COMMENTS OF

THE UTILITY SOLID WASTE ACTIVITIES GROUP,

THE EDISON ELECTRIC INSTITUTE,

THE AMERICAN PUBLIC POWER ASSOCIATION AND

THE NATIONAL RURAL ELECTRIC COOPERATIVE ASSOCIATION

IN RESPONSE TO

ADVANCE NOTICE OF PROPOSED RULEMAKING

CONCERNING RISKS POSED BY FIRES INVOLVING

PCB-CONTAINING TRANSFORMERS

49 Fed. Reg. 11070

(March 23, 1984)

Docket No. OPTS-62035

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The United States
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of Counsel:

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The following comments are submitted on behalf of the Utility Solid Waste Activities Group (USWAG), the Edison Electric Institute (EEI), the American Public Power Association (APPA), and the National Rural Electric Cooperative Association (NRECA) in response to an Advance Notice of Proposed Rulemaking (ANPR) issued by the U.S. Environmental Protection Agency (EPA). 49 Fed. Reg. 11070 (March 23, 1984). Specifically, EPA sought data regarding the risks posed by fires involving electrical transformers that contain PCBs and the mechanisms for eliminating or mitigating these risks.

USWAG is an informal consortium of EEI, APPA and NRECA and approximately 65 electric utility operating companies. EEI is the principal national association of investor-owned electric light and power companies. APPA is the national association of publicly-owned electric utilities. NRECA is the national association of rural electric cooperatives. Together, USWAG members represent more than 85 percent of the total electric generating capacity of the United States, and service more than 95 percent of the nation's consumers of electricity.*/

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*/ A list of USWAG members participating in these comments is attached hereto as Exhibit 1.

INTRODUCTION AND SUMMARY OF POSITION

In August 1982, EPA authorized the use of a population of transformers containing or contaminated with PCBs for the remainder of their useful lives. This authorization was based on EPA's determination that the continued use of such equipment did not pose an unreasonable risk to human health or the environment. Underlying this ultimate conclusion were the following findings (see 49 Fed. Reg. at 11070):

1. The resulting reduction in risk, in the absence of such authorization, was insufficient to outweigh the substantial costs (billions of dollars) involved in such an action.

2. Servicing conditions, maintenance activities, and inspection programs reduced the exposure risks associated with the use of PCBs in transformers.

3. Releases of PCBs to the environment and exposure to humans were minimal.

4. Accelerated phase-out and other risk reduction programs were not reasonable when compared to the potential reduction in release of PCBs achieved.

Prompted by a challenge to these findings filed by EDF/NRDC and reports of three fire incidents involving PCB Transformers, EPA issued the ANPR in March 1984 seeking further information on risks to the public health and environment posed by fire-related events. Notwithstanding the fact-finding mission intended by the ANPR, EPA concluded, based only on the very limited data there presented, that "PCB-Transformer fires pose relatively high risks, occur with unknown frequency and can result in relatively high clean-up costs." Id. at 11071. These comments and the analyses, studies and materials on which they are based demonstrate that EPA's initial conclusions cannot be supported.

Specifically, in response to the ANPR, USWAG conducted an extensive survey of electric utility companies regarding the current inventory of high-concentration, PCB Transformers (referred to hereinafter as "askarel transformers"); fire incidents that have involved such equipment; ensuing clean-up costs and other matters.*/ These data and other information discussed below regarding the matters on which EPA solicited data, show that:

1. The risks posed to human health and the environment in the event of a fire-related incident involving an askarel transformer, including any effects from exposure to the products of PCB combustion, are <u>de minimis</u> if not non-existent.

2. The probability of fire-related events occurring is extremely low.

3. The costs involved in cleaning-up the two fire incidents identified by EPA as "relatively high"**/ are not representative.

4. The costs associated with the available options for mitigating or eliminating the minimal risks posed by fires involving askarel transformers, are not reasonable when compared to the potential reduction in exposure risk; or put another way, the resulting reduction in risk clearly would not outweigh the substantial costs involved.

As EPA is aware, the electric utility industry has been deeply and responsibly involved in the management of PCBs for more than a decade. <u>See</u> USWAG/EEI/NRECA, Comments and Studies on the Use of Polychlorinated Biphenyls in Response to An Order of the United States Court of Appeals for the

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*/ A report on the survey conducted by Resource Planning Corporation is attached as Exhibit 2 ("RPC 1984 Report").

**/ 49 Fed. Reg. at 11071.

District of Columbia Court, Feb. 12, 1982, Vol. I at 1-2 ("1982 Comments"). The industry continues to be supportive of control measures that can be justified by the body of scientific evidence.*/ But however that evidence is weighed, there has been no acknowledgement of the effectiveness of the PCB control measures already in place. Thus there is growing industry concern that this failure to recognize the effect of the controls in substantially eliminating release of PCBs in the environment and exposure of humans to PCBs has distorted the public's view regarding the continued use of PCBs.

Current control measures, regardless of whether one now views them to be justified by the scientific evidence, are effective. The need for additional and more restrictive regulations is highly questionable. Even in the case of fire incidents involving askarel transformers, where EPA believes that certain by-products of pyrolysis or combustion -- more so than the PCBs themselves -- pose some sort of risk to human health, the perceived human risk described by EPA appears to be based on the presence of the chemical (whether PCBs, PCDFs or PCDDs) rather than on the actual exposure levels and the effect of that actual exposure. Overall, the existing evidence shows that fires involving askarel transformers are rare, that utilities

*/ It is USWAG's overall view that this evidence, notwithstanding prior Congressional and regulatory action, does not warrant many of the restrictions in place today.

have programs underway to eliminate any perceived potential risks resulting from even these rare incidents, and that further regulation of this industry's equipment is unnecessary.

While the focus of these comments is that no further regulation is warranted because of fires involving askarel transformers, USWAG wants to emphasize that the arguments against further regulation of mineral oil transformers are even stronger.

I. DATA REGARDING USE OF ASKAREL TRANSFORMERS AND FIRE-RELATED INCIDENTS

The electric utility industry has used equipment containing PCBs for over 50 years. Some equipment, because of its location or electrical properties, was designed to use PCBs as a dielectric fluid. This equipment included transformers that would be used in locations where fire prevention was a significant factor. Thus, as shown in USWAG's 1981 survey, of the 39,640 askarel transformers then owned by the industry, some 22,469 were located in the utilities' distribution systems. RPC 1984 Report at 6. Other transformers in use on electric systems, numbering about 20 million, customarily used mineral oil as a dielectric fluid. As a result of manufacturing or servicing conditions, some of this equipment was found to contain concentrations of PCBs over 50 ppm.*/

*/ Approximately 10% of the mineral oil transformers were found to have PCB concentration levels above 50 ppm, while only 1% were found to have concentration levels above 500 ppm. 1982 Comments, Vol. III at 9.

In responding to the ANPR, USWAG focused its data gathering efforts only on high concentration, askarel transformers. This approach was taken for several reasons. First, the three incidents that appeared to have triggered EPA's concern each involved an askarel transformer. Second, there is a general belief in the industry that the problems associated with mineral oil fires are substantially different than those raised by EPA in the ANPR; i.e., the significant concern of a mineral oil fire is the fire itself and its potential to cause severe injury to people and property. In addition, as discussed in Section III, the potential production of chemical by-products from conversion of PCBs during a mineral oil fire is believed to be minimal. Finally, as shown in the 1982 RPC report (see, e.g., 1982 Comments, Vol. III at 150-59), and as concluded by EPA in the August 1982 rule (see, e.g., 47 Fed. Reg. 37345-47 (1982)), the cost of the available risk reduction options regarding the use of mineral oil equipment, amounting to billions of dollars, would be totally unreasonable compared to the benefits achieved.

The 1984 RPC questionnaire, therefore, principally sought information in three areas:

1. The number and location of askarel transformers owned by the electric utility industry, including the utilities' plans affecting the future use of this equipment;

2. The frequency, timing, location and circumstances of fire incidents that occurred over the last three years and involved askarel transformers; the cost of clean up following such incidents, and the populations exposed to such incidents; and

3. The utilities' experience with retrofill options.

The complete results of the RPC survey are submitted herewith as Exhibit 2. A summary of the findings follow

A. Inventory of Utility-Owned Askarel Transformers

1. Current Inventory

When first surveyed in 1981, the utility industry was estimated to own 39,640 askarel transformers out of a total universe of about 140,000 then in service. Of those 39,640, some 57% or 22,469 were located on the utilities' distribution systems.

