the volume of gases sampled. The MDL of the

GC/ECD method is about 50 pg of total PCB's per 1 μ L injection. The MDL of the GC/MS system for PCB's ranges between 50 and 200 pg/ μ L. The MDL of the GC/MS system for dioxins and furans is approximately 1 to 20 pg/ μ L.

9.3 INTERFERENCES

Organochlorine compounds other than PCB, tetrachlorodibenzofuran (TCDF) or tetrachlorodibenzodioxin (TCDD) found in the raw waste may interfere with the analyses. Appropriate sample cleanup steps shall be performed as needed. Based on previous experience this will require a sulfuric acid treatment followed by aluminum and/or Fluorisil column chromatography.

Throughout all stages of sample handling and analysis, care should be taken to avoid contact of samples and extracts with synthetic organic materials other than TFE[®] (polytetrafluorethylene). Adhesives should not be used to hold TFE[®] liners on lids, (but, if necessary, blanks on these adhesives must be run).

9.4 PRECISION AND ACCURACY

From sampling with identical and paired sampling trains, the precision of the method has been determined to be 10 to 15% of the PCB concentration measured. Recovery efficiencies on source samples spiked with PCB compounds ranged from 85 to 95% (Reference 1).

9.5 APPARATUS

9.5.1 Gas Chromatograph

The gas chromatograph (GC) will be equipped with an electron capture detector (ECD) for the detection and quantitation of PCB's. The GC should also be equipped with a capillary column (such as a fused silica SE-54, 30 meter x 0.25 mm) capable of resolving the PCB isomers utilizing the appropriate temperature programming.* The GC/ECD should be vented to a scrubber or exterior vent for safety reasons. A compatible integrator should be used which has the ability to accurately integrate capillary peaks.

* Resolution of the 209 possible isomers into 50 peaks is considered adequate for work of this nature.

9.5.2 Gas Chromatograph/Mass Spectrometer/Data System

The gas chromatograph/mass spectrometer (GC/MS) should be equipped with a capillary column capable of resolving the PCB isomers. The MS system will have the capability of both total ion monitoring, as well as selective ion monitoring up to mass number 500.

9.5.3 Glassware

9.5.3.1 Soxhlet Extractors. Used for the extraction of the XAD-2[®] and Florisil[®] adsorbents. Select the proper size Soxhlet to accommodate the volume of adsorbent.

9.5.3.2 Kuderna-Danish Evaporator. Used to reduce the volume of solvent.

9.5.3.3 Separatory Funnel. Equipped with a Teflon[®] stopcock used for extraction of impinger solutions.

9.5.3.4 Miscellaneous Volumetric Glassware. Used for determining the volume of solvent.

9.5.4 pH Meter

A pH meter equipped with appropriate glass and reference electrodes for measuring the pH of the collected samples.

9.5.5 Glass Wool

Cleaned by thorough rinsing with hexane, dried in an oven at 110°C, and stored in a hexane-washed glass jar with TFE-lined screw caps.

9.6 REAGENTS AND CHEMICALS

9.6.1 Solvents

Pesticide quality, Burdick and Jackson "Distilled in Glass" or equivalent, stored in original containers. A blank must be screened by the analytical detection method.

9.6.1.1 Acetone.

9.6.1.2 Hexane.

9.6.2 Chemicals

9.6.2.1 Sodium Sulfate. Used for removing water from organic solvents before concentration step. Prepare by thoroughly rinsing with hexane and drying at 110°C overnight before use.

9.7 PROCEDURE

9.7.1 Cleaning Glassware

All glassware shall be cleaned by the following procedure as described in Section 3A of the 1980 issue of "Manual of Analytical Methods for Analysis of Pesticide Residues in Human and Environmental Samples". See Appendix I for details.

1. Removal of surface residuals immediately after use.
2. Hot soak to loosen and float most of residue.
3. Hot water rinse to flush away loosened residue.
4. Soak with deep penetrant or oxidizing agent to destroy traces of organic material.
5. Hot water rinse to flush away materials loosened by deep penetrant soak.
6. Distilled water rinse to remove metallic deposits left by the tap water.
7. Acetone rinse to flush off any final traces of organic material.
8. A preliminary flush of the glassware just before using with the same solvent to be used in the analysis.

9.7.2 Sample Preparation

9.7.2.1 Container No. 1. (Contents of 1st three impingers.) Note the physical properties of the sample as to color, consistency, presence of solids, and measure the volume and the pH. The sample will be spiked for QC purposes with the internal standard, tribromobiphenyl. Without adjusting the sample pH, transfer the impinger solutions to a 1,000 mL separatory funnel. Rinse the sample container with 20 mL of acetone, followed by two 20 mL portions of hexane, adding the rinses to the separatory funnel. Extract the sample with 3 separate 100 mL aliquots of hexane. Transfer the resulting extract into a Kuderna-Danish (K-D) evaporator first filtering through pre-extracted, dried Na_2SO_4 . The volume is reduced to the necessary level and then brought up to a known volume (i.e. 1 mL). Analyze the sample by the methods discussed in Section 9.7.3.

9.7.2.2 Container No. 2. (Hexane, acetone rinse of probe, filter holder, any Teflon[®] transfer line, impingers, and any miscellaneous glassware.) Note the physical properties of the sample as to color, consistency, presence of solids, and measure the volume. The original solvent sample will be spiked for QC purposes with the internal standard tribromobiphenyl. Proceed with the concentration step as described in Section 9.7.2.1. Analyze the sample by the methods discussed in Section 9.7.3.

9.7.2.3 Container No. 3. (Contents of 4th and 5th impingers and water rinses.) Note the physical properties of the sample as to color, consistency, presence of solids, and measure the volume and the pH. The samples will be spiked for QC purposes, with the internal standard tribromobiphenyl. Hold this sample in reserve for analysis, if required, at a later date. If sample preparation and analysis are required, proceed as outlined in Section 9.7.2.1. Store the sample in the dark at sub-ambient temperatures.

9.7.2.4 Florisorb and XAD-2[®] Adsorbent. Observe and note the physical properties of the sample. The samples will be spiked with tribromobiphenyl directly into the adsorbents before being removed from the glass sorbent trap. Expel the entire contents of the sorbent trap into a glass extraction thimble with a coarse-fritted bottom. The Florisorb[®] and XAD-2[®] are extracted separately.

Cover the resin in the thimble with glass wool (or an equivalent device) to prevent the resin from floating out into the Soxhlet. If the resin is "wet" from the condensation of water, the resin should be packed loosely in the thimble to allow it to float, but remain confined to the thimble.

Rinse the sorbent trap with 10 mL acetone and then three 10 mL portions hexane, and put these rinses into the receiver. Assemble the Soxhlet extractor after charging with 250 mL hexane. Extract for 20 hours with a cycle time of 10 to 14 times per hour. If a water layer is present, it needs to be removed before proceeding.

Transfer the resulting extract into a K-D evaporator. Proceed with the concentration step as described in Section 9.7.2.1. Analyze the sample by the methods discussed in Section 9.7.3.

9.7.2.5 Particulate Filter. Place the particulate filter in the Soxhlet with the Florisil® for extraction.

9.7.2.6 Raw Waste. Note the physical properties of the raw waste. A known volume of the PCB oil waste is appropriately diluted with hexane to bring the concentration of PCB's into the working range of the standards used for the analyses. A portion of the diluted raw waste can be subjected to a cleanup procedure, if necessary, before analysis by GC/MS. This cleanup can be performed utilizing Florisil® column chromatography to remove polar compounds (Reference 2). The sludge samples will be prepared in the same manner as described in Section 9.7.2.4.

9.7.2.7 Process Samples. (Scrubber water and incinerator ash.) The scrubber water and ash samples will be prepared as described in Section 9.7.2.1 and 9.7.2.4, respectively.

9.7.2.8 Sample Analysis Priorities. Samples may be analyzed individually or combined into a single sample depending upon the overall information desired and the levels of PCB's expected.

9.7.3 Analysis

9.7.3.1 GC/ECD Analysis. This method uses a temperature programmable GC equipped with a suitable detector such as an electron capture or Hall®, and fitted with a capillary column. Data will be acquire on a data system which has the capability of processing capillary peaks. Standards will be comprised of various Aroclors, as well as individual isomers.

9.7.3.1.1 Interferences. The specificity of the detector and the high resolution of the capillary column minimize the potential interferences.

9.7.3.1.2 Sample extraction. Sample extractions will be performed using distilled-in-glass hexane (Burdick and Jackson) or equivalent. Samples should be concentrated to 1.0 mL using a K-D evaporator. Additional concentration down to 0.1 mL may be performed if necessary.

9.7.3.1.3 Sample cleanup. It may be possible to analyze the extracted samples directly or diluted without further cleanup. The analysis itself should be the criterion for determining the need for further cleanup. If cleanup is required, use the Florisil method as described in Reference 2.

9.7.3.1.4 GC conditions. Use a glass capillary column such as a fused silica (SE-54, 30 meter x 0.25-mm I.D.) to achieve the necessary compound resolution. The temperature program selected should be one that gives the best possible resolution of compounds (for example, 100°C to 270°C at 3°/min., holding at 270° until all peaks elute). The injector and detector temperatures should be greater than the highest temperature achieved in the temperature program. A 1 to 5 µL sample size injection is made dependent on the sample concentration. Pure nitrogen or other suitable carrier gas should be used. The use of an oxygen scavenger on the carrier is recommended. It is recommended that similar columns will be used for the GC/ECD analyses and for the GC/MS analyses.

9.7.3.1.5 Qualitative identification of PCB's. Selected samples and diluted raw waste will be initially screened by GC/ECD and GC/MS to determine the number and intensity of potential PCB peaks. Selected Aroclor mixes and individual PCB isomer standards will be prepared and analyzed by GC/ECD to tentatively identify the observed peaks by retention time. Confirmation by GC/MS using a similar column will be performed.

9.7.3.1.6 Quantitative measurement of PCB isomers. Once the individual isomers have been confirmed, a calibration curve and response factors will be developed. If necessary, the sample will be diluted to bring the concentration level into the range of the standards. The concentration of a particular isomer will be determined by comparing the area counts of the unknown to those of the standard.

9.7.3.1.7 Detection limit. The minimum detectable limit is 50 pg per µL injected sample.

9.7.3.2 GC/MS Analysis. The method (References 3, 5) is designed primarily to address the problem of measurement of PCB emissions from combustion sources.

The method uses a gas chromatograph/mass spectrometer automated to acquire data in a select subset of masses and integrated according to gas chromatographic retention time criteria. Data are reported as quantity of monochloro-, dichloro-.....decachlorobiphenyl.

9.7.3.2.1 Interferences. Interferences in the PCB analysis are minimized with this procedure. Isotope abundance patterns are used to

verify the composition as a PCB. Selected mass chromatograms and retention time windows provide a high degree of specificity in the analysis of a specie as a PCB.

9.7.3.2.2 Sample extraction. Sample extractions should be done using distilled-in-glass hexane (Burdick and Jackson). Samples should be concentrated to 1.0 mL using a Kuderna-Danish evaporator. If necessary to achieve a minimum detectable quantity, samples may be further reduced in volume.

9.7.3.2.3 Sample cleanup. It may be possible to analyze the extracted samples directly without further cleanup. The analysis itself should be the criteria for determining the need for further cleanup as described for the Standard EPA Method For PCB's In Industrial Effluents (Reference 2). If cleanup is required, use the Florisil/silica gel procedures described in the EPA method.

9.7.3.2.4 GC conditions. Use a 30 meter x 0.25 mm I.D. fused silica capillary column containing any of several phases. Appropriate phases such as SE-54[®] and DB-5[®] (0.25-micron film) are acceptable and have been used successfully for PCB analysis. A temperature program at 3°C per minute from 100°C to 270°C (hold for 20 minutes) has been demonstrated to produce adequate separation and repeatability from run to run. A 1 to 5 µL sample size injection is made dependent on the concentration in the sample. The GC gas stream is diverted initially, allowing the solvent (hexane) to elute and be vented, and then the diverter is closed and data acquisition initiated.

9.7.3.2.5 GC/MS conditions. Exact conditions will depend on spectrometer type and condition. Care should be taken to calibrate the mass scale to accommodate the significant mass defect of the PCB's. It is recommended that an Aroclor mixture be used to construct an alternate mass calibration scale for the PCB analysis. Set the mass ranges for data acquisition as follows:

<u>PCB Group</u>	<u>Mass Range</u>	<u>Analytical m/e</u>
Cl ₁	186 - 190	188
Cl ₂	200 - 226	224
Cl ₃	254 - 260	258
Cl ₄	288 - 294	292
Cl ₅	322 - 328	326
Cl ₆	356 - 364	362
Cl ₇	392 - 400	394
Cl ₈	426 - 434	428
Cl ₉	460 - 468	464
Cl ₁₀	494 - 504	498

Because of the expected complex nature of the waste samples, gas chromatographic separations will be effected with high efficiency fused silica capillary columns. Mass spectral observation, confirmation, and quantitation of PCB's (and other materials if desired) will employ a sequence of limited mass range scans encompassing the principal ions of interest. Regions of the chromatograms designated for specific PCB observation will be defined with modified Kovat's indices, and/or specific PCB isomers. Quantitation will be accomplished against a spiked internal standard using relative response factors measured against individual PCB isomers.

For example, Relative Molar Response Factors (RMRF) are determined for each chlorine isomer group (i.e., mono, di, tri...chloro PCB's) relative to Tribromobiphenyl (TBB). The low mass ion (LMI) for the TBB (m/z 388) was monitored along with the LMI's for each chloro group in a given sample. The quantitative calculations were then performed in the following way.

For Cl₁ isomers,

(Area counts for the LMI of TBB) x (RMRF for Cl₁ isomers) = counts/p mole

then,

$$\frac{(\text{Total area counts for LMI of Cl}_1 \text{ isomers})}{\text{Counts per } \mu\text{ mole}} \times$$

Molecular weight of Cl₁ isomer = pg/ μ L.

