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US Army Corps
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PCB Transformer System User Manual: ETIS Version 2.0

by
Keturah A. Reinbold
Mary A. Curvey
Patrick T. Conroy

Regulations promulgated under the Toxic Substances Control Act of 1976 control the use of electrical transformers containing polychlorinated biphenyls (PCBs). The Department of Army has hundreds of PCB transformers.

This report describes the PCB Transformer System developed by the U.S. Army Construction Engineering Research Laboratories (USACERL). This program provides guidance on regulations and options for use or replacement of transformers containing 50 parts per million or more of PCBs in the insulating fluid. The system is described, and instructions are given for its use in helping to make decisions about the disposition of transformers, based on regulations and costs.

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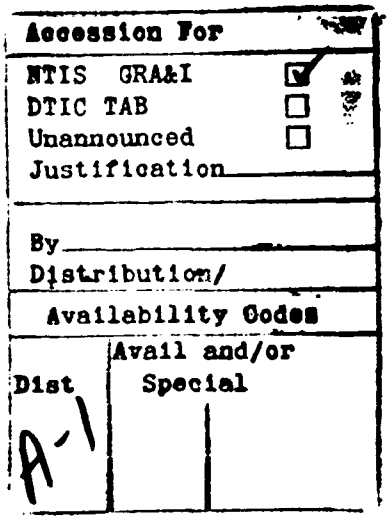
FOREWORD

This work was performed for the U.S. Army Materiel Command under Intra-Army Order 82-032, dated February 1982, titled "Retrofit of PCB Electrical Devices." The technical monitor was Harry Delong, AMCEN-A.

The project was conducted by the Environmental Engineering Division (EP) of the Environmental Sustainment Laboratory (EL), U.S. Army Construction Engineering Research Laboratories (USACERL). The Principal Investigator was Bernard Donahue, and the system developer was Dr. Keturah Reinbold. Dr. Edgar D. Smith is Acting Chief, CECER-EP, and William D. Goran is Acting Chief, CECER-EL. The USACERL technical editor was Gloria J. Wienke, Information Management Office.

The computer programmers for this system were Patrick Conroy, Mary Ann Curvey, Allan Edwards, and Tom Peschman.

COL Daniel Waldo, Jr., is Commander and Director of USACERL and Dr. L.R. Shaffer is Technical Director.



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PCB TRANSFORMER SYSTEM USER MANUAL: ETIS VERSION 2.0

1 INTRODUCTION

Background

According to the Polychlorinated Biphenyl (PCB) regulations promulgated under the 1976 Toxic Substances Control Act (TSCA), any servicing (including rebuilding) of PCB-filled transformers that requires removal of the transformer coil from the transformer casing is prohibited. Additionally, the use of PCB transformers that pose an exposure risk to food or feed was prohibited after October 1, 1985. The law required high secondary voltage PCB transformers configured in a network on or near commercial buildings to be removed by October 1, 1990 and improved electrical protection to be installed by that same date on other PCB transformers used in or near commercial buildings. When a transformer on an Army installation fails, Army managers must decide whether to replace it or to remove the PCBs from the dielectric fluid. This decision must be based, in part, on economics and lead time for replacement or for PCB removal services. A computer-aided evaluation process was needed to assist Army personnel in making these decisions. Because some Army environmental managers have access to the mainframe computer Environmental Technical Information System (ETIS) and others have access to personal computer (PC) processing equipment, both ETIS- and PC-based versions of the evaluation process were needed.

Objective

The objective of this report is to describe the data and programs in the mainframe PCB Transformer System and to provide Army environmental managers with the information needed to access the system, input appropriate data, and obtain output.

Approach

The PCB Transformer System was developed to provide Army environmental managers with guidance on regulations and options for use or replacement of transformers containing 50 parts per million or more of PCBs in the insulating fluid. The system is described, and instructions are given for its use in helping environmental managers make decisions about the disposition of transformers.

Mode of Technology Transfer

The PCB Transformer System is accessible through the ETIS in the Miscellaneous (MISC) Subsystem. ETIS is a mainframe computer system containing a variety of environmentally related computer programs. ETIS and the PCB Transformer System are maintained through the ETIS Support Center at the University of Illinois in Urbana-Champaign. Military, corporate, or private environmental managers can contact the ETIS Support Center located at 909 West Nevada Street, Urbana, IL 61801, telephone 217-333-1369 for information on registration and logon procedures. The USACERL Environmental Natural Resources Division point of contact can be reached at 217-398-5482, 800-USA-CERL (outside Illinois), or 800-252-7122 (within Illinois) or P.O. Box 9005, Champaign, IL 61826-9005.

2 THE PCB TRANSFORMER SYSTEM

Description

The PCB Transformer System is an interactive mainframe computer program that was developed to provide guidance on regulations and options for use of transformers containing 50 parts per million or more of PCBs in the insulating fluid. The system consists of several components in two categories: interactive subprograms and information files (Table 1). The information portions of the system include an on-line introduction and guide for use, definitions, help and information files, and abstracts of Federal and state regulations. The information files provide valuable references for using the subprograms and are a convenient source of information about the System and PCB transformers. The three subprograms include a Transformer Risk Assessment, a Fate Decision Analysis, and a Life Cycle Cost Analysis. These answer-driven programs, described in detail below, are easy to use, requiring little computer experience. They are intended to guide you in determining the best and most economical options for each transformer based on specific characteristics of the equipment and current regulations.