Current data show that the electric utilities now own about 36,000 such transformers of which some 18,291 remain in service on the distribution systems. As concluded by RPC, the magnitude of the decline in the inventory is greater than normally would be expected, primarily due to phase-out programs initiated by some of the companies.*/

The general location of the askarel transformers on the distribution systems was found to be as follows:**/

	Number of Transformers	Percent of Total
Inside Building	6,000	32.8
Sidewalk Vaults	10,919	59.7
Other	1,372	7.5
Total	18,291	100.0

The overwhelming majority of indoor transformers (84.5%) are located in vaults within the building, while 9.3%

*/ These programs are discussed in the next section.

**/ RPC 1984 Report, Table 1 at 6.

are located in separate transformer rooms; only 6.1% are installed in open areas.

Natural ventilation to the outside predominates even with regard to the indoor equipment. Further, less than half of the indoor transformers are installed in locations where there is direct access to air conditioning or heating system intake vents. In total, of the 6,000 indoor installations, less than 60 transformers are found in vaults or rooms in which such intake vents are located and less than 2,700 are found where such intake vents are in the area immediately adjacent to the transformer vault or room.*/ While other indirect routes to heating and air conditioning systems can be identified, it is considerably less likely that these routes would provide a pathway for significant smoke travel. RPI 1984 Report at 8.

2. Voluntary Phase-Out Programs

As indicated in the RPC survey, 76% of the surveyed utilities have askarel transformer phase-out programs in effect. Id. at 12. Based on these voluntary programs, it is

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*/ RPC 1984 Report at 8. Of the 12,291 transformers located in outdoor installations, approximately 1,350 are located immediately adjacent to building heating and/or air conditioning systems that could serve as a means of building access for smoke/soot. Id.

estimated that the number of distribution system askarel transformers will be reduced from 18,291 to 12,987 by the end of 1985 (a reduction of 29%), to 6,402 by 1989 (a reduction of 65%), and to 2,927 by 1994. Id., Table 5 at 13. Thus, of the distribution askarel transformers on line today, only 16% of them are expected to remain in use in ten years.

Notwithstanding the adoption of these programs by many of the utilities, USWAG believes that the continued use of askarel transformers does not pose an unreasonable risk of injury to human health or the environment. These actions have been undertaken against a background of several concerns. First, there has been media and community expression of perceived risk from any exposure to PCBs. In addition, there have been two instances (Binghamton and San Francisco) in which very high clean-up costs have been incurred, in part because of the absence of any clean-up standards. The uncertainty of the financial consequences that could be imposed in regard to clean up, and from potential litigation, regardless of its merits, has resulted in business judgments to phase out some of the askarel transformers.

We feel the actions the industry is collectively taking deserve some recognition and credit by the Agency in its analysis. At the same time, however, the initiation of these programs should not be viewed as industry agreement that any unreasonable risk exists or that further regulatory action is warranted.

B. Frequency and Nature of Fire Incidents

1. Frequency of the Incidents

As shown by the RPC data (RPC 1984 Report at 9-11), the annual number of expected fire incidents involving utility-owned askarel transformers is extremely low. Only eight such incidents have occurred over the last three years, indicating an annual estimated rate of 0.01%. Of these, none occurred in industrial locations or in utility substation or generating facilities. In addition, despite the one dramatic event at Market Plaza in San Francisco in 1983, the actual amount of smoke travel associated with the incidents was negligible. In one incident no smoke escaped from the transformer. While smoke escaped from the transformer in the other seven incidents, in five cases the smoke either did not enter the building (two outdoor installations) or entered only the area immediately adjacent to the equipment (three indoor installations). In only two incidents involving utility-owned equipment did smoke travel into public areas of a building. These situations involved the Market Plaza/San Francisco and First National Bank/Chicago incidents that are discussed more fully below.

2. Exposure Levels

The only data available regarding the chemical composition in samples taken following fire incidents involving askarel transformers are the data obtained following the Binghamton, Market Plaza and First National Bank incidents. As acknowledged by EPA in the ANPR, no PCDFs and no PCDDs were found in the wipe samples from the bank building. 49 Fed. Reg. at 11073. While contaminant levels were found at the other two locations, USWAG believes that the significance of these findings can only be determined in conjunction with the degree to which given populations can be expected to be exposed to the contaminants and the effect of any such exposure taking into account the expected levels of absorption.*/

USWAG believes that the current information regarding exposure and exposure effects from contaminants that might be produced when askarel transformers are involved with fires are insufficient to justify any new regulatory programs to restrict the use of such transformers. To provide an analytical tool by which to better evaluate these effects, USWAG is implementing a decision framework model that was developed in a research project by the Electric Power Research Institute ("EPRI") (RP 2595). The framework will be completed shortly and will be submitted to EPA. We note, though, that preliminary results indicate that even multiple exposure to the contaminants does not lead to unacceptable excess cancer risk.

3. Clean-Up Costs

Survey data indicate that the average clean-up cost for an inside building incident, excluding the Market Plaza fire, was about $278,925. Clean-up costs following an incident involving a sidewalk vault averaged a full order of magnitude less, or about $27,700. It thus appears that the clean-up costs associated with Market Plaza are aberrant.

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*/ For example, as reported in the RPC survey, few utility workers and firefighters were exposed to soot/smoke and even fewer members of the general public were involved. RPC 1984 Report at 10, 11.

4. Factors Decreasing Fire Incidents

As indicated above, phase-out programs in place will substantially reduce the number of askarel transformers that could become involved in a fire incident. That decline, coupled with the overall incident rate, shows conclusively that the risk of a fire incident in the future on utility systems is very low, as shown in the following table:

EXPECTED NUMBER OF ASKAREL TRANSFORMER FIRE INCIDENTS IN THE ELECTRIC UTILITY INDUSTRY

Year	Estimated # of Askarels**	Estimated # of Fire Incidents
1984	35,984	4.6
1985	30,238	3.9
1986	27,601	3.5
1987	25,147	3.2
1988	23,424	3.0
1989	21,885	2.8
1990	20,711	2.7
1991	19,538	2.5
1992	18,364	2.4
1993	17,373	2.2
1994	16,200	2.1

**RPC 1984 Report, Table 5 at 13, and assumes 20-year average useful remaining life for substation/generating facility transformer.

The likelihood of such incidents occurring also is mitigated by the presence of protective devices (fuses, switches or breakers) on many distribution systems. Such devices are installed to isolate the transformer in the event of a fault. Seventy-five percent of the distribution askarel transformers have protective devices on the low voltage side of the transformer, while 19% of the equipment have them installed on the high side. RPC 1984 Report at 12.

C. Retrofilling Experience

RPC sought data from the utilities concerning their experience with flush/refill and filtering processes to determine the frequency with which these methods have been used, the levels of PCBs achieved over time, and the costs of the program. As indicated in the report, the results have been extremely erratic and cannot be correlated with the methods used, the time elapsed or the expenditure made. RPC 1984 Report, Table 8 at 16. USWAG believes, therefore, that there is no basis to alter the conclusion it reached two years ago that retrofilling askarel transformers is not, in the overwhelming majority of cases, cost effective. **See** USWAG EEI NRECA Reply Comments on Proposed Rules on the Use of Polychlorinated Biphenyls in Electric Equipment, June 24, 1982, at 22. Furthermore, there continues to be too little known regarding the electrical and fire resistant properties and toxicity of the substitute fluids to in any way compel their use. **See** Section IV. A., infra.

D. Impact of RPC Data on EPA Initial Estimates

The information provided by RPC demonstrates that data on which EPA based its preliminary assessment of the risk posed by the continued use of askarel transformers are seriously flawed. Fires involving these transformers are rare, isolated events. In addition, while abnormally high clean-up costs have been incurred in two cases (one of which did not involve a utility-owned transformer), the expected level of clean-up costs is substantially less.

1. Frequency of Fire Incidents

The RPC data on the number of expected fire incidents contrast significantly with most of the estimates noted by EPA in the ANPR. If EPA continues to define a catastrophic incident as one in which clean-up costs of \$15-20 million can be expected, a catastrophic fire incident involving a utility-owned askarel transformer can be expected approximately once every 2.5 years. (This figure is based solely on the number of transformers adjacent to intake systems.)*/ RPC 1984 Report at 19, 20. If the focus is placed on the number of incidents in which

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*/ This frequency rate was derived as follows: RPC identified 2700 indoor askarel transformers (6000 total indoor transformers (Table 1, p. 6) x 44.7% (the percentage of indoor transformers adjacent to intake vents)) and 1300 outdoor askarel transformers (12,291 total outdoor transformers (Table 1, p. 6, and p. 8) x 10.9% (the percentage of outdoor transformers adjacent to intake vents)) as being potentially involved in what EPA has defined as a catastrophic fire. See generally RPC 1984 Report at 19. These 4000 transformers were multiplied by the reported frequency rate of askarel transformer fires of 0.01% to arrive at 0.4 fires per year, the equivalent of 1 fire every 2.5 years. If measured against the total population of equipment, the frequency rate would, of course, be dramatically less.

smoke reached substantial portions of a building, the expectancy rate based on the utility data is the same. Again, it was only in the Market Plaza incident that smoke was carried in any significant way into the public building.