$2100 \times 3.37 = 7,077$ counts/p mole.

$\frac{999}{7,077} = 0.14$ p mole for 2 μ L injection $\times 188 = 13.2$ pg/ μ L.

13.2 pg/ μ L $\times 4$ mL total sample = 53.1 ng total for Cl₁ isomers.

Upon quantitation of the mono- through deca-chlorobiphenyls in the input wastes and the collected emission samples, DRE's will be calculated per isomer group.

An overall DRE may be calculated by summing the mono- through deca-chlorobiphenyls in the input waste and comparing with the same run for the collected samples.

9.7.3.2.7 Qualitative identification of PCB's. A total ion chromatogram is constructed from the sum of all the masses used in data acquisition. Individual mass spectra are obtained at GC peak maxima. These spectra are examined to determine whether the proper isotope abundance patterns are present for the given chlorobiphenyl group.

9.7.3.2.8 Quantitative measurement of PCB groups. When the species have been confirmed as PCB's, individual mass chromatograms are obtained for the analytical masses corresponding to the PCB groups, 188, 224, --- 498. An Aroclor sample such as Aroclor 1232 and Aroclor 1254 is used to establish a relative retention time (RRT) scale using the data given by Webb and McCall (Reference 4). The area for each PCB group is integrated over the RRT regions indicated below:

<u>PCB Group</u>	<u>Analytical m/e</u>	<u>RRT Region</u>
Cl ₁	188	0(5) - 20
Cl ₂	224	15 - 35
Cl ₃	258	25 - 55
Cl ₄	292	40 - 100
Cl ₅	326	70 - 150
Cl ₆	363	125 - 250
Cl ₇	394	160 - 350
Cl ₈	428	275 - 600
Cl ₉	464	400 -1000
Cl ₁₀	498	650 -1200

The RRT windows may need to be adjusted slightly for proper measurement of total areas. Use of these windows minimizes interferences from other PCB's groups.

9.7.3.2.9 Detection limit. The detection limit of this method is expected to be in the range of 50 to 200 pg/ μ L per individual isomer injected (Reference 3).

9.7.4 Quality Assurance/Quality Control

9.7.4.1 QC. All glassware will be cleaned before each sample by cleaning by the prescribed method given in Section 9.7.1. Soxhlet extractors will then be charged with hexane, assembled, and extracted for two hours. The hexane is concentrated in a K-D and analyzed for PCB's.

All samples for PCB analysis will be spiked before extraction with the appropriate internal standard, tribromobiphenyl. All samples for dioxin and furan analysis will be spiked before extraction with the appropriate isomers as determined by UNL and indicated in Appendix H of reference 6.

Every sixth PCB sample will be a QC sample containing an internal standard. A hexane "blank" will be run every seventh sample. An additional "blank" will be run following any highly concentrated samples to demonstrate the absence of "memory effects" for subsequent analyses.

Duplicate sample analyses will be performed once daily, or at a minimum of once every 10 samples.

9.7.4.2 QA. QA samples may be submitted for analysis from an external, independant source at the request of the EPA Project Officer.

10. DATA ANALYSIS, VALIDATION AND REPORTING

The data reduction procedures to be used in calculating the concentration or value of all measured parameters in this program are required as part of the procedural write-up. However, it must be recognized that the final information to be derived from such data is dependent upon a complex sequence of data flows, beginning at the site sampling/measurement activity and terminating only after a final review of all data from various laboratories (including subcontracting laboratories) has been completed. The quality of the final information cannot usually be altered by repeat testing in the final stages of data review. An ultimate removal of outlying data, while improving the accuracy and validity of the data base, reduces the data completeness, sometimes below acceptable limits. It is therefore highly important that early data reviews be made in the data scheme so that timely corrective measures can be taken.

The approach taken in this program to maintain quality consists of implementing timely data reviews at the data generation source whenever possible.

10.1 FIELD DATA QUALITY REVIEWS

	<u>Objective</u>	<u>Action</u>	<u>Responsible Person</u>
1.	Sample and process information conforms to conditions and schedule in Section 6	Review of labeled samples and in-process samples using daily sample inventory	Sample Custodian
2.	Verify incoming data and sample completeness	Daily count of incomplete items	Sample Custodian

<u>Objective</u>	<u>Action</u>	<u>Responsible Person</u>
3. Verify completeness of field notebooks	Review Daily	Test Systems Site Manager
	Calibration criteria reviewed and test calibration acceptance recorded	Site Chemist
4. All data forms are completely filled out	Review and check off during each test. Forms provided by supervisor with non-required entries marked	Site Chemist

10.2 LABORATORY DATA QUALITY REVIEWS

<u>Objective</u>	<u>Action</u>	<u>Responsible Person</u>
1. Verify incoming data and sample completeness	Daily count of number and nature of samples received versus number and nature of entries made in log. Mark verified on log	Sample Custodian
2. Verify all data forms completed	Review and check off during each test. Forms provided by supervisor with non-required entries marked out.	Technician
3. Manual data reduction procedures	Daily review sample rank of calculated values against sample rank of raw data values. Rank to be the same.	Technician
4. Computer data reduction procedures	After daily set up, verify retrievability of data in memory. Check off in calibration log.	Technician
5. Verify completeness of field notebooks	Review Weekly	Laboratory Manager
	Calibration criteria in method reviewed and test calibration acceptance recorded.	Laboratory Chemist
	Record values of replicate analyses	Laboratory Chemist

10.3 ENGINEERING DATA QUALITY REVIEWS

<u>Objective</u>	<u>Action</u>	<u>Responsible Person</u>
1. Assure completeness of field and lab data.	Compare field and lab data forms against data list at each use and check off	Project Manager
2. Assure comparability of units	Review units reported for consistency in calculations at each use and check off.	Project Manager
3. Examine engineering validity of data	Review process parameter extremes and transients versus data gathering times. Document any data excluded on this basis.	Project Manager
4. Examination of statistical data homogeneity	Apply outlier tests to data groupings to be used. Record data and test results.	Project Manager

This review is also accomplished on a spot check basis by the Field Sampling Leader and the Project Manager. This review refers to the final data assessment step.

10.4 DATA BASE OUTLIER REVIEW

Three kinds of outlier reviews will be made during the engineer review in this program:

1. Values reported by data gatherer as associated with an atypical circumstance. Engineering judgement of the effect of the recorded anomaly on the datum will be made. The datum will be rejected if the magnitude and direction of the anomaly, compared to known effects, is sufficient to exceed the factor of 2 reproducibility, $CV_2 = .63$ (Section 14).
2. Values identified by data reviewer as nonrepresentative of the generalized circumstance being assessed. Process data reviews will be used to establish a nonrepresentative condition if present. One kind of nonrepresentative data would be data obtained during a controlled condition test phase in which the controlled condition did not comply with the specifications called for in the test plan.

Data obtained during non-normal test conditions may be acceptable and representative so long as the test and process conditions are known.

Representativeness expresses the degree to which data accurately and precisely typifies a characteristic of a population, parameter variations at a sampling point, a process condition, or environmental condition.

3. Values identified by inspection of results to be possible statistical outliers. The Dixon outlier test (see Section 14) will be applied to suspect data points at the 5 percent significance level. Data strongly suggestive of belonging to a logarithmic normal distribution rather than a normal distribution will be transformed to their logarithm before applying the test. A log normal distribution is suggested when the standard deviation(s) of the measurements varies with the mean value, (\bar{x}) , such that the coefficient of variation, s/\bar{x} , is constant. In this instance, two groups of data may be suspected, rather than an outlier to a single group. All outlier usage will be reported with the final data.

10.5 QUALITY MEASUREMENT

The quality of data analysis, validation, and reporting in this program will be maintained by early personnel indoctrination, review of technical understanding by the QA office, the provision for data forms to be encountered at various steps of the data gathering processes as part of the test plan, and by the examinations provided in Sections 10.1, 10.2, and 10.3 done by data processors at various levels. Experience has shown that many of the errors introduced into the data during recording and data reduction procedures are detected by subsequent checking; however, in some instances correction is made impossible by time lapses or sheer quantity of raw data sheets which would have to be searched. The major quality effect in such instances is then a decrease in completeness of the data.

The completeness check indicated for the field and laboratory custodian and for the engineering data processors in Sections 10.1, 10.2, and 10.3 will provide interim check points for preventing such

completeness lapses. The check is performed and recorded by the person receiving the transfer of information from a previous step.

10.6 LABORATORY DATA SYSTEM

This wide range of analytical activity in this project will produce a large and equally diverse amount of data. TRW has acquired a laboratory data system capable of storing, analyzing, and graphically presenting data of this nature. The data system consists of three components; (1) a Varian Vista-401 dedicated chromatography data system, (2) a microprocessor based computer system, and (3) a Hewlett-Packard 5985A Gas Chromatography/Mass Spectrometry/Computer System (see Figure 10-1).

The Vista-401 Data System, as configured in TRW's Eastern Operations laboratory, consists of a 68K microprocessor based data acquisition system capable of simultaneously monitoring four chromatographic channels, two dual channel printer/plotter units, and 200K of on-line floppy diskette storage. Analysis methods can be programmed into this system, stored in main memory or on diskette, and be used to monitor any of the four data channels. The Vista-401 is capable of plotting, on the fly, chromatograms from any or all of the data channels, and archiving this data in its complete form on diskette storage for later analysis. Post-run calculations, including peak area integration and retention time assignment, can be performed on data stored either in main memory or on diskette. All information concerning sample identification, analysis conditions, and results of post-run calculations is automatically documented upon completion of each analysis. The laboratory microcomputer is connected to the data acquisition system through a standard RS-232 serial interface which enables the transfer of raw chromatographic data and processed post-run reports from the Vista-401 to the microcomputer.

The laboratory microcomputer system consists of a 64K eight bit Apple microprocessor, 340K of online floppy diskette storage, a high speed printer, and a digital X-Y Plotter. This general purpose computer system greatly extends the range of data analysis capabilities available to the analyst. Computer programs have been written for linear regression analysis, statistical calculations, sample log-in and analysis

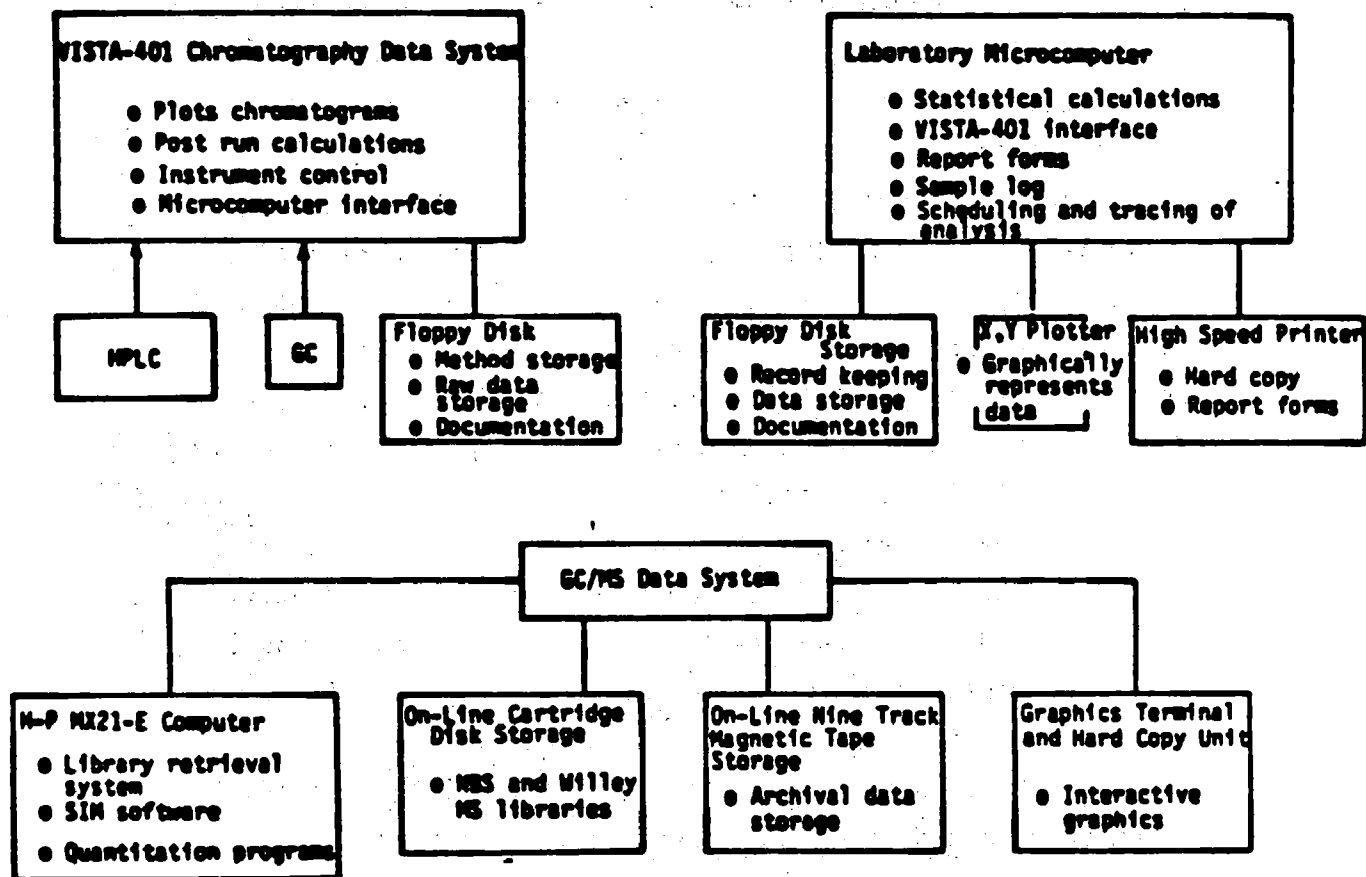
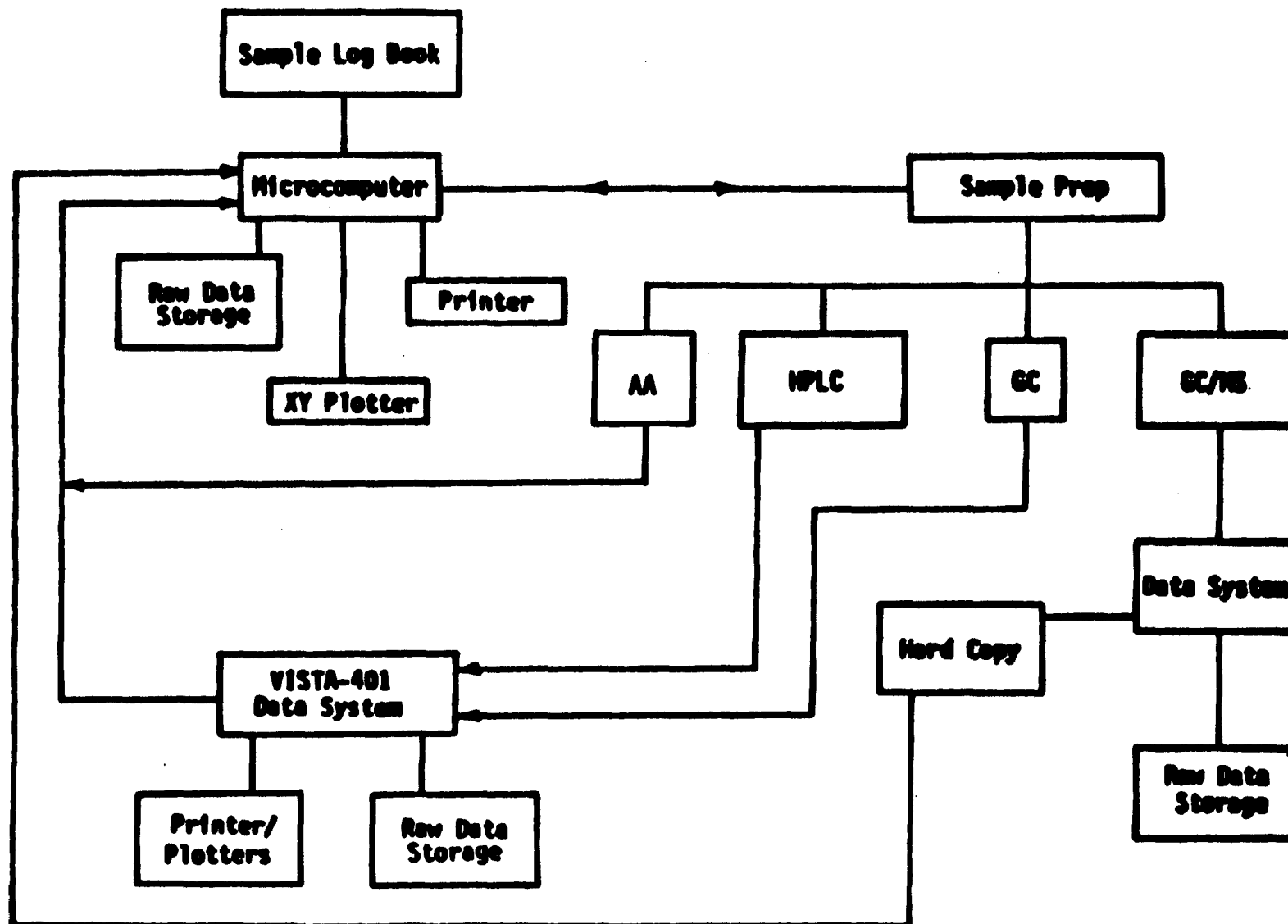