Information Files

The PCB Transformer System contains several types of data files. First, the Introduction files (type [1] or [intro]) gives an on-line description and reference for how to use the system. The Definitions file (type [2] or [defs]) provides terms and phrases related to electrical equipment and PCBs. It is recommended that you read through the definitions before using the system and refer to them whenever necessary.

The set of Abstracts files (type [3] or [abstract]) of Federal and state regulations concerning PCBs and transformers summarizes specific parts of the PCB regulations (40 CFR Part 761), such as conditions for use of PCBs in electrical equipment, conditions for storage and disposal of PCBs or PCB articles, and

Table 1

Systems Components

INFORMATION FILES

- Introduction
- Definition
- Abstracts
  - Federal
  - State
- Help Files

SUBPROGRAMS

- Transformer Risk Assessment
- Fate Decision Analysis
- Life Cycle Cost Analysis

requirements for spill cleanup and recordkeeping. You can scan the menu to determine which regulations you need to review. If you are not familiar with requirements concerning PCB transformers, it may be helpful to read these abstracts carefully or to refer directly to the Code of Federal Regulations Title 40 Part 761. The legal references and bibliography are listed at the top of each abstract. The state abstracts provide additional PCB requirements for each state the District of Columbia, and Puerto Rico. (For lists of the state abbreviations used on this system, type [28] or [states].)

The PCB Transformer Fate Decision Analysis and Life Cycle Cost Analysis subprograms contain a series of information files (type [8] or [9]) at several locations in the program to help you select appropriate responses. Since much of this information may be of more general interest, the information files in these subprograms can be accessed directly. The files contain trade names of transformer coolants containing PCBs, names and addresses of companies that decontaminate or retrofill transformers containing PCBs, tips on estimating the expected life of a transformer, and information about PCB spill cleanup kits. Table 2 contains a list of available files.

Transformer Risk Assessment

The Transformer Risk Assessment (TRA) subprogram enables you to assess the degree of risk associated with a specific transformer or group of transformers. Based on specific transformer characteristics and a procedure modified from one published by the Navy,[1] a hazard score is assigned. An overall hazard ranking comprised of the assessment points and the appropriate group and category can be compared to the rating of other transformers within the same group and category, thus helping to establish priorities for action.

Fate Decision Analysis

The Fate Decision Analysis (FDA) subprogram identifies the permissible and feasible options for a specific transformer. Four alternatives are considered: (1) retain in use without modification, (2) replace the transformer, (3) replace the fluid in the transformer with new dielectric fluid that does not contain PCBs, or (4) decontaminate the mineral oil dielectric contaminated with PCBs. In some cases, it may be clear from the Fate Decision Analysis that only one of the four alternatives is feasible. Often, however, more than one alternative may appear to be feasible. When this is the case, the ultimate decision must be based either on policy or on cost. Together with the Life Cycle Cost Analysis, the FDA can be a helpful tool for managing PCB transformers.

Life Cycle Cost Analysis

After determining the permissible options for the disposition of PCB and PCB-contaminated transformers, you may determine which of the permitted options is the most cost effective by using the Life Cycle Cost Analysis (LCCA) program.

Life cycle costing is a method to find the most cost effective of a set of options for a project. It allows you to find the "present worth" of a current or future cost based on whether it is a one-time cost or an annually recurring cost. The LCCA program allows you to perform life cycle costing without

---

[1] *PCB Compliance Assessment and Spill Control Guide*, NEESA 20.2-028A (Naval Energy and Environmental Support Activity, August, 1982).

Table 2

List of Information Files

Trade names of transformer coolants containing PCB.
PCB decontamination service companies.
Information to be provided to obtain a cost estimate for decontamination of a transformer.
Testing suitability of a transformer for retrofilling.
Information on high-fire-point retrofill fluids and associated filtering systems.
List of RTE authorized retrofill service agents for RTEmp fluid.
List of certified retrofillers for Dow Corning 561 silicone fluid.
Information to be provided to obtain a cost estimate for retrofilling a transformer.
The procedure for turning in PCB fluids and PCB transformers to the Defense Reutilization and Marketing Office.
An example cost comparison of retrofilling versus replacing a transformer.
Cost elements for transformer replacement.
Transformer replacement alternatives.
Estimating expected life of transformers.
Information on PCB spill clean-up kits.
Information on potential cost of spill cleanup.
Penalties and fines for spills.
List of DOE regions.
Estimate of decontamination costs.
Cost of disposal and removal of old mineral oil.
Risk reduction measures for a PCB transformer.
List of preventive maintenance tests and their
Table of annual failure rates for transformers and time for repair.
Electrical energy losses for various types of transformers and calculation of the costs.
Costs for disposal of a transformer and/or\ dielectric fluid.
Estimation of new transformer costs.
Estimation of transformer installation costs.
Estimation of time to replace a transformer.
Estimation of cost to retrofill.

having to know anything about the accounting ideas behind it. One of the costs calculated by the LCCA program is energy costs. The Department of Energy has established a methodology for calculating the present worth of energy costs.[2] The LCCA program calculates energy costs accordingly.