2. Clean-up Costs

As discussed above, the RPC data show that the level of clean-up costs averaged about $279,000 in indoor installations, and $27,700 in sidewalk vaults. These levels, rather than the aberrational $15-20 million figures, should be used in analyzing the regulatory programs relating to the continued use of askarel transformers.

II. REPRESENTATIVES OF THE BINGHAMTON, SAN FRANCISCO AND CHICAGO INCIDENTS

The issuance of the ANPR was essentially prompted by three fire incidents that involved askarel transformers. These fires occurred in Binghamton, New York, San Francisco, California, and Chicago, Illinois. From its analyses of these fires, EPA appears to have concluded that PCB Transformer "fires pose relatively high risks" and "can result in relatively high clean-up costs." 49 Fed. Reg. at 11071. As indicated in Section I, these conclusions cannot be supported based on the utility data collected. In addition to seeking new data, EPA solicited comments on the representativeness of three fires in terms of the risks posed. This aspect of the ANPR is addressed below.

USWAG believes that these incidents, as they are described by EPA, are anomalies for two reasons: (1) they are infrequent occurrences and (2) the potential risks are overstated. While the Agency indicates these fires are "the three most well-characterized and well-researched incidents." 49 Fed. Reg at 11071. the knowledge, as presented in the ANPR and rulemaking record, on the causes of the fires, the sources of contamination, the levels and extent of contamination, the exposure risks and the health consequences of that exposure is sparse. In addition, the circumstances and results of the fires are significantly different from one another and do not, together, create a picture of significant risk from the continued use of askarel transformers.*/

A. Fires Associated with Askarel Tranformers Are Rare

EPA has presented data on the three fires. The data for two of the incidents show the formation and distribution of PCBs and PCB combustion by-products. Based upon USWAG's study of the frequency of significant events, only one utility incident was identified as catastrophic based on EPA's definition, that being the San Francisco fire at One Market Plaza, May 15, 1983. While the electric utility industry may own only one-third of the askarel transformers in service, USWAG believes that its data indicate an infrequent occurrence of this type of event. From USWAG's survey, this indicates that a "catastrophic

*/ The three affected transformers on which EPA is focusing contained a high concentration of PCBs (65% or greater). USWAG has previously argued that askarel transformers (containing PCBs) are different from mineral oil transformers that may be contaminated with PCBs. See 1982 Comments, Vol. I. In this rulemaking, USWAG believes that it is particularly important for the Agency to distinguish between the two types of equipment in order to make a proper evaluation of the risks. It is imperative that the Agency formally acknowledge the difference in the preperation of its proposed rule.

failure," as EPA refers to it (49 Fed. Reg. at 11079), has the potential to occur approximately once in every 2.5 years (0.4 events per year) for utility-owned askarel transformers. RPC 1984 Report at 19, 20.

EPA must consider the frequency with which askarel transformer fires may occur in its risk evaluation. Equally important is the fact that the population of askarel transformers is declining in the utility industry. See Section I. Therefore, the chances that an askarel transformer will become involved in a fire are rapidly diminishing.*/

B. Potential Risks Are Overstated

Apart from the infrequency with which a Binghamton or San Francisco fire may potentially occur, the risks involved with such an event and continued use of askarel transformers are overstated as a result of the discovery of PCDFs and PCDDs at the two buildings. It thus appears, in retrospect, that the initial finding of concentrations of PCDFs and PCDDs at Binghamton led to an over-reaction and concern for public health protection from the use of askarel transformers. This over-reaction stems from the mere presence of two substances that are interpreted to be highly toxic. While the distribution

*/ The Agency also must not lose sight of the fact that the reason askarel fluids were originally used was because of their fire resistant properties.

of these by-products throughout the building in Binghamton and portions of the building in San Francisco is unfortunate, there is still much to be learned about the events and there are many unanswered questions that need be addressed. Some of the facts surrounding the incidents indicate a far lower hazard than EPA's analysis shows.

1. Causes of Fires May Be Preventable

The discussion of the cause of the Binghamton fire in the ANPR and Versar's Report (Exposure Assessment: Fires Involving PCB Transformers) is very sparse. We merely know, based on communications with the New York State Office of Government Services (which owns the equipment) and others that a fire occurred in the switch gear. USWAG is aware that EPRI is planning to conduct detailed case studies of Binghamton and San Francisco (RP 1263-20, Project Officer: Ralph Komai) that should be completed by October 1984.*/ The study's results should provide useful information on the actual causes of the events and thereby avoid any misinterpretation based only on current information. We therefore suggest EPA await the results of this report before determining whether any changes in the use rules are appropriate.

*/ PCB Technical Report from EPRI, Number 8, attached hereto as Exhibit 3, presents a summary of the many relevant projects now in progress.

Similarly, for the San Francisco and Chicago fires there is little or no information presented on the causes of the events. No conclusion, therefore, can be reached that these events and the occurrence at Binghamton resulted from comparable causes.

2. Levels of Contaminants Formed Is Inconsistent

The New York State Health Department was the first group to detect and quantify PCBs, PCDFs, and PCDDs in soot samples taken from the Binghamton fire. USWAG notes the extreme variation in results from the ANPR and the Versar report.*/ These divergent results indicate a great uncertainty about the levels of contaminants to which people potentially may have been exposed.

*/ See ANPR, 49 Fed. Reg. at p. 11072 and Versar Report at 6.

EPA notes the variation in results between samples, but fails to focus on the real import of the problem. That problem occurs because there is a huge disparity in test results for even a single sample. That sample, number 811711965, was tested by three analytical chemists in four chemical analyses. Versar Report at 6. The results are reported for 2,3,7,8-TCDF and TCDD as follows:

	Smith 1981a	Smith 1981b	Rappe 1981	Stalling 1981
2,3,7,8-TCDF (ug/g)	273, 124	48	12	- - -
2,3,7,8-TCDD (ug/g)	2.8, 2.9	1.2	0.6	5

There is more than a 20-fold difference in result between Rappe and Smith for 2,3,7,8-TCDF and more than an 8-fold difference between Rappe and Stalling on 2,3,7,8-TCDD.

Notwithstanding these major differences in results, EPA appears to rely on the results of soot samples first taken from Binghamton by the New York State Health Department. These values of 273 ppm and 124 ppm for 2,3,7,8-TCDF are significantly different from the values reported in a separate analysis of the sample by New York State, 48 ppm, and Dr. Rappe, 12 ppm. 49 **Fed. Reg.** at 11072. In light of these disparate results EPA cannot properly view the 273 ppm or 124 ppm levels of contamination as representative.

Evidently, the analytical chemistry of what are the toxic compounds of concern is uncertain. This fact was confirmed in a recent interview with Dr. Christoffer Rappe of the University of Umea, Sweden,*/ one of the Binghamton investigators and a leading world expert in the synthesis and analysis of PCDDs and PCDFs. Dr. Rappe indicated that (1) there are only three laboratories capable of performing the analysis of these compounds, (2) the separation of the 2,3,7,8 isomer from the 2,3,4,8 isomer (the latter, in his assessment, a non-toxic isomer) was critical to proper quantification, and (3) the extraction of PCDDs and PCDFs from soot particles is a rigorous operation requiring strong solvents; because of this problem, he suggested that the question of whether the by-products were actually biologically available to cause harm should be addressed.

In light of Dr. Rappe's remarks and the results of the 811711965 sample, it appears that there is an inconsistent, if not totally uncertain, knowledge about the contamination at Binghamton. Given the resulting levels and the significance of the level of contamination in evaluating exposure risks, the actual risk posed may be significantly less than assumed by EPA.