Figure 10-1. Data reduction and validation.

tracking, data report generation, and graphical presentation of QC charts, calibration curves, and project resource allocation charts.

The GC/MS/Computer system consists of a 32K, sixteen bit minicomputer, 20 megabyte of online cartridge disk storage, nine track magnetic tape storage, and a graphics terminal. Computer software is provided for the collection, storage, graphical presentation, and identification of data from either direct probe/MS or GC/MS analysis. Both the NBS and Wiley Mass Spectral Libraries are stored on cartridge disk for library retrieval search identification. The GC/MS data system allows data collection in either a selective ion monitoring or full scanning mode. All data collected is stored on-the-fly onto the cartridge disk, and can be transferred to magnetic tape for archival storage upon completion of the analysis.

The utilization of the laboratory data system is diagrammed in Figure 10-2. After a sample is entered in the laboratory sample log, the microcomputer assigns it a diskette master record file. The microcomputer then creates an analysis schedule for the sample, storing the projected completion dates of each assignment in the sample record file. Analysis assignment forms are then generated using the high speed printer, and the sample is routed to the appropriate instrument. Upon completion of each analysis, the status of the schedule of analyses is updated, new analysis assignment forms are printed out, and the sample is sent to the next instrument. Data from HPLC and GC analyses are acquired by the Vista-401 system, plotted, stored on floppy diskette, and transmitted to the microcomputer. Mass spectrographic data are collected by the GC/MS data system, stored in real time on cartridge disk, archived on magnetic tape, and encoded by the analyst into the microcomputer. Data from the atomic absorption spectrophotometer are manually fed into the microcomputer. The physical storage location of all data (including that on magnetic tape, cartridge disk, floppy diskette, and all chromatograms and X-Y Plotter graphs) is entered into the master record file for each sample. In this manner, the exact status of each analysis for any sample and the storage location of all of its data will be instantly available by querying the memory through the microcomputer console.



- 1) Sample logged into Master log book and computer according to analyses.
- 2) Computer tracks types of analyses performed and status.
- 3) HPLC and GC analyses in VISTA-401
- 4) VISTA-401 interfaces with computer.
- 5) GC/MS results transferred to microcomputer.
- 6) XY plotter graphically presents data.

Figure 10-2. Data flow and sample scheduling.

Once the data have been input to the microcomputer, the appropriate computer programs are implemented for the reduction of the data to the final report format. These results are then output on the high speed printer or X-Y Plotter.

10.7 DATA ANALYSIS AND VALIDATION

The reliability and acceptability of environmental analytical information depends upon the rigorous completion of all the requirements outlined in the QA/QC protocol. The elimination of any one step without a valid reason could easily jeopardize the entire testing program. Data analysis and validation is the process whereby data are filtered and accepted or rejected based on a set of criteria. This involves a critical review of a body of data in order to locate and isolate spurious values. It may involve only a cursory scan to detect extreme values or a detailed evaluation requiring the use of a computer. In either case, when a spurious value is located it is not immediately rejected. Each questionable value must be checked for validity. A comprehensive record of all questionable data, whether rejected or not, will be maintained along with rejection criteria and any possible explanation for their being questioned. A detailed approach such as this can be time consuming, but can also be helpful in identifying sources of error, and in the long run, save time by reducing the number of outliers.

Prior to any statistical approach, the reported data will be checked to ensure that it was accurately transcribed. Often times hard copies of raw data are not available directly from a measuring device. Here, the values must be accurately and legibly recorded. A quick double check of the value and a comparison to previously recorded data will be performed. Additionally, the use of prepared data recording forms conveniently formatted and bound is essential. Hard copies of data can also be obtained directly from measuring devices which are equipped with the necessary digital recording peripheral. Usually, this method of recording data is sufficient if the hard copies are properly labeled and filed. However, periodic checks will be performed to ensure the proper operation of such a device.

The collected data will be reviewed at a minimum by the analyst, his superior, and the QC coordinator. The data will be scrutinized at

least daily to eliminate the collection of invalid data should the measuring devices not be operating properly. The analyst will not hesitate to record any unusual instances (no matter how minor) in the daily cycles (such as power loss or fluctuations, temporary leaks or adjustments, or operator error).

Once the data have been confidently recorded and logically formatted, at least two working copies will be made. The original shall be stored by the program manager. The data can now be statistically validated either manually or by computer. In either case, the criteria applied to the data will depend on the individual measurement processes and the ultimate purpose of measurement. Confidence in the accuracy of analytical results and improvements in analytical precision is established by identification of the determinate sources of error. Precision is governed by the indeterminate error inherent in the procedures, and can be estimated by statistical techniques. To ensure the accuracy of a result, the quality control procedure must be without bias. Techniques have been developed for the elimination of bias.

Statistical data analysis control involves application of the laws of probability. This technique is employed to detect and separate assignable (determinate) from random (indeterminate) causes of variation. "Statistics" is the science of uncertainty. Any conclusions based on statistical inference contain varying degrees of uncertainty, which are expressed in terms of probability. Uncertainty can be qualified in terms of well defined statistical probability distributions. These probability distributions can be applied direct to quality control. The application of statistical quality control can most efficiently indicate when a given procedure is in control. A continuing program that covers sampling, instrumentation, and overall analytical quality will assure the validity of the analytical program.

All analytical methods are subject to experimental errors. Determinate errors contribute constant error or bias whereas indeterminate ones produce random fluctuations in the data. The concepts of accuracy and precision as applied to the detection and control of error have been clearly defined and will be used exactly.

The terms "determinate" error, "assignable" error, and "systematic" error are synonymous. A determinate error contributes constant error or bias to results which may agree precisely among themselves. A method may be capable of reproducing results to a high degree of precision, but only a fraction of the component sought is recovered. A precise analysis may be inaccurate due to:

- a. inadequate standardization
- b. inaccurate volumetric measurements
- c. inaccurate balance weights
- d. improperly calibrated instruments
- e. personal bias (color estimation)
- f. consistent carelessness
- g. lack of knowledge
- h. calculation errors
- i. use of contaminated or improper reagents
- j. nonrepresentative sampling
- k. poorly calibrated standards of instruments.

Determinate errors may be additive (the error has a constant value regardless of the amount of the constituent sought in the sample) or proportional (the error changes magnitude according to the amount of constituent present in the sample). Generally, determinate errors have a direct identifiable source and can be detected by such procedures as the use of "spiked" samples, control charts, or differing sample sizes.

Even though all determinate errors are removed from a sampling or analytical procedure, replicate analyses will not produce identical results. This erratic variation arises from random error indeterminate error, and may have several sources, e.g.:

- a. variation in reagent addition
- b. instrument response
- c. line voltage transients
- d. physical measurement of volume and mass.

In environmental analysis the sample itself is subject to a great variety of variability. Although indeterminate errors appear to be random in nature, they do conform to the laws of chance; therefore statistical measurements of precision can be employed to quantitate their effects.

A measure of the degree of agreement (precision) among results can be ascertained by analyzing a given sample repeatedly under conditions controlled as closely as conditions permit. The range of these replicate results (difference between highest and lowest value) provides a measure of the indeterminate variations.

Indeterminate errors can be estimated by calculation of the standard deviation (σ) after determinate errors have been removed. When indeterminate or experimental errors occur in a random fashion, the observed results (x) will be distributed at random around the average or arithmetic mean (\bar{x}).

Another useful and necessary technique to aid in data validation is the analyses of duplicate samples. Duplicate analyses are employed for the determination and control of precision within the laboratory and between laboratories. The control chart technique is directly applicable, and appropriate control limits can be established by arbitrarily subgrouping the accumulated results or by using appropriate estimates of precision from an evaluation of the procedures.

The QA functions in the project for data assessment are shown in Figure 10-3 and consist of the following:

- Verification of the acceptability of the computation steps and calculation checks used in the analytical procedures, including any computer programs for processing raw data
- Statistical evaluation of comparisons between standards, replicates, spiked samples, and the routine analyses
- Records and trend analyses to identify potential QA problem areas in the assessment scheme
- Definition of data validation procedures for all measurement systems
- Provision for clear definition of various parameters, such as flow rates and calibration data
- Use of minimum detectable limits to evaluate trace data for appropriateness
- Examination of outliers immediately for possible cause, error, or interferences

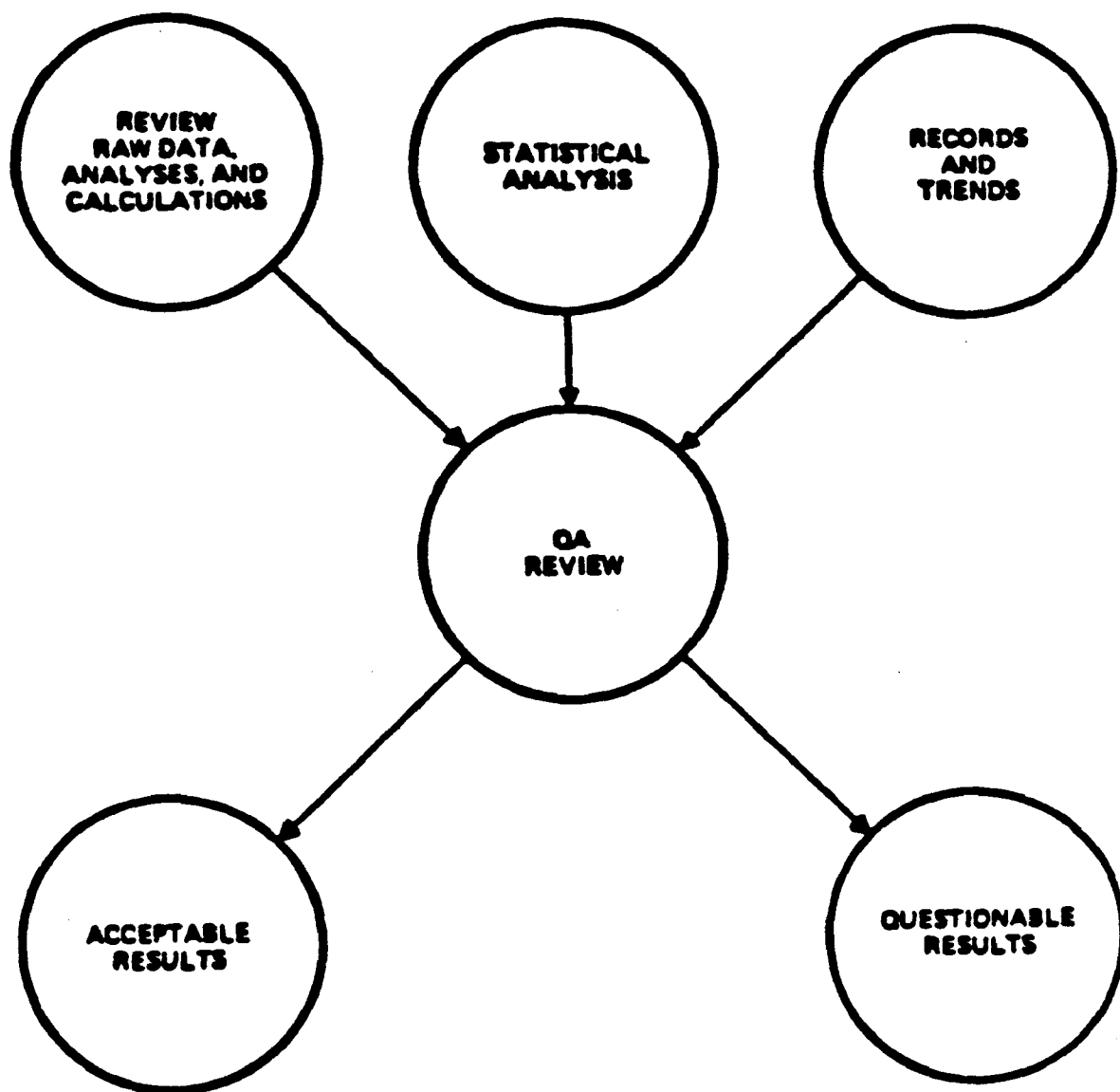


Figure 10-3. Activities for data quality validation and assessment.