[2] Rosalie T. Ruegg, *Life-Cycle Costing Manual for the Federal Energy Management Program*, NBS Handbook 135 (United States Department of Commerce, National Bureau of Standards, December 1980); Barbara C. Lippiatt, Stephen F. Weber, and Rosalie T. Ruegg, *Energy Prices and Discount Factors for Live-Cycle Cost Analysis*, Annual Supplement to NBS Handbook 135 and NBS Special Publication 709, NBSIR 85-3273 (United States Department of Commerce, National Bureau of Standards, November 1985).

3 USER INSTRUCTIONS

Symbols

The following is a list of symbols used in these instructions:

Symbol	Means	Action
"xxx"	the text between quotes will appear on the screen	
bold or [xxx]	type the text	
<cr>	press carriage return	continue
<space>	press space bar	
CTRL-s	hold down CTRL button and type "s"	stop text scroll
CTRL-q	hold down CTRL button and type "q"	restart text scroll
CRTL-PrtSc	hold down CTRL button and press PrtSc button (PCs only)	print text on screen

Access

The PCB Transformer System is in the Miscellaneous subsystem of the Environmental Technical Information System (ETIS). To use the ETIS system, you must make a connection between your terminal or personal computer and the Sequent Symmetry computer at the University of Illinois. For a personal computer, both a modem and a communication package are needed to communicate with the Pyramid. The commercial number for the computer is (217) 333-5067 through 5090, inclusive. Any of the numbers will reach the computer. (The toll-free WATS line is 1-800-637-0958 outside the state of Illinois.)[3] You should consult the manuals for instructions concerning the use of a specific communication package. Questions or requests for more detailed information on setting your equipment for ETIS should be directed to the ETIS Support Center, University of Illinois, 909 W. Nevada, Urbana, IL 61801; phone (217) 333-1369.

Login

To access ETIS, you should first acquire a login and a password from the ETIS Support Center at (217) 333-1369. Log into the system by typing your name and password at the appropriate prompt, "login" or "password." (The password will not show on the screen to ensure privacy.) After logging in with the correct name and password, you will receive system messages. If the system indicates

NO DIRECTORY

or a similar designation, access to the ETIS is probably closed down and you should try again later. If the system is in operation, the date of last login and a prompt (some cue that the system is waiting for a response, usually followed by a cursor) should appear on the screen. Figure 1 shows a sample login and entry to the PCB system.

[3] "Setting Your Equipment for ETIS," *ETIS and Its Subsystems* (Department of Urban and Regional Planning, University of Illinois at Urbana-Champaign, May 1986), p 1-10.

```
connected
Uofl Computing Services Office Network - Pyramid 90x
(osiris
(4.2 BSD / System 5) OSx 3.1

login:smith
Password:
Last login: Fri Aug 14 10:05:39 on ttyi56
TERM = (xx###)    <cr>

osiris 1:>etis

                              ETIS   (Trademark applied for)

                          United States Army Corps of Engineers
                          Environmental Technical Information Systems

ETIS:What program? (Type <cr> to see list):misc

                    Welcome to the ETIS/MISC systems.

ETIS/MISC:What program? (Type <cr> to see list):pcb

                    Welcome to the PCB Transformer System

PCB: Enter Command (type <CR> for list) ? <cr>
```

Figure 1. Sample Login and Entry to the PCB System.

Startup

To enter ETIS, type

etis

at the prompt. When the question "What program?" appears on the screen or terminal, type

misc

to get into the Miscellaneous subsystem. When the question "What program?" appears again, type

pcb

At this point the message "Welcome to the PCB Transformer System" will be displayed (see Figure 1).

Menus and Commands

Press the carriage return to view the main menu at the prompt,

PCB: ENTER COMMAND (type: <cr> for list)

The menu displays lists of numbered choices with a description of each (Figure 2). Type either the number or the short keyword to display that choice. Once familiar with the system, you may enter any command number at the prompt, bypassing the menu.

Responses

Valid answers to questions are generally indicated and usually consist of yes, no, help, or a number. If uncertain how to respond, type

help

to see more information to determine an appropriate response.
In places where the answer is yes or no, type

yes or

no

or simply the letter

y or

n

After items that are not questions, press the carriage return

<cr>

to continue when finished reading the information.

Text Control

There are places in the system where a large amount of data will be printed out. If at a terminal rather than a printer, the PCB Transformer System will display only one page of information at a time. The output will stop after each full page (usually showing "More xx%" on the last line). To see another page, press the spacebar

<space>

To see only the next line, press carriage return

<cr>

or to stop the output and return to the PCB system enter

q

```
PCB: Enter Command (type <CR> for list) ? <cr>

Type:
        1 or intro      For an Introduction to the PCB
                          Transformer System.
        2 or defs       For Definitions.
        3 or abs        For Abstracts of PCB regulations
                          affecting transformers.
        4 or tra        For Transformer Risk Assessment.
        5 or fda        For Fate Decision Analysis.
        6 or lcca       For Life Cycle Cost Analysis.
        7 or bye        To Leave the PCB system.
          or end
        8 or files      For a list of available help files from
                          the PCB Fate Decision Analysis.
        9 or files2     For a list of available help files from
                          the Life Cycle Cost Analysis.
        26 or rub       To turn off rubouts and interrupts
                          (if experiencing line noise).
        40 or comment   To send a suggestion or comment to the authors of the PCB system.

PCB: Enter Command (type <CR> for list) ?
```

Figure 2. Main MENU.