3. <u>Confounding Sources of PCDFs and PCDDs</u>

A further complicating fact that has not been addressed

*/ Representatives of USWAG met with Dr. Rappe in New York City on June 8, 1984, to discuss his scientific opinion on (1) sources of PCDDs and PCDFs, (2) linear by-product formation, (3) by-products of substitute fluids, and (4) human exposure.

at all is the existence of confounding sources of PCDFs and PCDDs. According to Dr. Rappe, it is difficult to distinguish the origin of PCDFs and PCDDs. Conceivable sources are polyvinyl chloride and flame retardant chlorinated hydrocarbons, both commonly used substances in buildings. Although the results of an inquiry into confounding sources could have a substantial bearing on the interpretation of potential risks from PCB fires, one questions why no investigation has been initiated on this matter. We also note that PCDDs and PCDFs may be produced in other situations not involving PCBs, such as barbecues, fireplaces and woodstoves in domestic dwellings

Given the economic impact of any further regulation of askarel transformers, the Agency must clarify whether other sources of PCDFs and PCDDs are present, and, if so, how that fact affected the cost and effectiveness of the clean-up effort. In addition, USWAG believes that it would be relevant to know what expected background levels of PCDFs and PCDDs in buildings might be for purposes of comparison.

4. Formation of Reaction Products

USWAG also spoke with Dr. Rappe regarding the formation of PCDFs and PCDDs following fires in which askarel transformers are involved. On the basis of this interview and other information available, USWAG believes that no conclusion can be drawn at this time regarding the linearity of by-product production or the quantitative conversion of PCBs to other contaminants.

On the subject of EPA's assumption that PCDFs and PCDDs are linearly formed from PCB mixtures, Dr. Rappe felt that this could not be assessed because at present, no data are available. He stated that the exact nature of the reaction, whether it is monomolecular or bimolecular, is not known. In fact, more than one mechanism may be operating. Therefore, models used to simulate pyrolysis that show linear relationships, according to Dr. Rappe, are not readily applicable to the fire situations. These models have limitations and do not necessarily mimic the effects of (1) a clean versus dirty combustion flame, (2) oxygen variation, (3) electrical versus chemical energy, and (4) temperature. Accordingly, without empirical data, the Agency may draw conclusions that misrepresent the severity of PCB combustion and conversion.

In addition, there is no adequate information upon which to assess the quantitative conversion of PCB askarel fluids to PCDFs and PCDDs at Binghamton or San Francisco. Only sketchy data have been presented to date. The analytical results we do have indicate the presence of one half to 45 times less 2,3,7,8-TCDF and of 10 times to 50 times less 2,3,7,8-TCDD in soot samples taken from One Market Plaza compared to Binghamton.*/ To USWAG, this shows that Binghamton and San Francisco are not comparable events, except in the qualitative identification of the compounds. The concentrations are significantly different.

EPA is aware that EPRI has contracted with the New York State Health Department to examine the pyrolysis and combustion of PCBs and retrofill fluids (RP 2028-4).**/ This

*/ Compare Table 2, p. 6 with Table 5, p. 10, of the Versar Report.

**/ See Exhibit 3.

project aims to "determine the linearity of PCDF as a pyrolysis or combustion product with decreasing PCB concentration." Ex 3 at 3. This study is critical and will have a significant bearing on EPA's findings with regard to askarel transformer use and the purported risks.

5. Exposure and Health Effects of PCBs, PCDFs and PCDDs

By virtue of the different levels of PCBs, PCDFs and PCDDs found in the Binghamton and San Francisco fires, the potential exposures to firefighters, clean-up workers, office workers, and bystanders is different. USWAG is attempting to characterize the exposure to and effects of PCDDs and PCDFs from fires. The project, being prepared by Decision Focus Incorporated, will examine dermal contact and inhalation as the primary routes of exposure to PCBs and the by-products. The project, as noted in Section I, is a decision framework model, prepared by EPRI (RP 2595), that allows the assessment of policy options in comparison with estimated health risks.

EPRI also is conducting an exposure assessment study for PCB spills and fires (RP 1826-13) that will be completed by December 1984. This project, too, should help EPA in its assessment of exposure risks.

In assessing the effects of exposure to PCDDs and PCDFs, it is important to consider the matrix of exposures and the bioavailability of toxins. One literature review study performed by EPA on the toxicity of the Binghamton soot concludes that "multiple exposures to soot from PCB-Transformer fires have the potential to produce toxicity in the thymus, the hematopoietic system, the salivary gland duct epithelial, and, possibly, the liver (Ref. 6)". 49 Fed. Reg. at 11073. While the effects are not insignificant, the means of exposures to humans during an event and following an event are totally different. Because there is so little information available to simulate the exposure and effects on humans, we suggest the Agency divert resources to this area before it prepares findings on exposure to PCB and PCB mixture by-products in different media by inhalation and dermal contact.

C. Conclusions Regarding the Binghamton, San Francisco and Chicago Incidents

EPA must weigh several factors in evaluating the risks actually posed from Binghamton, San Francisco and Chicago incidents and the representativeness of those circumstances These include:

(1) The frequency of such events;

(2) Future preventability and mitigation of the incidents;

(3) The actual severity of exposure to fire-fighters, clean-up workers, and others;

(4) The value of awaiting the completion of EPRI and USWAG studies prior to further action.

We have demonstrated through the most recent USWAG survey that the utility industry rarely experiences an askare.

transformer fire of the magnitude of San Francisco. We estimate 0.27 incidents per year or a frequency of 0.013 per year over the lifetime of the equipment. The industry has reduced its population of askarel transformers and this population is rapidly declining.

There is a need to further evaluate the causes of these fires, because experiences at Binghamton, San Francisco and Chicago may help us avoid future incidents and thereby avoid the need for further regulation.

The actual severity of the exposure of populations to the by-products EPA believes are associated with fires involving askarel transformers must be questioned given the (1) infrequency of the events, (2) lack of knowledge about exposure to these compounds through the expected primary routes of exposure -- dermal contact and inhalation, (3) the matrices in which PCDFs and PCDDs are bound and their relative biological unavailability, and (4) uncertainty about other sources of dioxins and dibenzofurans and associated fire toxins.

Lastly, in addition to voluntary programs for removing askarel transformers, the electric utility industry has shown a significant commitment to properly manage its PCBs through accelerated research programs. These programs, as they relate to fire episodes, are studying under severe time constraints the following matters:

(1) Mechanisms of PCDF and PCDD formation from studies of PCB, tri- and tetra-chlorinated benzene pyrolysis and combustion;

(2) Case studies of Binghamton and San Francisco,

(3) Engineering Options for PCB Askarel Transformer Risk Reduction;

(4) Exposure assessment for PCB Spills and Fires;

(5) Risk Management of PCB Fires and Spills;

(6) Utility Decision Framework for PCB Decisions;

(7) Studies on the Use and Toxicology of PCB Substitutes among other important PCB Research Projects.

Many of the projects will not be completed until December 1984 or later into 1985. Yet they could have a significant bearing on the proper direction for EPA to take in determining the need for further regulation of the use of askarel transformers. As we have shown, there are many uncertainties about the risks associated with PCB fires. Similarly, there are uncertainties about the risks associated with the use of new fluids.*/ Each of these considerations must be carefully assessed before any action is taken. What appears clear today, however, is that the three fires EPA evaluated as representative of risk do not adequately account for these uncertainties and do not present a sufficient basis on which to conclude that the continued use of askarel transformers pose an unreasonable risk of injury to human health or the environment.

*/ See Section IV.A, *infra*.

III. MECHANISMS OF PCDF AND PCDD FORMATION

A major issue in this rulemaking is the extent to which PCBs and PCB mixtures are converted to other compounds under pyrolysis and combustion conditions. As discussed more fully in Section II.B.4., a definitive conclusion on this question cannot be drawn from the currently available data.

While the focus of EPA's question was askarel transformers, the Agency also raised a more general question concerning fires involving mineral oil transformers. In USWAG's interview with Dr. Rappe, he indicated that an abundance of soot would be formed from the combustion of mineral oil which would probably result in a very complicated matrix. Because of this complex matrix, it might be very difficult to extract PCDFs and PCDDs and fairly strong solvents would be required. He related experiences he had has in spiking certain sediments with Carbon 13-labelled PCDFs and finding it exceedingly difficult to recover the material. He anticipated that similar problems, along with separating PCDDs and PCDFs from other hydrocarbons, could result.

In its ANPR, EPA examines laboratory studies and discusses them in terms of fire situations. EPA notes that chemical reactions which occur in a fire with Aroclors is far more complex than laboratory pyrolysis experiments. Yet, the Agency expects the same reactions to occur and chemical products to be formed. Further, EPA suggests that the lower PCB levels found in mineral oil "should have a minimal effect on the reaction rate or product yield at a given temperature". 49 Fed. Reg. at 11074. Lower PCB levels mean lower PCDF levels formed, according to the Agency's analysis.