- Concern with all rejected data and the cause or reason for rejection
- Relation between data and standard, replicates, and spikes
- Definition of a reporting scheme.

An important aspect of QA is the establishment of a mechanism for problem detection, reporting, and correction. It is vital that the problems encountered and corrective actions taken be thoroughly documented. Quality summary reports will be prepared and distributed to the project manager and appropriate levels of management. This report will address the following:

- Assessment of measurement data accuracy
- Results of system audits
- Significant quality problems and recommended solutions
- Names of persons responsible for corrective action
- Major milestones involving data quality.

In addition, these reports will serve as a basis for data quality reports to be supplied to the EPA.

The equations used to calculate values of measured parameters are available at the TRW laboratory. Data reduction programs for the gas chromatographs are stored in one of the computers and follows a standard peak area integration program.

Both the GC/MS and the GC/FID are Hewlett-Packard instruments and have their automatic internal integration devices which are generally accepted techniques. These methods along with calibrations and a routine daily tune up are used to validate the results from these instruments.

11. INTERNAL QUALITY CONTROL CHECKS

Leak checks will be the primary internal quality control on the sampling systems. Prior to and after each test, the leak check must be less than 0.02 cfm or 4% of the total sample volume, whichever is less.

Internal quality control checks in the laboratory analysis procedures consist of daily calibration checks and monitoring an internal standard tribromobiphenyl on each calibration check and on each sample. A multipoint calibration curve and response factors for PCB isomers will be developed. In order for the calibration to be valid, the regression coefficient must be greater than 0.90. The 95 percent confidence interval on an individual predicted y_0 (the response) for a given x_0 (the known concentration of the calibration standard) will be derived from the calibration data. Two calibration checks will be made daily covering the upper and lower ranges of concentration. The responses of these calibration checks must fall within the 95 percent confidence interval developed from the calibration data, or a new set of calibration standards must be made up, and a new calibration curve (and 95 percent confidence interval) derived.

12. PERFORMANCE AND SYSTEM AUDITS

The Program Manager and the Quality Assurance Officer for TRW will conduct performance and system audits on the records kept in the field and in the laboratory.

TRW will analyze external audit samples as appropriate if requested and approved by the EPA Project Officer.

13. PREVENTIVE MAINTENANCE

TRW's preventive maintenance program involves periodic assessment of all instrumentation and equipment being used. Instrument log books are kept by noting major repairs, modifications, and the next service date.

The following table provides a minimum schedule of maintenance.

<u>Item</u>	<u>Maintenance</u>	<u>Frequency</u>	<u>Documentation</u>
GC/FID	Full servicing	Quarterly, and as needed	Instrument log, tag
GC/TC	Full servicing	Quarterly, and as needed	Instrument log, tag
GC/ECD	Full servicing	Quarterly, and as needed	Instrument log, tag
GC/MS	Contract	Quarterly, and as needed	Instrument log
Field Meter Box	Full servicing	As needed	Calibration log

At the present time there are no spare parts that can be classified as critical or in short supply. Gas chromatographs require little preventive maintenance, but close attention to standards and quality control charts must be done to alert the analyst of problems. Instrument manuals and trained troubleshooters are on hand to resolve quickly any problems encountered. Capillary systems are evaluated initially and then periodically by injecting a standard test mixture to determine column efficiency, leaks, detector response, and injector function.

Gas chromatography/mass spectrometry systems at TRW are periodically maintained through a maintenance contract with the manufacturer

who performs a quarterly preventive maintenance call and checkout of the complete system and who is on-call within 48 hours as necessary. A log book is kept on all service calls, and also on the types of samples analyzed.

During field sampling a complete set of spare sampling equipment, glassware, and supplies will be available. Spare O₂ and CO/CO₂ monitors will be available. A complete Orsat[®] apparatus will serve as a spare for the GC/TC apparatus.

13.1 QUALITY MEASURES

Preventive maintenance will be reviewed by means of a weekly equipment downtime report to be provided to the quality office by the supervisor of each field or laboratory station. This report is required only in the event of equipment or test downtime. The report will include:

- the instrument identity,
- the nature of the problem,
- the required action,
- the percent downtime, and
- the reason for downtime.

The instrument is to be assumed available over the hours regularly scheduled for its usage, the downtime is to be considered the actual hours lost by the failure.

The report is only required in the event of inability to conduct the test because of lack of hardware, supplies or chemicals.

14. PROCEDURES USED TO ACCESS DATA PRECISION, ACCURACY, AND COMPLETENESS

The precision and accuracy of data must be routinely assessed on all environmental monitoring and measurement data. The specific procedures necessary to assess the quality of the data on a routine basis are discussed in the following paragraphs. Such routine statistical procedures applied to a great bulk and variety of samples can become quite cumbersome. To avoid this, an inhouse computer will be utilized to expedite the performance of statistical calculations. Standardized statistical program packages will be used to calculate any necessary parameters quickly and accurately, store and/or list previous values, and plot the data in the form of control charts.

The statistical techniques which best suit the needs of a given test procedure will be chosen to ensure the routine assessment of data precision, accuracy, and completeness. The following is a summary of examples of statistical techniques used in handling environmental measurement data which is in turn followed by an individual listing of each in more detail.

- Central tendency and dispersion
 - Arithmetic mean
 - Range
 - Standard deviation
 - Relative standard deviation
 - Geometric mean
- Measures of variability
 - Accuracy
 - Bias
 - Precision; within laboratory, between laboratories, and laboratory bias

- Significance test
 - u-test
 - t-test
 - F-test
 - Chi-square test
- Confidence limits
- Testing for outliers
- Control charts

14.1 CENTRAL TENDENCY AND DISPERSION

A. The Arithmetic Mean

The sum of all values in a measurement set (X_i), divided by the number of values summed (n), is the definition of the arithmetic mean, commonly called the "average." It is often denoted symbolically by a bar over the variable symbol, as " \bar{X} ".

$$\bar{X} = \sum_{i=1}^n X_i / n$$

B. Range

The difference between the maximum and minimum values of a set of values defines the range.

$$R = X_{\max} - X_{\min}$$

A rough indication of variability, particularly when the set of values is small (<10).

C. Standard Deviation

A standard deviation is an indication of the dispersion of a set of numbers about the mean value. Normal (and other) distributions are expressed as a function of the standard deviation.

For a given set of values, an equation to calculate s is:

$$s = \frac{\left(\sum_{i=1}^n x_i^2 - \frac{\left(\sum_{i=1}^n x_i \right)^2}{n} \right)^{\frac{1}{2}}}{n-1}$$

D. Relative Standard Deviation (RSD), or Coefficient of Variation (CV)

The dispersion of a set of values is expressed as a percentage of the mean.

$$\%RSD = (s/\bar{X}) \times 100$$

14.2 MEASURES OF VARIABILITY

A. Accuracy

Accuracy is defined in terms of the bias, B, which is the difference (either on an absolute or percentage basis) between a measured value and an assumed "true" value. The larger the difference, the lower the accuracy.

$$B = X - T, \text{ or}$$

$$\%B = \frac{X-T}{T} \cdot 100$$

B. Recovery

For spiked samples the recovery (REC) can be defined as a measure of accuracy as follows:

let c_0 = measured concentration analyzed in the sample without the addition of a spike, mg/kg

c^1 = concentration of a standard solution mg/L

v_{s_1} = volume of standard added to the sample for Spike No. 1, mL

c_1 = measured concentration analyzed in the sample after adding Spike No. 1, mg/kg

$$REC = \frac{c_1 - c_0}{(c^1 \times v_{s_1} \times 10^{-3})}$$

or on a percentage basis

$$\% REC = \frac{c_1 - c_0}{(c^1 \times v_{s_1} \times 10^{-3})} \times 100$$

Note that % Recovery would be related to % B, percent bias, as follows:

$$\% B = 100 - \% REC$$

C. Bias

Bias is a nonrandom measurement error: a consistent difference either between sets of results or between a measured value and a "true" value.

D. Precision

A measure of agreement among individual measurements of a variable, under identical or specified similar conditions. Precision may be expressed in several ways, and care must be exercised in the definition and use of precision measures.

One set of such measures* follows:

1. Within-laboratory: The within-laboratory standard deviation, s , measures the dispersion in replicate single determinations made by one laboratory team (same field operators, laboratory analyst, and equipment) sampling the same true concentration. This is also termed the repeatability.

* These definitions are taken from EPA collaborative test result publications, and are applied to the various federal reference sampling and analysis techniques.

2. **Between-laboratory:** The between-laboratory standard deviation, s_b , measures the total variability in a determination due to determinations by different laboratories sampling the same true concentration. The between-laboratory variance, s_b^2 , may be expressed as:

$$s_b^2 = s_L^2 + s^2$$

and consists of a within-laboratory variance plus a laboratory bias variance, s_L^2 (usually termed reproducibility).

Laboratory bias: The laboratory bias standard deviation,

$$s_L^2 = s_b^2 - s^2$$

is that portion of the total variability that can be attributed to differences in the field operators, analysts and instrumentation, and due to different manners of performance of procedural details left unspecified in a technique. This term measures that part of the total variability in a determination which results from the use of a technique by different laboratories, as well as from modifications in usage by a single laboratory over a period of time. The laboratory bias standard deviation is estimated from the within- and between-laboratory estimates previously obtained.

A corresponding set of relative standard deviations would be RSD_b , RSD_L . These are convenient to use if the precision is proportional to the mean value of the variable.

14.3 SIGNIFICANT TESTS

A. u-Test

This test measures the significance of individual values and experimentally estimated means where the normal population has a known mean and standard deviation.

$$u = \frac{X - \bar{X}}{s}$$

where

X = individual value being tested

\bar{X} = calculated mean of experimental results

s = calculated standard deviation of all data in population

u is a measure of the number of standard deviation units an individual data point is away from the mean, assuming normal distribution.

B. t-Test

If one has an assumed "true value," μ_0 , however obtained, the existence of a significant bias in other measurements of this value can be defined by as t-test:

$$t = \frac{\bar{d}}{s_d/\sqrt{n}}$$

where $\bar{d} = (\bar{x} - \mu_0)$

where

t = a parameter, the magnitude of which is referenced to tabulated values. A t -value which exceeds the tabulated value for given specifications of probability and number of degrees of freedom indicates the existence (within the definition of probability specified) of a significant bias. The more stringent the probability requirement; i.e., the smaller the probability chosen, the larger the tabulated t -value.

d = the average of the signed difference between the true value and the measured values; the average bias.

s_d = the standard deviation of the signed differences, d_i .

n = the number of measurements made.

C. F-Test

Fisher's F statistic is used in testing whether two sets of samples could have come from normally distributed populations having the same variance, σ^2 . The assumption involved in the test is that the samples are random and independent of one another and are selected from normally distributed populations. The first set has n_1 samples, and the second set has n_2 . The degrees of freedom are $v_1 = n_1 - 1$ and $v_2 = n_2 - 1$ for the two sets of samples. The statistic, F, is defined as

$$F \equiv \frac{s_1^2}{s_2^2}$$

and is distributed as Fisher's F with v_1 and v_2 degrees of freedom. If $F > F_{v_1, v_2, 1-\gamma/2}$ (with $s_1^2/s_2^2 > 1$), then the probability is $(1-\gamma)$ that the two sets of samples did not come from normally distributed populations having equal variances.

D. Chi-square test

If one has a reasonable estimate of the expected standard deviation of a set of measurements, the existence of a defined "excess variability" can be tested as follows:

$$\frac{\chi^2}{\phi} = \frac{s_d^2}{\sigma^2(x)}$$

where

χ^2/ϕ = a random variable with tabulated values ($\phi = n - 1$ = number of degrees of freedom).

$\sigma^2(x)$ = the expected variance of the measurements of x.

If χ^2/ϕ is larger than the chosen tabulated value (with specified probability), it is concluded that the measurements are exhibiting excess variability. The chi-square test is a measure of the validity of a series of measurements based on an "expected" variability. The test is worthwhile only whenever a measurement technique has been tested thoroughly, so that a realistic expectation can be estimated.