To stop output to the screen, simply type [s] while holding down the control key.

CTRL-s

To start again, press [q] while holding the control key.

CTRL-q

Transformer Risk Assessment

The TRA program (type [4] or [tra] to start) presents a series of multiple choice questions concerning characteristics of transformers such as size, location, condition, susceptibility to damage, and spill control structures. Respond to each question with the rating (not the letter) of the choice that best describes the unit(s) concerned. On the basis of individual scores for each item, a total hazard score is assigned and will be shown at the top of the screen after the last question. To see a listing of categories, type [yes] at the "Categories?" prompt.

Categories? yes

Finally, note the appropriate group and category for the transformer(s) concerned. Appendix A contains a sample session of the TRA.

Fate Decision Analysis

The FDA program (type [5] or [fda] to start) is a decision tree with numerous branches. At any branch, a question may be posed or useful information may be provided. For most items, help files assist decisionmaking or provide additional information. If you want help, type

help

when informed that help is available. For specific information needed to complete the FDA, see the introduction by answering

yes

to the first question. Generally, the questions require either a simple yes/no or a number. Answer questions at the "?" prompt. If the text scrolls by too quickly, refer to the section on Text Control above. Read each screen carefully. Responses to questions about the characteristics (e.g., level of PCBs in dielectric fluid, age, condition, load) of a specific transformer or group of transformers eventually lead to the possible alternative(s) for handling the equipment under consideration.

You may choose to consider alternatives to the option recommended. The decision path may be reviewed or saved in a file and printed (see Saving and Recovering Sessions below) at the end of a session. Also, to correct information or to explore options, the FDA may be repeated. Appendix B contains a sample FDA session.

Life Cycle Cost Analysis

The LCCA program (type [6] or [lcca]) presents a series of questions, most of which are answered by entering a dollar value or another number. You are allowed to save the current sessions, recover previously saved sessions, and update or correct your responses.

When you begin the LCCA, the system gives a brief introduction including a list of information that you will need to supply to the program. You should keep in mind that although the program displays the results in dollars and cents, the output is only as accurate as the data you supply. Help for estimating costs is available in the program, but the figures provided there are only advisory. The best cost data comes from estimates provided to you by vendors of the equipment or service required.

The system then changes to a menu giving the calculated values for the options investigated (Figure 3). Depending on your response, you will either be prompted for information on a previously untried option, allowed to edit the stored responses for an option (Figure 4), prompted for a new "base year" (the year that any corrective action may be taken) for the calculations, given a summary of the session so far (Figure 5), or allowed to quit the program. Appendix C contains a sample session of the LCCA.

There are several points you should keep in mind when entering data:

1. When entering any year of an event, always enter how many years from the base year the event will occur. Do not enter the calendar year of the event. The only exception is when entering the base year itself.

Example:
How many years of life are left in the transformer?

If there are 15 years of life left, type 15, not 2007. Otherwise the program will think that the transformer will last for over two millennia.

ANALYSIS FOR BASE YEAR 1985.

	1-Retain	2-Replace	3-Retrofill	4-Decontam
Initial Costs	NOT	55500.00	NOT	NOT
Recurring Costs		43118.77		
Nonrecurring	TRIED	-384.37	TRIED	TRIED
Total Costs		98234.00		
Ave. Annual Costs		10822.30		

You can investigate or correct data for an alternative by entering the number displayed with the alternative.
You can quit the program by typing 'q'.
You can change the base year of analysis by typing 'year'.
You can see a summary of your work by typing 'sum'.

What do you wish to do?

Figure 3. The LCCA Menu.

REPLACE OPTION

1	Unused value of old transformer	4000.00
2	Disposal cost of old transformer:	20000.00
3	Purchase cost of new transformer:	25000.00
4	Installation cost	5000.00
5	Downtime cost	1500.00
6	Discount rate	0.10
7	Lifespan of new transformer	25
8	Annual preventive maintenance costs	275.00
9	Failure rate	0.0059
10	Estimated hours to repair	79.00
11	Labor cost per hour.	20.00
12	Corrective maintenance materials	100.00
13	DOE region	5
14	Annual Energy losses	4500.00
15	Other recurring costs	100.00
16	Scrap value of new transformer	5000.00
17	Other non recurring costs.	200.00
18	When expenditure is anticipated.	10

Choose the number of the entry you would like to change,
or type q to quit:

Figure 4. Editing Screen.