From our discussions with Dr. Rappe and our reading of the literature, USWAG believes that the Agency's first statement, that PCB combustion in fires is complex, is correct. The reaction mechanisms and product yields are affected by many variables other than just temperature. For example, it may be plausible to conclude that diluted PCBs or chlorobenzenes cannot be converted to PCDFs or PCDDs, because mineral oil or other insulating fluids would consume the oxygen available to nurture the fire. Accordingly, there is no information available today from which to conclude that PCBs at low concentration levels can be transformed into PCDFs.

USWAG believes that research work being performed by EPRI, EPA, and possibly others is pivotal to any finding on the conversion of diluted PCBs and, for that matter, even PCB askarel fluids encountering combustion.

IV. OTHER RELEVANT FACTORS

In assessing the reasonableness of the continued use of transformers containing or contaminated with PCBs when such equipment may become involved with a fire, a number of other factors must be considered. EPA has sought information on two of these factors, substitute fluids and exposure risk from contaminated water. A third factor, building fires generally, also should be considered. Each of these matters is addressed briefly below.

A. Substitute Fluids for PCBs

EPA has requested information on substitutes for PCB fluids. Specifically, it seeks data on the toxicity of substitute fluids in the event of a fire. Reviewing the available materials, USWAG concludes that not much is really known about the properties of these fluids, their toxicity, or the effect on them of pyrolysis or combustion.

EPA identifies six major substitute dielectric fluid types: silicones, high-temperature hydrocarbons, chlorinated hydrocarbons, non-PCB askarels, fluorocarbons and mineral oil. Several investigators have reviewed the scientific literature on both PCB capacitor and PCB askarel transformer fluids. EPA itself has performed analyses through SRI International (February 1981) and more recently PEDCO Environmental Incorporated (January 6, 1984). Similarly, EPRI is in the process of completing a study on PCB substitutes. See Exhibit 3. Although a recent article published in Environmental Science and Technology (17:486A, 1983) concludes that some substitutes currently marketed have a low acute toxicity, appear to be more biodegradable than PCBs and less likely to bioaccumulate appreciably, there is limited knowledge, especially in comparison with PCBs, on chronic and subchronic health effects. Thus, the normal day-to-day use of the substitutes generally has not been adequately evaluated from a health risk standpoint.

Some information is available, however, on the effect of combustion. For example, during arcing of a perchloroethylene transformer, the PEDCO study indicates the breakdown products include hydrogen chloride, carbon, carbon monoxide, and carbon dioxide. In contrast, initial EPRI literature analysis shows that the predominant resulting product is <u>phosgene</u>. Other hazardous decomposition products include hydrogen chloride and carbon monoxide. This disparity indicates that a rigorous analysis of the potential health risks of substitutes and their by-products remains to be made.

The current EPRI project should be completed by December 1984. In addition, EPRI will be performing several studies in the area of substitutes:

1. Pyrolysis and Combustion of PCB Contaminated Dielectric Fluids and Retrofill Fluids, such as tetrachloroethylene (RP 2028-4), scheduled for completion by November 1984.

2. Arc and Spark By-products (RP 1499-4-5) of Perchloroethylene, scheduled for completion by August 1984.

3. State-of-the-Art Toxicological Review of PCB Substitutes that will focus on pyrolysis and combustion products (RP 2028-12), scheduled for completion by December 1984.

Although these studies may not be definitive, they should help EPA in its deliberations.

B. <u>Risk from Contaminated Water</u>

EPA solicits comments on the exposure risk from contaminated water resulting from PCB fires. From the limited information we have been able to obtain, it appears that both contamination of water and exposure levels are potentially nonexistent.

Judging from a conversation with Pacific Gas & Electric Company, there was very little water used to dowse the transformer at One Market Plaza, and the little ultimately used was contained within the vault.*/ Further, it can be expected in future fires that firefighters will control such types of electrical fires either by removing the source of oxygen or by using carbon dioxide to control the fire.

Therefore, USWAG believes there should be little contamination and no spread of contamination through water run-off because water is not required to control such a fire.

C. <u>The Consequences of Building Fires</u>

The focus of the ANPR is on askarel transformer fires and the risks from exposure to the associated combustion by-products. Given that askarel transformer fires do not burn as raging fires and in fact prevent the spread of fire, a convincing argument can be made that the installation of askarel equipment significantly prevents the direct loss of life from building fires and the damage costs that result from those fires. In Binghamton, San Francisco, and Chicago, whether there was a real concern from PCB exposure or not,

*/ In the case of Binghamton, it is not apparent whether any water was used to control the fire.

there was no loss of life and people could be safely evacuated. USWAG believes that in making any further risk assessment, the measure of safety that askarel transformers provide must be weighed against the consequences of building fires, regardless of the type of transformers that serve them.

Every year there are over one million building fires.*/ In 1981, fires were attributed as the cause of 900 deaths in public and work environments at a cost of $3.4 billion. According to a recent article published in Civil Engineering magazine (May 1984, pp. 41-43), about 80% of the deaths that occur in building fires are attributed to the inhalation of toxic gases emitted from certain burning materials. Thus we can estimate that 720 people died in 1981 from exposure to toxic fumes.

The toxic fumes result from the decomposition of plastics and other synthetic building and furnishing materials. In a resolution brought before the California Assembly, Assemblywoman Maxine Waters cites a test developed by a University of Pittsburgh toxicologist which "reveals that about 5 ounces of burning of polyvinyl chloride, one of the commonly used synthetics in buildings, could emit enough hydrogen chloride gas to kill all the people in an average-size bedroom in 10 minutes."**/

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*/ In 1981, for example, there were 1,003,775 building fires. See 1981 Database, Federal Emergency Management Authority, National Fire Incident Report.

**/ Civil Engineering/ASCE, May 1984, p. 42.

CONCLUSION

From the information provided in the RPC 1984 Report and elsewhere, USWAG believes that no unreasonable risk is posed to human health or the environment from the continued use of transformers containing or contaminated with PCBs. Many studies now being conducted will shed further light on many of the questions arising from the involvement of the transformers in fires. As of today, however, there is insufficient reliable information on which to place further restrictions on the use of the transformers under consideration. EPA should, therefore, issue a statement that further rulemaking at this time is unnecessary.

EXHIBIT [illegible] PARTICIPATING [illegible]

Edison Electric Institute
National Rural Electric Cooperative Association
American Public Power Association
American Electric Power Service Corporation
    Appalachian Power Company
    Columbus & Southern Ohio Electric Company
    Indiana & Michigan Electric Company
    Kentucky Power Company
    Ohio Power Company
Atlantic City Electric Company
Baltimore Gas & Electric Company
Central Hudson Gas & Electric Corporation
Central Illinois Light Company
Central Illinois Public Service Company
Central & South West Corporation
    Central Power & Light Company
    Public Service Company of Oklahoma
    Southwestern Electric Power Company
    West Texas Utilities Company
Cincinnati Gas & Electric Company
Commonwealth Edison Company
Consolidated Edison Company of New York, Inc.
Dayton Power & Light Company
Duke Power Company
Duquesne Light Company
Florida Power & Light Company
Gulf States Utilities Company
Houston Lighting & Power Company
Illinois Power Company
Indianapolis Power & Light Company
Iowa-Illinois Gas & Electric Company
Iowa Power & Light Company
Iowa Public Service Company
Jersey Central Power & Light Company
Los Angeles Department of Water & Power
Middle South Services, Inc.
    Arkansas Power & Light Company
    Louisiana Power & Light Company
    New Orleans Public Service, Inc.
    Mississippi Power & Light Company
Monongahela Power Company
New England Power Company
New York State Electric & Gas Corporation
Niagara Mohawk Power Corporation
Northern Indiana Public Service Company
Northern States Power Company
Ohio Edison Company
Ohio Valley Electric Corporation
Oklahoma Gas & Electric Company
Pacific Gas & Electric Company
Pennsylvania Power & Light Company
Philadelphia Electric Company
Potomac Electric Power Company
Public Service Electric & Gas Company
Public Service Company of Indiana, Inc.
Southern California Edison Company
Southern Company Services, Inc.
    Alabama Power Company
    Georgia Power Company
    Gulf Power Company
    Mississippi Power Company
Tampa Electric Company
Texas Utilities Generating Company
The Cleveland Electric Illuminating Company
The Detroit Edison Company
The Potomac Edison Company
Toledo Edison Company
Union Electric Company
Virginia Electric & Power Company
West Penn Power Company
Wisconsin Electric Power Company
Wisconsin Power & Light Company
Wisconsin Public Service Corporation

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REPORT OF THE STUDY OF RISKS POSED
BY ASKAREL TRANSFORMER FIRES

Exh. 2

RPC

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REPORT OF THE STUDY OF RISKS POSED BY ASKAREL TRANSFORMER FIRES

Prepared For

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June 19, 1984

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1.0 INTRODUCTION

1.1 PCB Regulatory Background

In August, 1982, EPA issued the PCB Electrical Use Rule authorizing the use of certain electrical transformers containing polychlorinated biphenyls (PCBs). Among other provisions, this rule allowed electric utilities to continue to use the approximately 40,000 askarel transformers then in service.