14.4 CONFIDENCE LIMITS OR INTERVALS

Confidence limits take two forms. One form for a mean or average value defines a numerical range within which one has a (arbitrarily chosen) probability of finding the true mean value of the measured variable. If the measurement variability is expressed as a standard deviation, the confidence limits as defined above can be calculated as follows:

$$CL = \bar{X} \pm ts/\sqrt{n}$$

where all symbols have been previously defined. Note that as the number of measurements, n , increase, the magnitude of CL decreases. Also, for higher probabilities of containing the true mean within CL, the larger the value of t and therefore the larger the size of CL.

The second form of confidence limit defines an interval within which the next individual measurement can be expected to fall with a given probability. The calculation of this limit, sometimes called a probability limit on a specified type of tolerance limit, is by the following relationship:

$$TL = \bar{X} \pm ts$$

While n , the number of measurements, does not explicitly appear in the equation for TL, it does determine (along with the selected probability) the value of t ; i.e., as n increases, t decreases.

14.4.1 Confidence Interval in Calibration Data (Linear Regression)

Calibration data most often consist of multiple values of the instrument response y_i for known values of concentration x_i . An equation $y = a + bx$ is sought so as to minimize the sum of squares of $(y_i - \hat{y}_i)$, where y_i are the experimental values of the response and \hat{y}_i are the calculated values of the response, i.e., $\hat{y}_i = a + bx_i$. This is the method of least squares and results in the calculation of a and b for a set of x_i, y_i data (where $i = 1, \dots, n$, the number of calibration data). The calibration curve is then

$$y = a + bx \tag{1}$$

The calibration data for $n = 5$ are

x_i	y_i
x_1	y_1
x_2	y_2
x_3	y_3
x_4	y_4
x_5	y_5

The method of least squares gives

$$a = \frac{\sum_{i=1}^n (y_i)/n - b \sum_{i=1}^n x_i/n}{1} \quad (2)$$

$$b = \frac{n \sum_{i=1}^n x_i y_i - \sum_{i=1}^n x_i \sum_{i=1}^n y_i}{n \sum_{i=1}^n x_i^2 - (\sum_{i=1}^n x_i)^2} \quad (3)$$

Other useful statistics are:

The residual mean square, s^2

$$s^2 = \left(\sum_{i=1}^n y_i^2 - a \sum_{i=1}^n y_i - b \sum_{i=1}^n x_i y_i \right) / (n-2) \quad (4)$$

The correlation coefficient

$$r = \frac{\sum_{i=1}^n (x_i - \bar{x})(y_i - \bar{y})}{\left[\sum_{i=1}^n (x_i - \bar{x})^2 \sum_{i=1}^n (y_i - \bar{y})^2 \right]^{1/2}} \quad (5)$$

$$r = \frac{n \sum_{i=1}^n x_i y_i - \left(\sum_{i=1}^n x_i \right) \left(\sum_{i=1}^n y_i \right)}{\left[\left(n \sum_{i=1}^n x_i^2 - \left(\sum_{i=1}^n x_i \right)^2 \right) \left(n \sum_{i=1}^n y_i^2 - \left(\sum_{i=1}^n y_i \right)^2 \right) \right]^{1/2}} \quad (6)$$

The confidence interval on an individual predicted y_0 , given x_0 is

$$a + bx_0 - t_{n-2, 1-\gamma/2} \left[1 + 1/n + \frac{(x_0 - \bar{x})^2}{\frac{n}{\sum_{i=1}^n (x_i - \bar{x})^2}} \right]^{\frac{1}{2}} s < y_0 < a + bx_0 + t_{n-2, 1-\gamma/2} \left[1 + 1/n + \frac{(x_0 - \bar{x})^2}{\frac{n}{\sum_{i=1}^n (x_i - \bar{x})^2}} \right]^{\frac{1}{2}} s$$

$t_{n-2, 1-\gamma/2}$ is the cumulative Student's t statistic having $n-2$ degrees of freedom and $(1-\gamma/2)$ level of significance. A 100 $(1-\gamma)$ percent confidence interval gives the following values for $t_{n-2, \gamma/2}$. Note that for the 95% confidence interval, $(1-\gamma/2) = 0.975$, and

n	$t_{n-2, 0.975}$
10	2.306
9	2.365
8	2.447
7	2.571
6	2.776
5	3.182
4	4.303
3	12.706

14.5 TESTING FOR OUTLIERS

An outlier is an extreme value, either high or low, which has questionable validity as a member of the measurement set with which it is associated.

Detection of outliers may be on one of the following basis:

- A known experimental aberration, such as an instrument failure or a technique inconsistency.
- A statistical test for significance, such as the Dixon ratio test. This test is described below.

The Dixon criteria is based entirely on ratios of differences between observations where it is desirable to avoid calculation of s or where quick judgment is called for. For the Dixon test, the sample criterion or statistic for various levels of significance are tabulated.

Table 14-1 presents selected significance (probability) levels for criteria over the n range 3 to 20. Note that the measurement values are first arranged in order of ascending magnitude: i.e., x_n is the largest value.

The ratios shown in Table 14-1 are used if the smallest value, x_1 , is the suspected outlier. If the calculated value of the ratio is greater than the appropriate maximum ratio in the table, then x_1 is declared an outlier. If the largest value, x_n , is the suspected outlier, then the appropriate ratios are shown below:

$n < 8$	$\frac{x_n - x_{n-1}}{x_n - x_1}$
$8 < n < 15$	$\frac{x_n - x_{n-2}}{x_n - x_2}$
$n \geq 15$	$\frac{x_n - x_{n-2}}{x_n - x_3}$

For this case, if the ratios calculated are greater than the appropriate maximum ratio shown in Table 14-1, then x_n is declared to be an outlier.

The control chart provides a tool for distinguishing the pattern of indeterminate (stable) variation from the determinate (assignable cause) variation. This technique displays the test data from a method in a form which graphically compares the variability of all test results with the average or expected variability of small groups of data - in effect, a graphical analysis of variance, and a comparison of the "within groups" variability versus the "between group" variability.

The data from a series of analytical trials can be plotted with the vertical scale in units of the test result and the horizontal scale in units of time or sequence of analyses. The average or mean value can be calculated and the spread (dispersion or range) can be established.

Table 14-1. MAXIMUM RATIO OF EXTREME RANKING OBSERVATIONS

Recommended for sample size	Rank difference ratio	Sample size, n	Maximum ratio		
			Probability level		
			0.10	0.05	0.01
n < 8	$\frac{x_2 - x_1}{x_n - x_1}$	3	0.886	0.941	0.988
		4	0.679	0.765	0.889
		5	0.557	0.642	0.780
		6	0.482	0.560	0.698
		7	0.434	0.507	0.637
8 < n < 15	$\frac{x_3 - x_1}{x_{n-1} - x_1}$	8	0.650	0.710	0.829
		9	0.594	0.657	0.776
		10	0.551	0.612	0.726
		11	0.517	0.576	0.679
		12	0.490	0.546	0.642
		13	0.467	0.521	0.615
		14	0.448	0.501	0.593
		15	0.472	0.525	0.616
n > 15	$\frac{x_3 - x_1}{x_{n-2} - x_1}$	16	0.454	0.507	0.595
		17	0.438	0.490	0.577
		18	0.424	0.475	0.561
		19	0.412	0.462	0.547
		20	0.401	0.450	0.535
$x_1 < x_2 < x_3 \dots < x_{n-2} < x_{n-1} < x_n$					

14.6 CONTROL CHARTS

A. Application and Limitations

In order for quality control to provide a means for separating the determinate from indeterminate sources of variation, the analytical method must clearly emphasize those details which should be controlled to minimize variability. A check list includes:

1. Sampling procedures
2. Preservation of the sample
3. Aliquoting methods
4. Dilution techniques
5. Chemical or physical separations and purifications
6. Instrumental procedures
7. Calculation and reporting results.

The next step to be considered is the application of control charts for evaluations and control of these unit operations. Decisions relative to the basis for construction of a chart are required.

1. Choose method of measurement
2. Select the objective
 - a. Precision or accuracy evaluation
 - b. Observe test results, or the range of results
 - c. Measurable quality characteristics
3. Select the variable to be measured (from the check list)
4. Basis of subgroup, if used:
 - a. Size

A minimum subgroup size of $n=4$ is frequently recommended. The change that small changes in the process average remain undetected decreases as the statistical sample size increases.
 - b. Frequency of subgroup sampling

Changes are detected more quickly as the sampling frequency is increased.

5. Control Limits

Control limits (CL) can be calculated, but judgment must be exercised in determining whether or not the value obtained satisfy criteria established for the method, i.e., does the deviation range fall within limits consistent with the solution or control of the problem. After the mean (\bar{X}) of the individual results (X) and the mean of the range (\bar{R}) of the replicate result differences (R) have been calculated, then CL can be calculated from data established for this purpose (Table 14-2).

$$\text{Grand Mean } (\bar{\bar{X}}) = \bar{X}/k$$

$$\text{CL's on Mean} = \bar{\bar{X}} \pm A_2$$

$$\text{Range } (\bar{R}) = \Sigma R/k \text{ or } d_2\sigma$$

$$\text{Upper Control Limit (UCL) on Range} = D_4\bar{R}$$

$$\text{Lower Control Limit (LCL) on Range} = D_3\bar{R}$$

Where: k =number of subgroups, A_2 , D_4 and D_3 are obtained from Table 4, R may be calculated directly from the data, or from the standard deviation (σ) using factor d_2 . The lower control limit for R is zero when $n \leq 6$.

The calculated CL's include approximately the entire data under "in control" conditions, and therefore are equivalent to $\pm 3\sigma$ limits which are commonly used in place of the more laborious calculation. Warning lights (WL) set at $\pm 2\sigma$ limits (95%) of the normal distribution serve a very useful function in quality control. The upper warning limit (UWL) can be calculated by:

$$\text{UWL} = \bar{R} + 2\sigma_R$$

$$\text{UWL} = \bar{R} = 2/3 D_4\bar{R} - \bar{R}$$

Table 14-2. FACTORS FOR COMPUTING CONTROL CHART LINES

Observations in subgroup (n)	Factor A_2	Factor d_2	Factor D_4	Factor D_3
2	1.88	1.13	3.27	0
3	1.02	1.69	2.58	0
4	0.73	2.06	2.28	0
5	0.58	2.33	2.12	0
6	0.48	2.53	2.00	0
7	0.42	2.70	1.92	0.08
8	0.37	2.85	1.86	0.14

Where the subgrouping is $n = 2$, UWL reduces to

$$UWL = 2.51 \bar{R}.$$

B. Construction of Control Charts

1. Precision Control Charts

The use of range (R) in place of standard deviation (σ) is justified for limited sets of data $n \leq 10$ since R is approximately as efficient and is easier to calculate. The average range (\bar{R}) can be calculated from accumulated results, or from a known or selected σ ($d_2\sigma$). $LCL_R = 0$ when $n \leq 6$. (LCL = lower control limit.)

The steps employed in the construction of a precision control chart for an automatic analyzer illustrates the technique:

- a) Calculate R for each set of side-by-side duplicate analyses of identical aliquots.
- b) Calculate \bar{R} from the sum of R value divided by the number (n) of sets of duplicates.
- c) Calculate the upper control limit (UCL_R) for the range:

$$UCL_R = D_4 \bar{R}$$

Since the analyses are in duplicates, $D_4 = 3.27$ (from Table 14-2).

- d) Calculate the upper warning limit (UWL):

$$UWL_R = \bar{R} + 2\sigma_R = \bar{R} \pm 2/3 (D_4 \bar{R}) = 2.51 \bar{R}$$

(D_4 from Table 1) which corresponds to the 95% confidence limits.

- e) Chart \bar{R} , UWL_R and UCL_R on an appropriate scale which will permit addition of new results as obtained.
- f) Plot results (R) and take action on out-of-control points.

2. Accuracy Control Charts -- Mean or Nominal Value Basis

\bar{X} charts simplify and render more exact the calculation of CL since the distribution of data which conforms to the normal curve can be completely specific by \bar{X} and σ . Stepwise construction of an accuracy

control chart for the automatic analyzer based on duplicate sets of results obtained from consecutive analysis if known serves as an example:

- a) Calculate \bar{X} for each duplicate set.
- b) Group the \bar{X} values into a consistent reference scale (in groups by orders of magnitude for the full range of known concentrations).
- c) Calculate the UCL and lower control limit (LCL) by the equation.

$$CL = \pm A_2 \bar{R} \quad (A_2 \text{ from Table 4})$$

- d) Calculate the Warning Limit (WL) by the equation:

$$WL = \pm 2/3 A_2 \bar{R}$$

- e) Chart CL's and WL's on each side of the standard which is set at zero as shown in Figure 12 and Table 6.
- f) Plot the difference between the nominal value and \bar{X} and take action on points which fall outside of the control limits.

14.7 PRECISION

This section provides the basis for the quantitative limits used to control the precision. Sections that follow address accuracy, and completeness of the data and the compliance with test procedures generated for this project. The primary measurement of data precision is the percentage Relative Standard Deviation, or the percentage Coefficient of Variation,

$$\%RSD \equiv \frac{s}{\bar{X}} \cdot 100, \text{ where}$$

the estimated standard deviation,

$$s = \sqrt{\sum_{i=1}^n \left[\frac{(X_i - \bar{X})^2}{n - 1} \right]}, \text{ and}$$

the estimated mean,

$$\bar{X} \equiv \sum_{i=1}^n \left[\frac{X_i}{n} \right].$$

Additional measures of precision will be calculated for the duplicate samples.