Replacement option	Input Values	Present Worth
Unused value of old transformer :	4000.00	4000.00
Disposal cost of old transformer:	20000.00	20000.00
Purchase cost of new transformer:	25000.00	25000.00
Installation cost	5000.00	5000.00
Downtime cost	1500.00	1500.00
Discount rate	0.10	
Lifespan of new transformer	25	
Annual preventive maintenance costs	275.00	2496.19
Failure rate	0.0059	
Estimated hours to repair	79.00	
Labor cost per hour.	20.00	
Corrective maintenance materials	100.00	
Total corrective maintenance:		89.97
DOE region	5	
Annual Energy losses	4500.00	39624.91
Other recurring costs	100.00	907.70
Scrap value of new transformer	5000.00	461.48
Other non recurring costs.	200.00	77.11
When expenditure is anticipated.	10	

Figure 5. LCAA Replace Summary.

2. When entering costs, do not use dollar signs. Just type the number. Entering any characters other than a digit or decimal point will cause an error.

3. Don't worry about making mistakes. You can always go back and correct your work.

Saving and Recovering Sessions

The record of an LCCA session is saved in an LCCA file. These files are distinguished by the fact that their names always end in ".lcca".

tank500c.lcca

When storing or recovering sessions, the name of the file must be typed in full (including the ".lcca"). These files only work with the LCCA program, and cannot be printed or displayed meaningfully outside of the LCCA program. When you enter the program, you are given a list of all LCCA files.

FDA sessions also may be saved. Choose a descriptive file name to help identify the session. Adding ".fda" as an ending also aids identification, but is not necessary for successful recovery of the file.

NOTE: For users familiar with UNIX--Any LCCA or FDA files are stored in the directory from which the PCB system was invoked. It is recommended that this directory be the home directory, or saved sessions may be difficult to recover.

Obtaining a Hard Copy

If you have an IBM or IBM-compatible personal computer, turn on the printer and print a file summary by holding down the 'ctrl' key and pressing 'Prt Sc'. For other systems, or for different communications software, consult the printer manuals or contact the ETIS Support Center at (217) 333-1369.

Leaving the System

To immediately exit the PCB system or any of its parent systems, type

bye or

end or

quit

at the prompt. [Bye] or [quit] are also valid answers to any question in order to exit a subprogram and return to the system prompt. Once the original prompt appears on the screen, you have successfully exited the system. Type

logout

and then disconnect remote communication according to the manual. If problems arise, contact the ETIS Support Center at 217-333-1369.

4 SUMMARY AND RECOMMENDATIONS

This report has provided user instructions on accessing and using the PCB Transformer System interactively. The necessary commands and instructions are included. Some typical examples were provided to illustrate system use.

It is recommended that the PCB Transformer System be used as an aid for making sound decisions on maintaining or replacing PCB transformers to meet the requirements of the Toxic Substances Control Act and the regulations controlling the use of these transformers.

APPENDIX A: Transformer Risk Assessment

Transformer Risk Assessment

MODIFIED FROM: PCB Compliance Assessment and Spill Control Guide. NEESA 20.2-028A. Navy Environmental Support Office, August, 1982.

The Transformer Risk Assessment will help to determine the degree of hazard associated with a particular transformer or group of transformers. This risk assessment is intended to be used for determining priorities for action.

After answering the following questions, you will see a listing of the total risk factors and the risk categories. The specific number of points given to a transformer will rank it against others.

A suggested scheme for assigning PCB transformers to priority groups for overall hazard ranking is also included.

Please Note: You must input the Risk Factor listed to the left of each alternative for the assessment to work correctly. Remember, input the number; not the letter. Please read the choices carefully and select the choice which describes the transformer most closely.

Press the carriage return to continue.

Transformer Type

Risk Factor		
(0)	a)	Non-PCB filled (determined by analysis).
(2)	b)	PCB Contaminated Liquid (determined by analysis).
(5)	c)	PCB filled (determined by nameplate or analysis).
(5)	d)	Contents Unknown.

Input the Risk Factor: **2**

Labeling of Transformer

Risk Factor		
(0)	a)	No label required (non-PCB).
(1)	b)	Properly labeled.
(2)	c)	Insufficiently labeled (e.g. too small, old).
(5)	d)	Requires label, but not present.

Input the Risk Factor: **1**

Quantity

Risk Factor		
(1)	a)	Fluid level in transformer full. (If you rely on the gauge, make sure its accurate.)
(2)	b)	3/4 full.
(3)	c)	Less than half full.

Input the Risk Factor: **1**

PCB dielectric fluid in transformer:
(According to manufacturer nameplate and fluid level)

Risk Factor		
(1)	a)	Less than 10 gallons.
(2)	b)	More than 10 but less than 100 gallons.
(15)	c)	More than 100 but less than 500 gallons.
(20)	d)	More than 500 but less than 1000 gallons.

Input the Risk Factor: **15**

Location of Transformer on Site

Risk Factor		
(1)	a)	Located outdoors in transformer vault.
(2)	b)	Located outdoors on pad.
(3)	c)	Located outdoors in underground vault.
(4)	d)	Located outdoors on pole.
(5)	e)	Located in vault inside occupied building.
(6)	f)	Located in basement of occupied building.
(25)	g)	Located on upper floor in occupied building or on roof.