In March, 1984, EPA issued an Advance Notice of Proposed Rulemaking (ANPR) stating that the risks posed by fires involving PCB Transformers had not been considered during formulation of the 1982 rule, and that consideration of such risks might result in the necessity for additional regulation. Accordingly, the ANPR solicited data specific to the risks of fires posed by PCB Transformers.

1.2 Purpose of this Study

In the summer of 1981, Resource Planning Corporation (RPC), under contract to the Edison Electric Institute and the Utility Solid Waste Activities Group (EEI/USWAG), surveyed the 100 largest utilities in the United States. This survey collected data regarding the use of PCBs by the electric utility industry, and was responsive to information requirements defined by EPA, EEI/USWAG, and the Environmental Defense Fund as part of an order issued by the U S. Court of Appeals for the District of Columbia Circuit. Although the 1981 survey collected substantial data regarding the use of PCBs and formed the basis for the August, 1982 rule, no data were collected regarding risks posed by PCB Transformer fires.

This report describes the results of a 1984 survey of electric utilities specifically designed to obtain data relevant to the fire risk ANPR. The survey was again performed by Resource Planning Corporation under contract to EEI/USWAG. This recent survey provides substantial empirical data regarding PCB Transformer fire risks, and should be particularly useful in describing the location and environment of askarel transformers and estimating the frequency of PCB Transformer fires - two issues critical to EPA analysis of alternative regulations

1.3 Study Methodology

In order to respond to the fire risk ANPR, three general types of information had to be obtained from utilities: detailed information regarding the location and environment of askarel transformers,[1] information regarding transformer fires, and retrofill experience. Four approaches to the collection of these data were considered, including:

- Surveying those utilities that reported owning askarel transformers in 1981 (90 of 100 surveyed)
- Surveying the 10 or 20 utilities that reported the most askarels in 1981
- Collecting some data (i.e., fire data and retrofill experience) from the 1981 sample, and more detailed data on transformer location and environment from a small sample of utilities that are known to have such data available
- Surveying those utilities that reported owning askarels in 1981, and asking them to provide detailed data on a sample of their transformers.

The advantages and disadvantages of these various approaches are relatively straightforward. Using the same utility sample as in 1981 would facilitate data comparisons, i.e., the 1981 transformer inventory could easily be compared with the 1984 inventory. However, it was deemed impractical to expect 90 utilities to promptly provide detailed information regarding the location and environment of each askarel transformer they own.

Surveying the 10 or 20 utilities reporting the most askarels in 1981 would provide a somewhat more manageable sample, but the problem facing individual utilities of providing detailed data on hundreds of

1. Although PCBs were sold under a variety of trade names, they are commonly referred to by the generic name "askarel." Throughout this report, "askarel transformer" refers to transformers typically containing PCBs at levels of 80% or greater

askarels would remain. The response rate would likely be low, particularly given the time constraints

Collecting some data from the 1981 sample and more detailed data from a small number of utilities (3-6) that are known to possess the data was considered a reasonable approach The survey would be manageable, and data could be obtained on a substantial number of askarels within a relatively short time frame. The disadvantage with this approach is its representativeness. It would be necessary to generalize to the industry based on a small group of utilities If the response of all sampled utilities were similar, it could be reasoned that such comparability allowed reasonable population projections. However, if responses were dissimilar projections would be of questionable validity

All of the disadvantages associated with the above approaches could be overcome if a random sample of utility industry transformers were selected and data obtained regarding their location and environment No single utility would be required to provide data on a large number of askarels, thereby alleviating their reporting burden, and reliable projections could be made to all industry equipment from a relatively small sample of transformers. Such an approach seemed the best methodology for obtaining data required to respond to the ANPR.

In refining this methodology, the 1981 survey data were reexamined in light of the ANPR data requirements Electric utilities have askarel transformers located in substations, generating facilities, and distribution systems. However, the major concern stated by EPA in the proposed rule-making was the risk to the public of askarel transformers, i.e., distribution system askarels. Given that expressed concern, and in the absence of any reports that askarel transformers located in utilities' restricted access areas have been involved in fire incidents similar to those that prompted EPA's ANPR,[2]

2. Substations and generating facilities also pose little or no risk, i e., there is no public exposure, equipment monitoring and inspection occurs frequently, and utility workers are both sensitive to the hazards posed by electrical equipment and trained in the use of PCBs Nonetheless, the survey did seek information on fire incidents involving askarel transformers wherever the equipment was located

data collection efforts were focused on the distribution system askarel transformers.

In defining our study sample, it was determined that 52 utilities owned 99% of the distribution system askarel transformers reported in 1981. Therefore, it was decided to focus survey activities on these 52 utilities.[3]

Each of the 52 were asked to provide:

- General Data, including their current askarel transformer inventory and risk reduction measures taken or planned.
- Fire Incident Data, including information regarding all fire incidents during the last three years which involved an askarel transformer, PCB Transformer, or transformers containing askarel substitutes.
- Askarel Transformer Data, including detailed information regarding the location and environment of a sample of their askarel transformers.

A sample of 450 randomly selected askarel transformers was deemed sufficient to make projections to the electric utility industry distribution system askarel transformer population. Each of the 52 surveyed utilities was given specific instructions regarding the transformers for which data were to be reported. It should be noted that only transformer location and environment data were collected on a sample basis. All other survey data covered all askarel transformers owned by respondent utilities. For example, the data on fire incidents covers all fire incidents in the last three years experienced by the sampled utilities.

1.4 Organization of this Report

The remainder of this report comprises two major sections.

- 2.0 SURVEY FINDINGS describing the data obtained via the survey of 52 electric utilities.

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3. Appendix A provides a list of utilities surveyed, and Appendix B provides a copy of the survey questionnaire.

- 3.0 COMPARISON OF SURVEY DATA WITH EPA MATERIALS analyzing the preliminary EPA regulatory analysis[4] in light of data obtained via the utility survey

4. Putnam, Hayes & Bartlett, Inc., 1984. Preliminary Study and Cost-Effectiveness Analyses of Alternative Regulations for Indoor PCB Transformers, EPA, Office of Pesticides and Toxic Substances OPTS 62035 PCB (Fires), February 1984.

2.0 SURVEY FINDINGS

2 1 Survey Response

Of the 52 utilities, 51 provided data The single non-respondent indicated that insufficient time was available in which to respond The following results represent projection to the population of utility-owned transformers based on the results of the survey

2 2 Askarel Transformer Population

Based on the 1981 utility survey, it was estimated that the electric utilities owned 39,640 askarel transformers, with 22,469 in distribution systems The 1984 survey indicated that the electric utilities now own 35,984 askarel transformers, and the number of distribution system askarels has declined by approximately 18.5% since 1981 There are now an estimated 18,291 askarel transformers in service in utility distribution systems.[5]

This overall decline as well as the decline in distribution system askarels is somewhat greater than would be expected via normal attrition, because a number of utilities have instituted accelerated phase-out programs.

2.3 Location and Environment of Distribution System Askarels

Table 1 indicates the general location of the 18,291 electric utility distribution system askarel transformers

TABLE 1: Location of Distribution System Askarels

	Number of Transformers	Percent of Total
Inside Building	6,000	32 8
Sidewalk Vault	10,919	59 7
Other	1,372	7 5
TOTAL	18,291	100 0

5. The reported decline in the total number of utility-owned askarel transformers from 1981 to 1984 is somewhat less than the decline in the number of distribution system askarels, i.e., the 1984 survey reported more substation/generating facility askarels than the 1981 survey. It was determined that two utilities underreported their 1981 population of generating facility askarel transformers. The result of this reporting error on 1981 equipment projections was less than 4%.