Where X_1 and X_2 are any measurement taken on duplicate samples 1 and 2,

$$\bar{x} = (X_1 + X_2)/2$$

$$s_x = \pm(X_1 - X_2)/\sqrt{2}$$

$$\% \text{ RSD} = \frac{s_x}{\bar{x}} \cdot 100 = \frac{100 \sqrt{2} (X_1 - X_2)}{(X_1 + X_2)}$$

$$\% \text{RSD} = \frac{\sqrt{2}(X_1 - X_2)}{X_1 + X_2} \cdot 100$$

$$\% \text{RSD} = \frac{100 \sqrt{2} (X_1 - X_2)}{(X_1 + X_2)}$$

14.8 ACCURACY

Accuracy is defined as the bias, or the difference between a measured value and an assumed true value. Thus,

$$B_i = X_i - T$$

$$\text{or } \%B_i = [(X_i - T)/T] \cdot 100.$$

For example, for any particular run using the GC/MS, one might calculate a bias, B_i or $\%B_i$, for the internal standard using the mean area as the expected or true value, T , by the equations given above. A better measure of accuracy will be given by the external standards that are expected to be used in the course of the project, considering the true values, T , to be those of the external standard.

14.9 COMPLETENESS

Measurement completeness, C , can be described as the ratio of acceptable measurements obtained to the total number of planned measurements for an item. In this program, the meaning of completeness has been extended to include supporting information such as identities, dates, or other data sheet entries. For this extended meaning, completeness is defined as:

$$C \equiv 1 - \frac{\text{number of defective items}}{\text{total number of items}}$$

The control criterion for completeness is based on a count of defective items within a time period sufficient to cause the total number of items to be large. A monthly count is used for this program.

15. CORRECTIVE ACTION

Corrective action procedures for this program will be initiated by the analyst directly involved with the laboratory procedures, by the laboratory supervisors or the QA coordinator specified in the program organization chart. Quality control charts of standard curves and intra-laboratory quality control samples will be utilized to indicate the necessity of corrective action. Control charts will be established for each procedure indicating upper and lower limits of 2 standard deviations as the acceptability ranges. At the point when the control charts show a deviation beyond the acceptability ranges, investigation as to the cause will be initiated. Corrective actions will also be initiated as a result of other QA activities which include performance audits, systems audits, and laboratory comparison studies.

The corrective action relative to the control charts relate more to precision than to accuracy. These charts give clues when some factor, generally of a procedural nature, is causing the results to drift or when an unexpected difference beyond the control limit occurs. The data within the upper and lower control limits of the control charts are well within the precision accuracy, and completeness criteria outlined in Section 5.5 above.

Corrective actions taken as a result of TRW internal audits will be initialed by a memorandum or an audit report and will be given to the program manager and to the party responsible for the action that needs correction. Part of the periodic audit procedure will be to verify that previously recommended corrective actions have been taken. Actions taken that do not result in the keeping the data within the goals set for precision, accuracy, and completeness will be reported to the EPA Project Officer and discussed with him.

16. QUALITY ASSURANCE REPORTS

The quality assurance officer will provide a written quality assurance report to the project manager on a monthly basis. This report will address quality control problems arising in the application of this QA plan, an assessment of the probable significances of the problems, and recommended actions. Quality control problems to be addressed may arise from:

- Poor compliance with test procedures reported by the several quality assurance monitors
- Completeness and precision test limit failures relayed through the quality assurance monitors
- In-Process procedure changes required by the nature of a specific sample matrix
- Quality control waivers dictated by operation conditions.

The assessment of the problem significance will be based, in part, on the probable effect on the program completeness and validity of inferences to be made from the data should the problem continue.

Recommended actions will include, as applicable:

- Tests which may clarify the problem, such as use of standards
- Corrective actions to alleviate the problem
- Further documentation of the problem
- Acceptance of the anomalous condition with associated risk

These reports will also include:

- Periodic assessment of measurement data accuracy, provision and completeness
- Results of performance and system audits.

The final report will contain a section summarizing the quality information contained in the monthly reports and for the entire project.

17. REFERENCES

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APPENDIX A OF
QUALITY ASSURANCE PROJECT PLAN:
SAMPLING AND ANALYSES OF PCB
CONTAMINATED WASTE OIL INCINERATION
FROM A MULTIPLE HEARTH
INCINERATOR AT THE ANCHORAGE WATER AND
WASTEWATER UTILITY -
POINT WORONZOF SEWAGE TREATMENT PLANT
FACILITY EVALUATION

Prepared by: TRW Energy and Environmental Division
June 2, 1983

1. SUMMARY

A program is getting underway to burn transformer oil containing PCB's in concentrations less than 50 ppm in a multiple hearth sewage sludge incinerator at Point Woronzof, Alaska. The incinerator is similar in design to the New Bedford, Massachusetts incinerator that cannot be tested due to mechanical failures. Thus, in a broad sense; data collected on destruction efficiency, PIC's, and by-products at Point Woronzof is expected to be comparable to New Bedford incinerator performance. The incinerator will operate in a temperature range of 870-980°C. It is expected that the feed waste will have to be spiked to 50-500 ppm to determine destruction efficiencies. Transformer oil is available from Anchorage Municipal Light and Power to do the spiking.

A preliminary verbal agreement has been reached with Anchorage Water and Sewer Utilities to test their incinerator at Point Woronzof provided that burning PCB's of 50 ppm and greater concentrations will be permitted or exempted.⁽¹⁾ Municipal Light and Power has verbally agreed to provide the PCB laced oil at an agreed upon date after August 23, 1983.⁽²⁾

The New Bedford incinerator, when operating, is fed with wastes containing about 10 ppm of PCB's. Since the concentration is below 50 ppm, Region I impetus to obtain data is to define the by-product concentrations in the emissions and in the scrubber water, particularly PCDF and PCDD. (3)

We conclude that from a technical perspective the Point Woronzof incinerator is a viable facility for gathering data that would be indicative of the New Bedford incinerator performance.

2. BACKGROUND

A review of the literature on previous PCB destruction tests in multiple hearth sewage sludge incinerators was recently conducted by GCA Corporation. (4) This review identified four facilities in which PCB destruction testing had been performed. Results of these tests are summarized in Table 1. The tabulated data are sufficiently limited that they do not provide clear insight to the PCB destruction efficiencies achievable in multiple hearth sewage sludge incineration units. In particular, the true incineration destruction efficiencies for the New Bedford incinerator were masked by high concentrations of PCB's in the scrubber feed water.

Additional testing at at least one facility which would supplement the existing PCB destruction efficiency data base is currently in planning. The Region I office of EPA is conducting a comprehensive study of all PCB sources in the New Bedford, Massachusetts Harbor area. Since the New Bedford Municipal Wastewater Treatment Plant at one time received PCB contaminated industrial wastewaters, there is concern that leachable PCB residues may be remaining within the plant. Indeed, PCBs have been detected in the water and sludge discharges of the plant. Hence, there is potential for PCB emissions with the incineration flue gas. To quantify PCB emissions, PIC's and by-products from this incinerator, Region I officials had planned PCB destruction efficiency tests at the New Bedford plant. However, the incinerator is not operating due to equipment failure.

TABLE 1. SUMMARY OF PCB DESTRUCTION RESULTS FROM MULTIPLE HEARTH
SEWAGE SLUDGE INCINERATION FACILITIES (4)

Facility/Location	Test Date	PCB Concentration in Waste, ppmw (dry basis)	PCB Concentration in Flue Gas, pg/m ³	Destruction Efficiency, %	Comments
Palo Alto Incinerator, Palo Alto, Calif.		50	103	94.6	Unit has 6 hearths, a precooler and a wet scrubber. Sludge was deliberately doped with PCB for testing. No PCBs detected in scrubber water or ash.
		50	14.7	91.7	
		50	51.7	97.1	
Blue River Facility, Kansas City, MO	1976	Not available	305	Not available	Number of hearths not identified. Wet scrubbing of flue gas employed.
		Not available	308	Not available	
		Not available	287	Not available	
		Not available	98	Not available	
Mission City, Kansas	1976	Not available	3.8	Not available	Unit has 4 hearths and a wet scrubber.
		Not available	3.7	Not available	
New Bedford Municipal Incinerator,* New Bedford, Mass.	1977	5.40	3.08	Not available	Unit has 7 hearths, precooler and a wet scrubber. Scrubber feed water contained levels of PCB suf- ficiently high to mask incinerator performance. PCB in ash ranged from 0.95-2.35 ppmw.
		5.25	10.56	77.5	
		2.20	5.11	46.3	
		1.40	7.00	-63.8	

*The New Bedford municipal incinerator is a BSP-Envirotech incinerator measuring 14 ft. 3 in. in diameter and consisting of 7 hearths. Maximum rated incinerator capacity is 1500 pounds per day of dry sludge. Incineration temperatures range from 2150°F at the ash outlet to nearly 1800°F in the fixed carbon burning zone.

3. FACILITY EVALUATION⁽⁸⁾

The Point Woronzof wastewater treatment plant is located on a 46-acre tract on the northwestern corner of the Greater Anchorage area of Alaska. This plant began operation in 1972 and operates 24 hours a day, 7 days a week to provide primary treatment for the sewage from the local community. The optimum plant treatment capacity is 34 million gallons per day (MGD) with a hydraulic capacity of 75 MGD. Raw wastewater enters the plant through a screening process and is clarified to recover settleable and floatable solids. These solids are pumped to other units for thickening, drying, and incineration. Ash from incineration is disposed of in a sanitary landfill. Clarified water is chlorinated for reduction of bacteria and is ultimately discharged to the waters of Cook Inlet.

This treatment plant typically treats nearly 24 MGD of wastewater to yield 250 to 300 tons per day of wet sludge containing 10 to 12 tons per day of dry solids. The sludge is conditioned and dewatered to about 24 percent solids prior to incineration. From 1.5 to 2 tons of incineration ash is produced each day and, together with about 1.25 tons per day of grit from raw wastewater, is hauled to a landfill for final disposal.

During normal operation, PCBs are not known to be present in the raw wastewaters treated nor in plant effluents. However, during May 1983 the co-incineration of PCB-containing transformer fluid will be initiated. These fluids contain less than 50 ppmw PCB, and no special permitting was required.⁽⁵⁾ The PCB's are made up of a number of Aroclors (1242, 1254, 1260 were mentioned). However, Arochlor 1260 predominates.⁽²⁾

The sludge incinerator is a BSP-Environtech multiple hearth incinerator (Furnace No. T1343) measuring 14 feet 3 inches in diameter and having six hearths. Each hearth is approximately 3 feet in height. A typical unit is depicted schematically in Figure 1. A schematic of the incinerator scrubber system is presented in Figure 2. The unit's maximum rated capacity is 1261 pounds of dry sludge per hour and its minimum is 626 pounds per hour. The normal operating factor for this unit is 22 hours per day, 7 days per week.⁽⁵⁾ Nominal natural gas requirements for supplemental fuel are 36,000 standard cubic feet per day. Typical hearth temperatures and burner configurations are as follows:⁽⁶⁾

LIKE
 ~ BUFFALO SEWER AUTHORITY
 UNIT

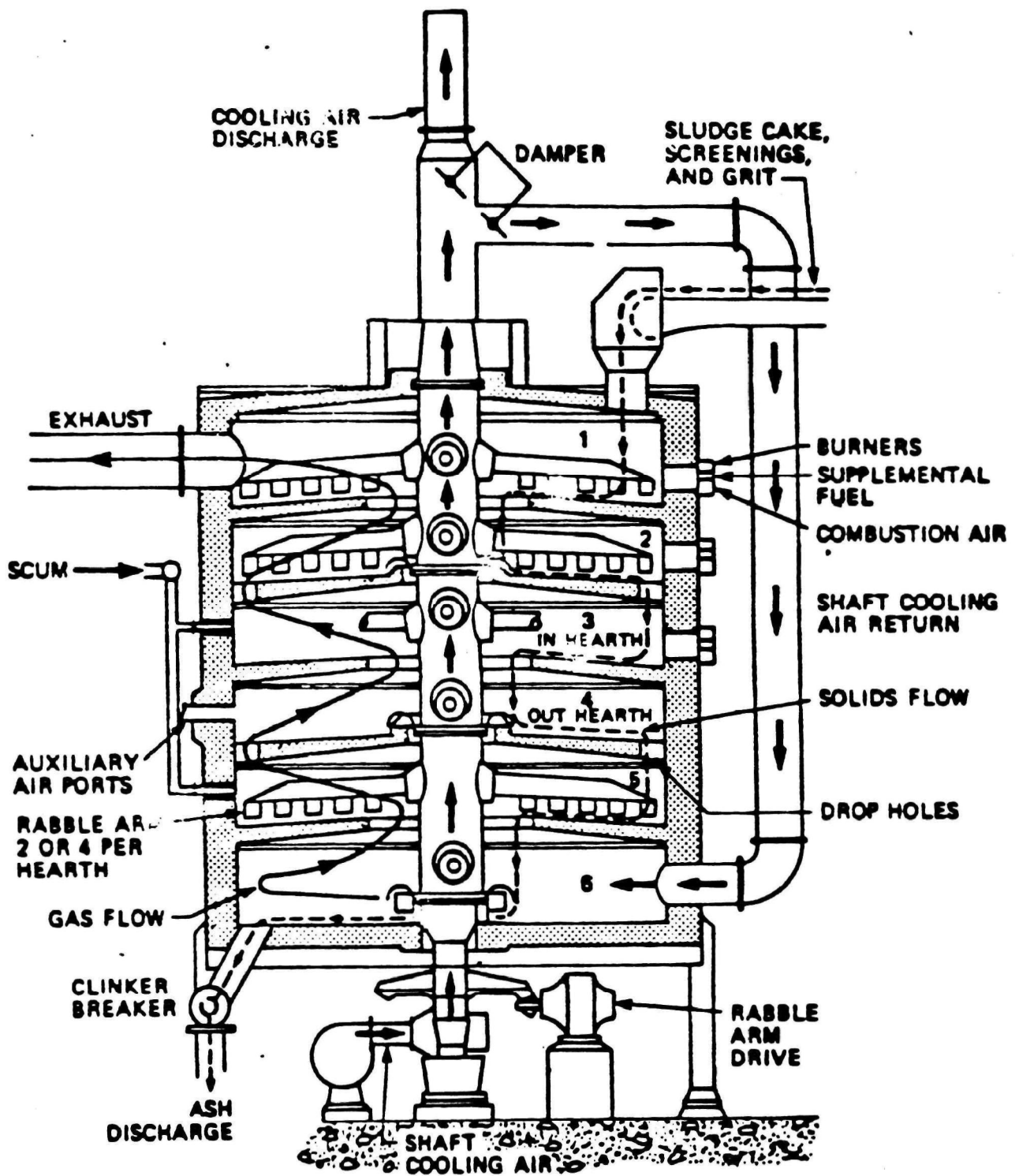


Figure 1. Cross section of a multiple-hearth furnace (7)