Input the Risk Factor: **6**

Electrical Protection

Risk Factor		
(1)	a)	Unit is NOT located in or near commercial buildings.
(5)	b)	Unit has appropriate electrical protection from current faults to reduce risk of fire.
(100)	c)	Unit is a radial PCB transformer OR a lower secondary voltage network transformer and does not have electrical protection from high current faults.
(100)	d)	Unit is a radial PCB transformer with higher secondary voltages and does not have electrical protection from low current faults.

(350) e) Unit is a network PCB transformer with higher secondary voltages.
NOTE: By USEPA regulation, the use of network PCB transformers with higher secondary voltages in or near commercial buildings is prohibited, as of October 1, 1990.

Input the Risk Factor: **5**

Condition of Transformer

Risk Factor		
(1)	a)	Transformer not leaking.
(5)	b)	No active leak, but old stains visible on casing or pad.
(100)	c)	New small stains noted, mainly around bushings or gaskets.
(150)	d)	Moderately active leak requiring control by drip pan or other means.
(175)	e)	Large leak that needs immediate repairs.
(200)	f)	Active spill contaminating transformer pad and surrounding areas.

Input the Risk Factor: **100**

Warning: This is a potentially hazardous situation and corrective measures should be taken.

Spill Containment

Risk Factor		
(1)	a)	Transformer and pad or vault has EPA-approved dike or curb to contain spilled material.
(25)	b)	Dike or curb deteriorated or damaged or not EPA approved.
(100)	c)	No spill containment (dike or curb); transformer located outdoors.
(100)	d)	Curb or dike insufficient to contain at least 10% of the material if spill occurs.
(100)	e)	No spill containment; transformer located in occupied building.

Input the Risk Factor: **1**

If entire content of the transformer were to spill, fluid would:

Risk Factor		
(1)	a)	Be contained or confined.
(2)	b)	Contaminate pad or exterior of transformer only.
(105)	c)	Contaminate nearby soil, gravel, or other materials.
(125)	d)	Contaminate occupied areas or grazing lands or vegetable gardens.
(150)	e)	Contaminate water drains, ditches, sewer, etc.
(150)	f)	Contaminate bodies of water located nearby, and migration of fluid would cause extensive contamination.
(200)	g)	Contaminate sources of public or private drinking waters.

(350) h) Be in risk of fire where occupied areas could be contaminated.
(350) i) Contaminate food storage, preparation, or serving area.
NOTE: By USEPA regulation, if this is a PCB transformer, it must have been removed from service by October 1, 1985.

Input the Risk Factor: **125**

Warning: This is a potentially hazardous situation and corrective measures should be taken.

Your Total Risk Factor is 314

Points	Risk Evaluation
350 and above	Extreme Hazard - Transformer requires immediate major corrective action.
200 - 349	Potential Hazard - Requires minor repairs.
100 - 199	Poor - Requires mainly spill containment, berm, dike, etc.
0 - 99	Good - Requires annual inspection and normal maintenance.

Do you want to see a list of steps which can be taken to reduce a high risk factor to the 0-99 range? Corrections? **n**

Would you like to see the different risk categories in order to complete the transformer(s) rating? Categories? **n**

Press carriage return to continue.

APPENDIX B: Fate Decision Analysis

Welcome to the PCB Transformer Fate Decision Analysis Program.

Would you like to see the instructions ? y

Introduction

This program will help you to determine the best option(s) for the fate of transformers containing PCBs, depending upon particular situations.

Information Needed to Answer the Questions

The age and condition of the transformer.

Whether need for the transformer will continue for more than 5 years.

Whether the capacity of the transformer is still appropriate for current use.

Whether the transformer has special characteristics (such as voltage transformation, frequency) as shown on the nameplate.

It will help if you know the concentration of PCB in transformers with contaminated insulating fluid.

The alternative options considered in the program for transformers that contain PCBs are as follows:

1) Continue to use the transformer for the remainder of its useful life (except where prohibited by regulation), accepting the responsibilities required by the PCB regulations and the risks associated with this use.

2) Decontaminate the liquid in a transformer that contains mineral oil insulating fluid contaminated with PCB in order to achieve a PCB level below 50 ppm and, thus, a nonregulated transformer.

3) Retrofill with new dielectric fluid to reduce the level of PCB and the associated risks, preferably followed by post-retrofill filtering or other method to achieve a PCB level below 50 ppm.

4) Replace the transformer with a unit containing no PCBs.

Is the liquid-filled transformer

a) Filled with an insulating fluid (askarel, etc.) that purposely contains PCB?

b) Filled with mineral oil insulating fluid known to contain 500 ppm or greater of PCB?

c) Missing the nameplate and lacking information on the identity of the insulating fluid or whether it contains PCB?

d) Filled with insulating fluid known to contain 50 ppm or greater but less than 500 ppm of PCB?

e) Filled with mineral oil insulating fluid that has not been tested for PCB content?

f) Filled with insulating fluid known to contain less than 50 ppm of PCB as the result of analysis?

Choose (a,b,c,d,e or f) or type 'help' to see list of coolants which contain PCBs.

? **a**

This is a PCB transformer.
Press <cr> to continue.