Approximately 10,919 transformers are located in outdoor sidewalk vaults, and an additional 1,372 are in other outdoor locations

In the case of a fluid loss, 66.6% of all distribution system askarel transformers locations would contain the fluid and prevent release into the environment, 6 5% would contain the fluid in a catchment area, 7.7% of the locations would drain to sewer systems, and 19 2% would drain to surrounding soil, gravel or concrete

For transformer cooling purposes, 94% of all distribution system askarel transformers are ventilated to an outside area, 4.5% vent to an indoor area, and less than 1% are in a sealed room or vault. Less than 20% of these ventilation mechanisms involve forced-air systems

2 3 1 Indoor Installations

Of the 6,000 transformers located in buildings, Table 2 provides additional information on the various types of building installations

TABLE 2: Buildings in Which Transformers are Located

Building Type	Number of Transformers	% of Total
Residential (Condo, Apt. Hotel)	727	12 1
Institution (School, Hospital, Church)	318	5 3
Office	3,232	53 9
Industrial/Mfg.	180	3 0
Storage (Warehouse)	180	3 0
Other Public (Store, Mall)	727	12 1
Other*	636	10 6
Total	6,000	100%

* Primarily includes parking garages, and uninhabited industrial structures

In those instances where transformers are located inside buildings, the average age of the buildings is 29 years, and although the average height of the building is 19 floors, over 50% of the transformers are in buildings of 11 floors or less.

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While 51 2% of the indoor transformers are installed in the basements of buildings, only 3 1% of the indoor installations are roof top installations, the remaining 45 7% are located on other intermediate floors within the building

The overwhelming majority (84 5%) of the indoor transformers are located in vaults within the building, 9 3% are located in separate transformer rooms, and the remaining 6 1% are installed in open areas

Of the transformers that are located in a vault or transformer room, less than 1% have air conditioning or heating system intake vents in the transformer enclosure itself, and less than one-half (11.7%) have air conditioning or heating system intake vents in the area immediately adjacent to the transformer vault or room. Other than these direct routes, approximately 31.2% of the transformer locations are judged to provide some, albeit indirect, access to building heating and air conditioning systems The responses to the survey indicate these indirect routes may include access to heating and air conditioning through open windows in the building, holes in concrete walls and ceilings, spaces under doors, gaps around electrical conduit, etc.

2 3 2 Outdoor Installations

There are approximately 12,291 askarel transformers in sidewalk vaults and other outdoor locations. In the case of a transformer fire, 10 9% of these transformer enclosures are located immediately adjacent to building heating and/or air conditioning systems which could serve as a means of building access for smoke/soot

2.4 Frequency and Nature of Fire Incidents

The 1984 utility survey defined a PCB Transformer fire incident as a fire in which a transformer has been directly exposed to a fire, either from within the transformer or an immediately adjacent source. Using this definition, survey respondents reported that 8 PCB Transformer fire incidents have occurred in the last three years All of these incidents were reported to involve askarel transformers

Using these data and the total number of askarel transformers owned by surveyed utilities, it can be estimated that 0.01 percent of all askarel transformers owned by electric utilities can be expected to be involved in a fire incident each year Because so few incidents occur, it is difficult to develop reliable incident predictors, i.e . the small size of the sample does not allow the correlation of fire incidents with transformer age, KVA rating, type of building, time of day, or any other measured variable. However, a review of the circumstances surrounding the 8 reported incidents may be useful in considering the likely results of future incidents

Table 3 indicates the locations of utility industry askarel transformers involved in fire incidents during the past three years.

TABLE 3: Location of Transformer Fire Incidents

Location	Number of Incidents
Outside - sidewalk vaults	4
Inside - office building	4
TOTAL	8

Because the risks of exposure posed by outdoor transformers may be significantly different than those of indoor transformers. each is discussed separately below.

2.4.1 Sidewalk Vault Incidents

Four of the eight fire incidents involved transformers in outside sidewalk vaults. KVA ratings were reported for three of the four transformers (500, 750 and 1,000) and the ages of the four transformers were 8, 12, 15 and 20 years. Two of the fires occurred in the morning, one in the evening, and for one the time was not provided. All but one occurred on a weekday.

In two of the three incidents smoke escaped from the transformer enclosure via the sidewalk grate but did not enter any public buildings In one incident smoke did not escape the transformer vault. In one incident smoke escaped the vault and entered a nearby building. In one of the three incidents, no fluid was released from the transformer, and in the other three incidents, releases of 5, 25, and 60 gallons occurred.

Data regarding exposure of the public, utility personnel, and firefighters were reported for two of the four incidents. Neither reported that more than five members of the general public were exposed to smoke/soot from the fire and the average number of firefighters and utility personnel exposed to smoke/soot was nine.

Limited data were reported regarding the lapse of time between fire start, de-energization, fire department response, and extinguishment. In one of the incidents, the transformer was de-energized approximately 10 minutes after the fire started, in one incident de-energization required an hour, and in one incident as much as three hours may have elapsed. For one incident no data were reported regarding de-energization. No data were available regarding the time required for fire department response. For one incident it was reported that two hours elapsed from fire start to extinguishment, and for another total time lapse was reported as three hours.

PCB, PCDF, and PCDD test results were generally not available for the four sidewalk vault fires. For one incident PCB fluid levels of 13,000 ppm were reported before cleanup and 12 ppm after.

2.4.2 Inside Building Incidents

The four office buildings in which transformer fires occurred ranged from 1 to 48 floors. One building was 10 years old, one was 13 years old, and the ages of two were not reported. Transformer KVA ratings ranged from 500 to 2,000. The ages of two of the transformers were 10 and 13 years, with two ages unknown.

In each of the four incidents occurring inside buildings, the transformer was enclosed in a vault, and in each incident smoke/soot escaped the transformer vault. In three of the four incidents the escaping smoke/

soot only entered immediately adjacent areas of the building. In one incident the smoke escaped the vault and was picked up by the air intake of an adjacent building.

Fluid was released from the transformer in each of the four incidents, with the quantity released ranging from 4 to 100 gallons and the average being 41 gallons. The extent of exposure of the public, utility personnel and firefighters to smoke/soot was generally not known. However, for one incident no exposure to the public was reported, and for two incidents exposure of 12 and 18 utility personnel and firefighters was reported.

For one incident, PCB levels were reported in the soot before cleanup of 2-98 micrograms per 100 square centimeters and 1-21 after. Another reported 860-2,000 micrograms of PCB per 100 square centimeters of wipe area in soot before cleanup, with no after cleanup results available. A third incident reported 18 micrograms per 100 square centimeters of PCDF in the transformer vault, with no PCDDs or PCDFs found elsewhere (after extensive testing).

2.5 Cost of Fire Cleanup

When calculating the average cleanup cost associated with reported fire incidents, one incident stands substantially apart from all others. Of the 8 incidents reported, cleanup of one is estimated to have cost $15 to 20 million. No other incident reported costs as high as $425,000. To avoid the distortion of the one $15 to 20 million incident, Table 4 excludes that $15 to 20 million incident and indicates the average cost of cleanup associated with all other reported fire incidents.

TABLE 4 Average Cleanup Cost

Cost Type	Sidewalk Vault	Inside Building
Analysis/Testing	$ 233	$ 16,625
Cleanup/Decontamination	2,487	144,375
Disposal	5,000	8,750
Equipment Replacement	20,000	109,175
TOTAL	$27,700	$278,925

2.6 Utility Risk Reduction Measures

Survey data indicate that utilities have undertaken a variety of measures to reduce the likelihood of PCB fire incidents. More specifically

- 78% of surveyed utilities have conducted risk-assessment inspections of their askarel transformers
- 76% of surveyed utilities have askarel transformer phase-out programs completed or currently in effect
- 35% of surveyed utilities have notified fire departments in their service area of the location of askarel transformers
- 20% of surveyed utilities have posted warning signs for firefighters in the approaches to askarel transformers
- 75% of the distribution system askarels have a protective fuse, switch, or breaker on the low voltage side of the transformer, approximately two percent of which are oil-filled. These protective devices are designed to isolate (de-energize) the transformer in the event of a fault in the low voltage line.
- 19% of the distribution system askarels have a protective fuse, switch, or breaker on the high voltage side of the transformer, approximately 52% of which are oil-filled. These protective devices are designed to isolate (de-energize) the transformer in the event of a fault in the high voltage line

Askarel phase-out programs are currently in effect in 76% of the surveyed utilities. These programs are primarily directed toward phasing out distribution system askarel transformers, although 13% of these utilities also have reported programs and plans for phasing out substation and generation facility askarels. Based on the phase-out programs voluntarily instituted among the utilities, it is estimated that the number of distribution system askarel transformers will be reduced from 18,291 to 12,987 by the end of 1985. This represents a reduction of 29%. By the end of 1989 the total will have been reduced to 6,102, a reduction of 65%. Table 5 shows the projected reduction in distribution askarels through 1994, given the phase-out programs currently in effect.