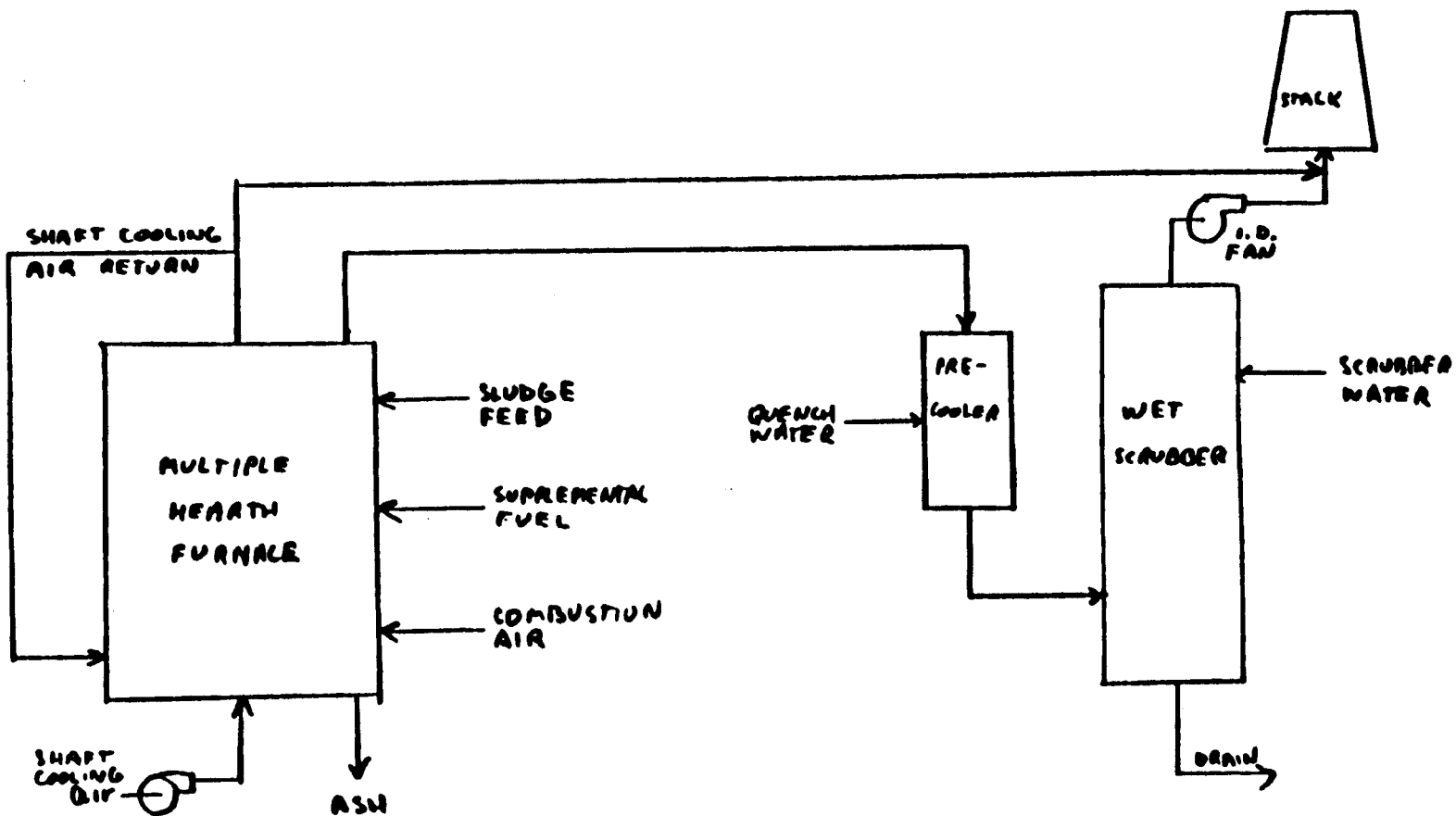


Figure 2. Incineration system flow diagram (8)

<u>Hearth</u>	<u>Gas Burners</u>	<u>Temperature, °F</u>
1-top	2	-
2	2	-
3	2	1600-1800
4	-	1600-1800
5	2	-
6-bottom	-	500 (maximum)

The furnace is nominally designed to operate at temperatures of up to 2000°F, with higher operating temperatures resulting in damage.

Currently, transformer fluid is being mixed into the scum tanks and the mix is injected at a rate of about 1 gallon per minute into hearth number 3 via a screw pump. There are no flow meters for measuring the feed rate.

Flue gas from the incinerator is ducted to a precooler and from there to a scrubber. Recent testing indicates that PM emissions are in good control (0.0052 to 0.0067 grains/scf dry). Stationary gases were as follows:

CO₂: 4.40 - 5.23 percent

CO: 0.009 - 0.03 percent

O₂: 14.0 - 15.7 percent

Combustion efficiencies ((CO₂ - CO)/CO₂) were 99.3 - 99.8 percent.

The major deficiency at this incinerator may be the lack of flow measurements for obtaining good mass balance data. It may be possible to calibrate the scum pump to obtain viable metering of that stream. The dry weight rate of sewage sludge is estimated from filter cake thickness, surface area of filter, filter rotational speed, and frequent analysis of the sludge cake. Fuel gas flow rate is metered. Air flow rate is not metered.

4. REFERENCES

1. By telephone to R. C. Adams from Richard E. Hutson, Manager, Treatment Division, Anchorage Water and Sewer Utilities, June 1, 1983.
2. By telephone to R. C. Adams from Ron Kuccek, Municipal Light and Power, May 23, 1983.
3. By telephone to R. C. Adams from Tom Michel, Region I, June 1, 1983.
4. McInnes, R. G. and R. J. Johnson. Provision of Technical Assistance to Support Regional Office Implementation of the PCB Regulations - East and West. Report prepared jointly by GCA Corporation and TRW Incorporated for the U.S. Environmental Protection Agency, IERL, Research Triangle Park, North Carolina.
5. Information provided to TRW by Bill MacClarence, State of Alaska Department of Environmental Conservation. Telephone conversation on May 9, 1983.
6. By telephone to R. C. Adams from Chris Warren, Anchorage Water and Sewer Utilities, May 23, 1983.
7. Robinson, J. M., R. J. Kindya, and R. R. Hall. State of New Jersey Incinerator Study, Volume II, Technical Review and Regulatory Analysis of Sewage Sludge Incineration. Draft Final Report prepared by GCA/Technology Division, Bedford, Massachusetts, for the U.S. Environmental Protection Agency, IERL, Research Triangle Park, North Carolina. November 1976.
8. Background data package provided to TRW by Bill MacClarence, State of Alaska Department of Environmental Conservation, April 1983.

APPENDIX B OF
QUALITY ASSURANCE PROJECT PLAN:
SAMPLING AND ANALYSES OF PCB
CONTAMINATED WASTE OIL INCINERATION
FROM A MULTIPLE HEARTH
INCINERATOR AT THE ANCHORAGE WATER AND
WASTEWATER UTILITY -
POINT WORONZOF SEWAGE TREATMENT PLANT
TRIP REPORT

Prepared By:

TRW Energy and Environmental Division

Anchorage Water and Wastewater Utilities

Anchorage, Alaska

June 14, 1983

Purpose of the trip was to meet with a potential host, Anchorage Water and Wastewater Utilities (AWWU), of a site to burn PCB's and IERL/Ci's test waste in a sewage sludge incinerator.¹ Additionally, the incinerator facility would be inspected and samples collected if possible. This report provides information supplementing "Facility Evaluation of Point Woronzof, Alaska Municipal Sewage Sludge Incinerator" prepared by TRW and submitted on June 2, 1983. This report also answers additional questions about the New Bedford facility obtained from Region I (Tom Michel) and GCA (Bob McGinnes) following the June 14 site visit. Two separate meetings were held; the first meeting is best characterized as a problem

¹Burning of IERL/Ci's test waste not included in Quality Assurance Project Plan.

definition session and a technical information exchange and the second meeting was an attempt to set priorities and identify action items as the next step in getting a test program underway. Attendees of each meeting are appended.

SUMMARY

AWWU is the water and sewage treatment division of Anchorage Public Utilities, a municipal owned and operated department. Municipal Power and Light (MP&L) is the power generating division of Anchorage Public Utilities.

AWWU had planned to start feeding PCB laced transformer oil to the Point Woronzof sludge incinerator as early as May of this year. The oil provided by MP&L is flushed from transformers during overhaul and contains less than 50 ppm PCB. Delays for various reasons had prevented PCB burns in the incinerator at the time of the meeting. Don Oberacker raised the possibility of incomplete destruction of PCB and the emission of dibenzo furans and dioxins at the operating temperatures of the incinerator. Based on this concern, AWWU decided that PCB would not be burned until tests have been conducted. Meanwhile, TRW will provide those elements of a test plan at an early date that determines the concentration of PCB in the feed and how the concentration can be increased (spike the oil or feed the oil at a higher concentration than planned). This information will determine if there is a need for permitting to burn PCB at concentrations greater than 50 ppm and will determine feed tank and pumping requirements for the transformer oil.

COORDINATION ISSUES

AWWU has agreed to operate the incinerator at stable operating conditions and at temperatures as high as possible (probably 1600-1800°F) consistent with avoiding incinerator damage. AWWU has further agreed to honor reasonable requests to install additional sampling openings if needed.

The question was raised as to whether a memorandum of understanding is needed between the municipality and EPA. It is recommended that AWWU or the Anchorage Air Pollution Control Agency advise us of the municipality's requirements.

Test results are urgently needed by the host to determine if they should continue to destruct PCB in their incinerator. Accordingly, they requested early release of the test data for their review.

HOST SITE DESCRIPTION

The incinerator is operated by AWWU, a department of the Municipality of Anchorage. Municipal Power and Light (MP&L) is a parallel department within the Anchorage public utilities organization. MP&L is storing a sizable quantity of oil washed from transformers that contains less than 50 ppm PCB and wants to dispose of the PCB by burning the oil in the AWWU incinerator. It was planned to start feeding the transformer oil by May of this year but due to various delays no PCB had been burned at the time of the meeting.

The Point Woronzof sewage treatment plant provides primary treatment of sewage from the Municipality of Anchorage. Sludge from primary treatment is incinerated in a BSP-Envirotech multiple hearth furnace referred to herein as the incinerator. Discharges from the incinerator are ash that is landfilled, flue gas that is precooled and scrubbed to remove particulate matter before being emitted to the atmosphere, and the scrubber water. The incinerator is a six hearth furnace about 14 feet in diameter. Each hearth has a height of about 3 feet. Sludge that has been dewatered on a rotary filter is transported by conveyor belt and dropped through a hopper onto the top hearth. Ash is discharged from the bottom hearth and flue gas exhausts from the top hearth. The incinerator operates at a negative pressure maintained by an induced draft fan located after the scrubber. A forced draft fan feeds air to the bottom hearth and auxiliary air ports are located on Hearth 4, 5, and 6.

Scum can be fed to the third hearth. Scum consists of the concentrated skimmings from the primary treatment clarifiers. The intent was to feed the transformer oil to one clarifier skimmer box. The treatment plant has three clarifiers. The PCB contaminated scum would be combined with scum from the other two clarifiers and pumped to the scum concentrator through existing piping. The concentrator decants

the top layer of scum from an entrained water phase. The concentrated scum is fed to a screw (Moyno) pump that discharges to the third hearth through a combination of rigid pipe and flexible hose. Feed rate is up to one gpm and is controlled by varying the speed of the pump. A water phase separates from the organic phase (scum) in the concentrator and is returned to the plant influent. At least during the test, to assure better material balance closure, the transformer oil should be fed to the pump discharge pipe. A feed tank, a pump, and possibly a flowmeter would be needed.

The incinerator was operating as follows during our inspection. Scum was being fed. Sludge was being fed at a fairly high rate as a "catchup" measure after shutdown. Temperature profile and gas burners in service were as follows:

	<u>°F</u>	<u>No. of Burners</u>
Hearth 1	1000	2
Hearth 2	1450	2
Hearth 3	1460	2
Hearth 4	1300	-
Hearth 5	920	2
Hearth 6	200	-
Inlet to scrubber	200	

The incinerator is normally operated at temperatures no higher than necessary to incinerate the sludge and maintain a clean stack. However, during testing AWWU will operate at higher temperatures (1600-1800°F) than those observed. The incinerator cannot operate at 2000°F and above without damage or increased maintenance. At given sludge and scum feed rates, temperature is further controlled by thermostatically controlling natural gas flow to the burners. There is a thermostat, set by the operator, for each hearth where burners are installed.

The precooler and scrubber feed water is primary effluent that returns to the primary treatment system. The precooler consists only of two sets of sprays in the vertical duct leading to the gas entrance of the scrubber. The scrubber is a three stage impingement plate scrubber operating at a pressure drop of 12" W.C. Water rates to the precooler and to the scrubber were 60 gpm and 260 gpm, respectively, during our inspection.

Other incineration system data is given in the next section.

ANCHORAGE/NEW BEDFORD COMPARISONS

Comparative data is shown in Table 1. One objective of the proposed test is to gather data on an incinerator that is similar to an incinerator located in New Bedford, Massachusetts that has been fed with PCB contaminated sludge. The major differences in design and operation of the two incinerators are summarized as follows:

- Neither incinerators are equipped with afterburners. Both feed sludge to the top hearth. The essential difference is that Anchorage normally adds heat to the top hearth whereas New Bedford does not.
- Anchorage feeds scum to the third hearth. New Bedford does not feed scum by a side stream and it is not known how they dispose of their scum.
- New Bedford has seven hearths, Anchorage six. New Bedford has 50 percent more dry sludge capacity.
- New Bedford has operated its scrubber at a pressure drop way below design, apparently because of partial bypassing in the scrubber. Repairs are expected during an ongoing outage.