? **<cr>**

As of December 1, 1985, combustible materials (including paints, solvents, plastics, paper and wood) must not be stored within a PCB transformer enclosure, within 5 meters of a transformer enclosure, or within 5 meters of a PCB transformer.

Additionally, as of December 1, 1985, all PCB transformers must be registered with fire response personnel. If the transformer is involved in a fire-related incident, the owner must immediately report the incident to the National Response Center (800-424-8802) and measures must be taken as soon as practically and safely possible to contain and control any releases of PCBs and incomplete combustion products into water (or the environment or into areas where humans may be exposed.)

Press <cr> to continue.

? **<cr>**

Does the transformer pose an exposure risk to food or feed as defined by USEPA (i.e., located where human food or feed products could be exposed to PCBs released from the transformer)?
(See Definitions if clarification is needed.) (yes or no)

? **n**

Is the transformer located in or near commercial buildings (see definitions for clarification) ? (yes or no)

? **y**

Installation of PCB transformers in or near commercial buildings is prohibited as of October 1, 1985.

As of October 1, 1990, the use of network PCB transformers with higher secondary voltages in or near commercial buildings is prohibited; all radial PCB transformers and lower secondary voltage network PCB transformers in use in or near commercial buildings must be equipped with electrical protection to avoid transformer failure caused by high current fault; and all radial PCB transformers with higher secondary voltages in use in or near commercial buildings must be equipped with protection to avoid transformer failure caused by sustained low current faults.

These precautions are to prevent the possibility of transformer failure resulting in rupture or fire.

Do you want to see what considerations are necessary for transformer replacement? (yes or no)

? **y**

Can the transformer be relocated at the facility to serve the same load without an increase in hazard?
(yes or no)

? **n**

In order to select a replacement transformer it is necessary to first determine what size and type of transformer will meet your requirements? If you would like to see a listing of alternative types of transformers available, type <help> or press <cr> to continue.

? **<cr>**

If you would like to see a list of cost elements to consider to determine the cost of transformer replacement, type <help> or press <cr> to continue.

? **<cr>**

If you want to see information on the contents and use of spill cleanup kit, type <help> or press <cr> to continue.

? **<cr>**

If you would like to see information concerning USEPA fines and penalties for spills, type <help> or press <cr> to continue.

? **<cr>**

If you would like to see information on potential costs of PCB spill cleanup, type <help> or press <cr> to continue.

? **<cr>**

When a PCB or PCB-contaminated transformer is replaced or removed from service, the old transformer and dielectric fluid must be disposed of properly. For additional information on disposal requirements, see abstract #35 under the main menu item #3 of the PCB Transformer System. [Note: ARMY facilities should turn in the transformer to the Defense Reutilization and Marketing Office.] If you want to see a listing of the procedures type <help> or <cr> to continue.

? **<cr>**

Do you want to try another alternative for your transformer?
(yes or no)

? **n**

Do you want to see the path you took during this session? **y**
Do you want the path saved in a file? **y**
Input the file name? **tank5.fda**
Would you like to repeat the Fate Decision Analysis ? **n**

Goodbye from the Fate Decision Analysis . . .

APPENDIX C: Life Cycle Cost Analysis

Life Cycle Cost Analysis

You will need the following information to complete the life cycle cost analysis:

1) Estimate of cost of service (decontamination or retrofill) or product (transformer) for which life cycle cost analysis is being performed and delivery costs, installation costs, etc...

---Some helps for obtaining estimates of these costs are available in the program.

2) Estimate of useful life of the transformer unit.

3) Estimate of operation and maintenance costs--preventive maintenance, corrective maintenance (see table), operation labor, operation materials.

---Some helps for obtaining estimates of these costs are available in the program.

4) Estimate of transformer efficiency for determining power losses. Some information is available in the program to help make a rough estimate, but the best information comes from the manufacturer of the particular transformer.

If you do not have the above information enter stop. Enter a carriage return to continue.

ok, here we go...

Available records of previous sessions are:
*.lcca not found
You may continue one of these sessions by typing its name,
or press <CR> to start a new session. : **<cr>**

NOTE: 1985 is the default base-year for energy cost calculations.

Analysis for base year 1985.

	1-Retain	2-Replace	3-Retrofill	4-Decontaminate
Initial Costs	NOT	NOT	NOT	NOT
Recurring Costs				
Non-Recurring Costs	TRIED	TRIED	TRIED	TRIED
Total Costs				
Ave. Annual Costs				

You can investigate or correct data for an alternative (eg. Retrofill) by entering the number displayed above with the alternative.
You can quit the program by typing 'q'.
You can change the base year of the analysis by typing 'year'.
You can see a summary of your work by typing 'sum'.

What do you wish to do? **2**

Initial Costs

The following are costs to replace a transformer with a new one. For any cost that does not apply in a particular case, enter a zero on the appropriate line.

Enter the unused value of the old transformer, if any.
[If a PCB transformer is disposed before the end of useful life, that value is discarded and is considered part of the cost of replacing the transformer. However, if the transformer can be sold or used elsewhere, its value is not lost and is not a cost of replacement. NOTE: Remember that a PCB transformer (500 ppm or more) can not be sold for scrap. At the end of its useful life it must be properly disposed.]

Enter unused value of old transformer: **4000**

Enter removal costs and, if any, disposal costs for the old transformer and dielectric fluid. Type help for information on estimating disposal costs for transformers and fluids.
NOTE: Army facilities should arrange with the local Defense Reutilization and Marketing Officer for disposal of transformers and fluid containing PCBs. Consult the DRMO about disposal costs.

HELP AVAILABLE

Disposal cost is: **20000**

Enter total cost of acquisition of a new transformer. Include purchase cost of transformer and dielectric fluid, delivery costs, and testing costs. Type help if you want to see information on estimating these costs.

HELP AVAILABLE

Purchase cost is: **25000**

Enter installation costs, including costs of any structural changes such as impoundment basin or vault per the National Electric code or costs for transition wiring, etc., if the transformer will be installed in a different location. Type help if you want to see information on estimating these costs.

HELP AVAILABLE

Installation cost is: **5000**

Enter downtime costs. Type help if you want to see information on estimating these costs.

HELP AVAILABLE

Downtime cost is: **1500**

Recurring Costs

Enter the annual cost estimate for preventive inspection and general maintenance including labor and material. Type help if you want to see a list of recommended preventive maintenance tests and their estimated costs.

HELP AVAILABLE

Annual preventive maintenance costs **$275**

Corrective maintenance costs for the transformer must be considered.
Do you wish to see the annual rate of failure for various types of transformers and the time for repair as determined from a survey of industrial plants? (yes or no)

Table ? **n**

Enter failure rate per year for transformer.

Failure Rate: **.0059**

Enter estimated hours to repair or replace with a spare, as appropriate in your case.

Total Hours: **79**

Enter current value for labor cost per hour.

Labor Rate: **20**

Enter estimated materials costs for corrective maintenance.
If none, enter zero.

Materials Costs: **100**

We will now consider the present value of electrical costs spent sometime in the future. You must enter your DOE region and the amount you now spend for electricity for energy losses (mid 1983). These will be used to calculate the present value of your future electrical costs.

Enter your DOE region. If you are unsure what your DOE region is, enter the word help.

HELP AVAILABLE

DOE region is: **5**

Now enter your current annual costs for electrical energy losses.
Type help if you want to see information on losses for various types of transformers and calculation of the costs.

HELP AVAILABLE

Current costs are: **4500**

Enter estimated annual costs in current dollars for other recurring costs, if any. If none, enter zero.

Annual recurring costs are **$100**

A discount rate must be used to convert future to present worth. The Federal Office of Management and Budget and the Dept. of the Army have stipulated the use of a discount rate of 10 percent except for certain costs such as fuel and electricity.

Enter the discount rate as a decimal (10 percent = 0.1).
Discount rate is **.10**

Enter the estimated years of remaining life of the transformer.

Expected lifespan of new transformer: **25**

Analysis for base year 1985.

	1-Retain	2-Replace	3-Retrofill	4-Decontaminate
Initial Costs	NOT	55500.00	NOT	NOT
Recurring Costs		43118.77		
Non-Recurring Costs	TRIED	-384.37	TRIED	TRIED
Total Costs		98234.40		
Ave. Annual Costs		10822.30		

You can investigate or correct data for an alternative (e.g., Retrofill)
by entering the number displayed above with the alternative.
You can quit the program by typing 'q'.
You can change the base year of the analysis by typing 'year'.
You can see a summary of your work by typing 'sum'.

What do you wish to do? **sum**
You can print a copy of the summary by turning on your printer now.
Press Return to continue **<cr>**

Replacement option	Input Values	Present Worth
Unused value of old transformer :	4000.00	4000.00
Disposal cost of old transformer:	20000.00	20000.00
Purchase cost of new transformer:	25000.00	25000.00
Installation cost	5000.00	5000.00
Downtime cost	1500.00	1500.00
Discount rate	0.10	
Lifespan of new transformer	25	
Annual preventive maintenance costs	275.00	2496.19
Failure rate	0.0059	
Estimated hours to repair	79.00	
Labor cost per hour.	20.00	
Corrective maintenance materials	100.00	
Total corrective maintenance:		89.97
DOE region	5	
Annual Energy losses	4500.00	39624.91
Other recurring costs	100.00	907.70
Scrap value of new transformer	5000.00	461.48

Other non recurring costs.	200.00	77.11
When expenditure is anticipated.	10	

Please Return to continue **<cr>**

Analysis for base year 1985.

	1-Retain	2-Replace	3-Retrofill	4-Decontaminate
Initial Costs	NOT	55500.00	NOT	NOT
Recurring Costs		43118.77		
Non-Recurring Costs	TRIED	-384.37	TRIED	TRIED
Total Costs		98234.40		
Ave. Annual Costs		10822.30		

You can investigate or correct data for an alternative (e.g., Retrofill) by entering the number displayed above with the alternative.
You can quit the program by typing 'q'.
You can change the base year of the analysis by typing 'year'.
You can see a summary of your work by typing 'sum'.

What do you wish to do? **q**
Do you want to save this session? **y**
Enter a filename, or just press <CR> for default.lcca: **leaker.lcca**
Saving session in leaker.lcca.
Session saved in leaker.lcca.

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