TEST FACILITIES

Test ports are available for traversing flue gas ducts at exit of incinerator and at discharge of ID fan. There are 3-4" ports in a rectangular section of duct at exit of incinerator. The ID fan discharge sampling location is five feet above roof level in an 18" circular duct. There are 4-4" ports at right angles at this location. The sampling location is downstream of the incinerator's air bypass line. Connections

are available for sampling precooler and scrubber influent water, scrubber effluent water, and scum feed to the incinerator. Sludge can be sampled at the feed hopper to the incinerator. Ash can be sampled from Hearth No. 6.

The following operating data is measured:

- temperature, all hearths and scrubber inlet,
- flue gas static pressure,
- scrubber ΔP ,
- flue gas oxygen,
- flue gas flow rate,
- precooler water flow rate, and
- scrubber water flow rate.

Sludge feed rates are determined from the circumferential surface area of the filter, the filter rotational speed, and the weight of a 0.25 square foot sample of cake taken from the filter twice a shift. Water analysis of the sample also defines the dry solids feed rate. Dry solids volatiles are also determined.

Samples were collected as follows:

- sludge feed to incinerator,
- concentrated scum,
- ash,
- primary effluent, and
- scrubber effluent.

Table 1. COMPARATIVE DATA FOR NEW BEDFORD AND ANCHORAGE SEWAGE SLUDGE INCINERATOR

	Anchorage	New Bedford
No. of hearths	6	7
Approx. dimensions	14' diameter	same
Scum feed	No. 3 hearth	N/A*
Scum feed rate	1 gpm max	N/A
Sludge feed rate, design	1000 lb/h dry solids (May: 959 lb/h)	1500 lb/h dry solids
% Solids in sludge	22.4% May actual	25-30%
227 Gas flow	3500 scfm	2500 scfm dry
% Volatiles in sludge	78.1% of dry solids (May actual)	75-80%
Natural gas flow rate	1500 cfh	N/A
Shaft cooling air returned to	No. 5 hearth	No. 6 hearth
PCB feed	with scum	sludge
Stack diameter	18"	36"
Precooler	similar	12 nozzles arranged in two rows
Scrubber	W.W. Sly 3 - stage impingement plate	same

(continued)

Table 1. Concluded

	Anchorage	New Bedford
Scrubber data	design N/A 12" ΔP actual 320 gpm actual, primary effluent (not chlorinated) N/A	8.5" ΔP design max 3.3" ΔP actual 300 gpm city water guarantee 0.2 lb/1000 lb dry gas corrected to 12% CO ₂
Afterburner	No	No
Sampling ports, equiv. diameters	7-8 upstream N/A downstream	2.3 upstream 1.8 downstream
Temperature	Actual 6/14/83 1 - 538°C 2 - 788 3 - 793 4 - 704 5 - 493 6 - 93 (can be operated at 870-980°C on high temperature hearths)	Actual 10/7/81 1 - 699°C 2 - 566 3 - 977 4 - 871 5 - 681 6 - 371 7 - 102
Sludge dewatering	rotary filter	centrifuge
Sludge transfer to incinerator	conveyor belt	screw feeder
Sludge fed to	No. 1 hearth	No. 1 hearth
Gas burners	No. 1 - 2 No. 2 - 2 No. 3 - 2 No. 5 - 2	No. 1 - 2 No. 3 - 2 No. 5 - 2 No. 6 - 2

*N/A - information not available.

ATTENDEE LIST

Meeting One, Point Woronzof Sewage Treatment Works

EPA/IERL,Ci - Don Oberacker

TRW - Rad Adams

Alaska Dept. of Environmental
Conservation - Bill MacClarence

Anchorage Air Pollution Control
Agency - George LaMore

AWWU - Gene Nordgren,
Superintendent, Wastewater
Treatment

AWWU - Kris Warren, Operations
General Foreman

Meeting Two, AWWU Water Treatment Works

EPA/IERL,Ci - Don Oberacker

TRW - Rad Adams

Alaska Dept. of Environmental
Conservation - Bill MacClarence

Anchorage Air Pollution Control
Agency - George LaMore

AWWU - Kris Warren, Operations
General Foreman

AWWU - Dick Hutson, Manager,
Treatment Division

Anchorage Public Utilities -
Jim Sweeney, Manager, Environmental
Resources

APPENDIX C OF
QUALITY ASSURANCE PROJECT PLAN:
SAMPLING AND ANALYSES OF PCB
CONTAMINATED WASTE OIL INCINERATION
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DETAILS OF THE GLASSWARE CLEANING PROCEDURE

1. As soon as possible after use of glassware coming in contact with PCB's, i.e., beakers, pipets, flasks, or bottles used for standards, the glassware should be acetone flushed before placing in the hot detergent soak. If this is not done, the soak bath may serve to contaminate all other glassware placed therein. Many instances of widespread laboratory contamination are traceable to the glassware washing sink.
2. The hot soak consists of a bath of a suitable detergent in water of 50°C or higher. The detergent, powder or liquid, should be entirely synthetic and not a fatty acid base. There are very few areas of the country where the water hardness is sufficiently low to avoid the formation of some hard water scum resulting from the reaction between calcium and magnesium salts with a fatty acid soap. This hard water scum or curd would have an affinity particularly for the chlorinated compounds and, being almost wholly water insoluble, would deposit on all glassware in the bath in a thin film.

There are many suitable detergents on the wholesale and retail market. Most of the common liquid dishwashing detergents sold at retail are satisfactory, but are more expensive than other comparable products sold industrially. Alconox[®], in powder or tablet form, is manufactured by Alconox, Inc., New York and is marketed by a number of laboratory supply firms. Sparkleen[®], another powdered product, is distributed by Fisher Scientific Company.

NOTE: Certain detergents, even in trace quantities, may contain organics that will contribute significant background contamination by electron capture detection. For this reason, any detergent selected should be carefully checked to ensure freedom from such contamination. The following procedure is recommended:

Add 25 mL dist. water, previously checked for background contaminants, to a 250 mL separatory funnel. Add 1 drop of the liquid detergent (50 mg if in powder form), followed by 100 mL hexane. Stopper funnel and shake vigorously for 2 minutes. Allow layer separation, draw off and discard aqueous layer. Add a pinch of anhydrous Na_2SO_4 to the hexane extract and shake 1 minute. Transfer extract to a Kuderna-Danish assembly fitted with a 10 mL evaporative concentrator tube containing one 3 mm glass bead. Reduce extract volume to about 3 mL in a hot water bath. Cool, rinse down $\frac{2}{3}$ joint and sides of tube with hexane, diluting extract to exactly 5 mL. Stopper tube and shake on Vortex mixer 1 minute. Chromatograph by electron capture GLC and evaluate chromatogram for contaminant peaks.

3. No comments required.

4. The most common and highly effective oxidizing agent for removal of traces of organic compounds is the traditional chromic acid solution made up of H_2SO_4 and potassium or sodium dichromate. For maximum efficiency, the soak solution should be hot (40°C to 50°C). Safety precautions must be rigidly observed in the handling of this solution. Prescribed safety gear should include safety goggles, rubber gloves, and apron. The bench area where this operation is conducted should be covered with lead sheeting as spattering will disintegrate the unprotected bench surface.

The potential hazards of using chromic sulfuric acid mixture are great and have been well publicized. There are now commercially available substitutes that possess the advantage of safety in handling. These are biodegradable concentrates with a claimed cleaning strength equal to the chromic acid solution. They are alkaline, equivalent to about 0.1 N NaOH upon dilution and are claimed to remove dried blood, silicone greases, distillation residues, insoluble organic residues, etc. They are further claimed to remove radioactive traces and will not attack glass nor exert a corrosive effect on skin or clothing. One such product is "Chem Solv 2157", manufactured by Mallinckrodt and available through laboratory supply firms. Another comparable product is "Detex", a product of Borer-Chemie, Solothurn, Switzerland.

5,6, and 7. No comments required.

8. There is always a possibility that between the time of washing and the next use, the glassware may pick up some contamination from either the air or direct contact. To ensure against this, it is good practice to flush the item immediately before use with some of the same solvent that will be used in the analysis.

The drying and storage of the cleaned glassware is of critical importance to prevent the beneficial effects of the scrupulous cleaning from being nullified. Pegboard drying is not recommended as contaminants may be introduced to the interior of the cleaned vessels. Neoprene-coated metal racks are suitable for such items as beakers, flasks, chromatographic tubes, and any glassware then can be inverted and suspended to dry. Small articles like stirring rods, glass stoppers and bottle caps can be wrapped in aluminum foil and oven dried a short time if oven space is available. Under no circumstance should such small items be left in the open without protective covering. The dust cloud raised by the daily sweeping of the laboratory floor can most effectively recontaminate the clean glassware.

APPENDIX D OF
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CALCULATION OF MINIMUM SAMPLE VOLUME
NECESSARY TO VERIFY A DRE OF 99.9% FOR PCB's

Assumption

PCB feed 0.5 gal/min. of 400 ppm Aroclor

Total flue gas effluent - 4866 cfm

PCB Feed

0.5 gal/min = 1.893 liter/min = 1893 mL/min @ density of 0.9
= 1704 grams/min

400 ppm = $(400 \mu\text{g/g})(1704 \text{ g/min}) = 681600 \mu\text{g/min}$

Total Flue Gas Effluent

$(4866 \text{ cf/min})(28.3 \text{ liter/cf})(1 \text{ m}^3/1000 \text{ liter}) = 138 \text{ m}^3/\text{min}$

PCB Concentration at Specified DRE

$$\frac{681600 \mu\text{g}/\text{min}}{138 \text{ m}^3/\text{min}} = 4939 \mu\text{g}/\text{m}^3 \text{ at } 0\% \text{ DE} \quad (\text{as Aroclor})$$

$$\frac{4939 - x}{4939} = 0.9999$$

$$\begin{aligned} x &= 0.494 \mu\text{g}/\text{m}^3 \text{ (as Aroclor)} \\ &= 0.494 \text{ ng/L (emission at 99.99\%)} \\ &\times \underline{2.4\%} \text{ (as anyone isomer)} \\ &0.0119 \text{ (ng/L of air collected, 99.99\%)} \\ &0.119 \text{ (ng/L of air collected, 99.9\%)} \end{aligned}$$

Sample Volume Required for Specified DRE

1000 pg/uL injected as MDL

1000 ng/mL extraction vol

$$(1000 \text{ ng})\left(\frac{1 \text{ liter}}{0.119 \text{ ng}}\right) = 84034 \text{ liters needed to be collected for 99.99\%}$$

or 8403 liters needed to be collected for 99.9%

Sampling Time Required for Specified DRE

If sampling rate is 0.75 cfm then

$$(.75)\left(\frac{28.3 \text{ liters}}{\text{cf}}\right) = 21.2 \text{ liters/min}$$

$$(84034 \text{ liters})\left(\frac{\text{min}}{21.2 \text{ liters}}\right) = 3964 \text{ min}/60 = 66.1 \text{ hours (for 99.99\%)}$$

or

$$(8403 \text{ liters})\left(\frac{\text{min}}{21.2}\right) = 396 \text{ min}/60 = 6.61 \text{ hours (for 99.9\%)}$$

APPENDIX E OF
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ACTION ITEMS

Meeting at AWWU on September 8, 1983

Actions generated in subject meeting and subsequent test site visit for Anchorage Utilities and TRW are tabulated herein. All of the actions supplement or expand on the responsibilities specified in the QA Project Plan and memorandum of August 22, 1983, both prepared by TRW. Meeting attendees are appended.

Anchorage

1. Prepare an Operations Plan for submittal to EPA Region X. Submit Operations Plan and QA Project Plan to Region X by September 19, 1983.
2. Install feed system for oil feed.
3. Make a "dry run" with uncontaminated transformer oil by September 22, 1983. Dry run will be to determine operable feed rate and temperatures. Feed system installed for test burn will be used. Make data available to TRW.
4. Provide 500 gallon trailer for transport of oil to Point Woronzof (by MPL).
5. Install an oil feed gun on third hearth that extends into gas space and disperses oil droplets. Gun will have to be water cooled to avoid flashing of oil upstream of spray nozzle. Check with vendor for guidelines as to how this may be done. EPA and/or TRW will provide design information.

6. Provide TRW with free volume of incinerator for calculating residence time.
7. Install flowmeter on well water used for quenching/scrubbing.

TRW

1. Provide revisions to QA Project Plan that incorporate expanded test program to include continuous or high frequency (at least every 15 minutes) monitoring of CO, CO₂, and O₂.
2. Provide guidelines for deciding when operation is transient to the extent that sampling will be suspended, for restarting sampling, and for coordination of those actions with AWWU.
3. Provide design information for oil gun.
4. Prepare a list of reagents and gases and submit to Dick Hutson for possible local availability.
5. Based on results of dry run, recalculate sampling requirements for determining DRE out to 99.9%.

LIST OF ATTENDEES

Test Plan/Program Review Meeting Point Woronzof Municipal Incinerator September 8, 1983

David Sanchez	IERL, U.S. EPA	919/541-2547
Rad Adams	TRW Inc.	919/541-9100
Bill MacClarence	ADEC	907/274-2533
Kris Warren	AWWU	907/243-2151
Gene Nordgren	AWWU	907/338-3820
Alan Boggs	AWWU	907/338-3870
Sandra Morris	AWWU	907/243-2151
Jim Sweeney	Public Utilities	907/564-1336
Ron Kuczek	ML&P	907/279-7671
Richard Hutson	AWWU	907/338-3870
George LaMore	AAPCA	907/264-4713