TABLE 5 Estimated Reductions in Distribution Askarel Transformers Based on Current Phase-out Programs

Year	Estimated Number of Distribution Askarels	Percent Remaining
1984	18,291	100
1985	12,987	71
1986	10,792	59
1987	8,780	48
1988	7,499	41
1989	6,402	35
1990	5,670	31
1991	4,939	27
1992	4,207	23
1993	3,658	20
1994	2,927	16

A variety of priority considerations are being taken into account by the utilities in their phase-out programs. The most common factors considered pertain to the location of askarel transformers within or in relation to the location of buildings. The type and location of the buildings in which these transformers are located are also being considered, with schools, hospitals, commercial and other buildings in congested areas receiving higher priorities. Several utilities are prioritizing askarels for phase-out based on the assessed risk to food, feed, and water supplies. Other factors being considered are the age, condition, and voltage of the askarel equipment.

Seventy-eight percent of surveyed utilities have conducted risk assessment inspections of their askarel transformers to evaluate exposure risk. These inspections have often been performed in conjunction with phase-out planning. Ten percent of those utilities conducting risk assessments have increased the frequency of their askarel transformer inspections as a fire risk reduction measure. An additional 10% have sealed cable ducts and other holes in transformer areas in order to contain smoke in case of a fire. Other efforts reported to reduce fire risk include installing fire detection or fire suppressant systems within vaults, equipping vaults with a coolant sensor, sealing excess grating area or sidewalk vaults, and assuring that a CO_2 fire response vehicle is available.

2.7 Retrofill Experience

Of the 52 utilities surveyed, 11 reported having retrofilled one or more askarel transformers, with a total of 48 askarel transformers retrofilled among these utilities. The average cost of retrofilling reported by those providing cost data was $15,700 per transformer. Approximately 45% of the costs reported were $5,000 or less, while the remaining 55% ranged between $10,000 and $41,000.

The range in KVA rating and fluid capacity of the askarel transformers retrofilled is shown in Table 6.

TABLE 6: KVA Rating and Fluid Capacity of Retrofilled Transformers

Fluid Capacity (in gallons)	Transformer KVA (Nameplate Rating)			
	101-500	501-1000	1001-5000	TOTAL
≤100	7	0	0	7
101-200	1	0	0	1
201-300	14	9	2	25
301-400	0	1	2	3
401-500	0	2	3	5
501-600	0	0	1	1
601-700	0	0	2	2
701-800	0	0	0	0
801-900	0	0	5	5
TOTAL	22	12	15	49

None of the retrofilled transformers had nameplate ratings less than 100 KVA or higher than 5,000 KVA.

PCB levels reported for these transformers prior to retrofilling ranged from 400,000 ppm to 750,000 ppm. Over 60% of the transformers had starting PCB levels estimated at 700,000 ppm or above.

In 27% of the retrofills, a flush/refill method was used, and in 35% of the cases a filtering process was used. The remaining 38% were retrofilled using both the flush/refill and filtering methods. In several cases the filtering process was reported to be ineffective.

whereas in other cases the flush/refill process alone was considered insufficient.

The fluid used in retrofilling 40% of the transformers was silicone RTemp was used in 29% and oil in 31% of the transformers.

A variety of flush solvents were used in these retrofills Table 7 identifies these solvents along with the frequency of their use

TABLE 7 Flush Solvents used in Retrofills

Solvent	Number of Retrofills	% of Total
Silicone	3	6
Trichlorethane	4	8
Trichlorethane and Silicone	1	2
Chlorothane	10	20
Trichlorobenzene	7	14
Oil	11	22
Rtemp	1	2
None	8	16
No Response	4	8
TOTAL	49	98*

*Total does not equal 100% due to rounding

In order to assess the effectiveness of the retrofill methods, respondents were asked to report the PCB level after their 1st, 2nd, and 3rd refill or filter change Data on PCB level were provided on 40 transformers and are summarized in Table 8.

TABLE 8 Retrofill Results

Beginning PCB Level**	Type Process*	Subsequent PCB Level (ppm) 1st Flush/Filter	2nd Flush/Filter	3rd Flush/Filter	Time Begin-End
1,000,000	B	703	48	287	3
1,000,000	B	1,251	85	316	3
750,000	F	--	--	20	13
750,000	F	--	788	27	3
700,000	B	779	130	472	5
700,000	B	760	--	6,913	5
700,000	B	8,673	2,806	6,175	5
700,000	B	10,103	2,758	3,416	5
700,000	B	3,744	6,443	4,510	5
700,000	R	42,000	3,000	400	30
700,000	R	32,000	2,200	240	30
700,000	R	53,000	4,600	850	30
700,000	R	31,000	5,000	2,100	6
700,000	R	24,000	1,800	360	6
700,000	R	36,000	3,200	300	6
700,000	R	14,200	--	--	--
700,000	R	81,000	--	--	30
700,000	R	1,200	--	--	33
700,000	R	3,200	--	--	21
700,000	R	1,000	--	--	21
700,000	B	57,000	32,200	--	5
700,000	B	47,000	3,149	--	33
600,000	F	1,180	11	--	3
600,000	F	578	25	--	3
600,000	R	269,016	--	--	--
600,000	R	274,690	--	--	--
600,000	F	20,000	5,000	4,500	2
600,000	F	7,075	590	37	2
600,000	R	150	10	10	3
500,000	F	22	7	91	5
500,000	F	19	95	--	4
500,000	F	172	--	--	1
400,000	B	158,094	105,840	--	2
400,000	B	48,220	30,942	--	2
400,000	B	15,040	10,157	--	2
400,000	B	34,575	23,087	--	2
400,000	B	13,737	9,171	--	2
400,000	B	25,060	16,817	--	2
400,000	B	14,735	9,849	--	2
400,000	B	14,665	9,822	--	2

* F = Filter; R = Flush/Refill; B = Combination
** For these transformers whose beginning PCB level was reported as askarel a 70% PCB concentration was assumed.

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These survey data indicate that 13% of the transformers attained a PCB level of ≤500 ppm after the first refill/filter change. Of those transformers refilled/filtered a second time, 26% attained a PCB level of ≤500 ppm. After the third refill/filter change, the PCB level in the 18 transformers were lowered to ≤10,000 ppm and 56% of these 18 attained a PCB level of ≤500 ppm. However, as is readily apparent the retrofill results are quite erratic. Results of the first refill/filter change range from 19 ppm to 274,690 ppm, the second refill/filter change from 7 to 105,840 and for the third refill/filter change from 10 to 6,913. There is no apparent correlation with time, beginning level, or process type. In eight cases, the PCB levels increased between refills/filter changes rather than decreased. This was reportedly due to PCB being retained in the paper insulation and windings. Even where PCB levels are apparently decreased substantially after three refills/filter changes, comments by respondents indicate the possibility of future increases due to continued PCB leaching.

Utilities have been spending an average of eleven months between first and third refill/filter change procedures. Thirty-seven percent of those reporting indicated spending two months or less. Twenty-one percent, however, indicated spending over two years. As stated, there appears to be no relationship between the length of time spent for retrofilling and the PCB levels reached.

3.0 COMPARISON OF STUDY DATA WITH EPA MATERIALS

3.1 General*

With regard to risks posed by askarel transformer fire incidents, EPA states in the ANPR.

> If EPA is not provided with adequate data, especially in the areas of the risks posed in the event of a fire, the probability of these fires occurring, and the costs associated with clean-up following these incidents, EPA will make its regulatory judgments based upon the data set forth in this document. These data indicate that PCB Transformer fires pose relatively high risks, occur with unknown frequency, and can result in relatively high clean-up costs

This report provides substantial empirical data regarding the frequency with which transformer fires occur and the costs of cleanup. A comparison of these data with the estimates developed in the preliminary EPA analysis is presented below

The ANPR also solicited general comments regarding the preliminary EPA cost-effectiveness analyses. As part of our study activities, the EPA analyses were reviewed, and the final section of this report provides our commentary.

3.2 Frequency and Nature of Fire Incidents

In the ANPR, EPA presents a variety of estimates of the frequency of PCB Transformer fire incidents, ranging from a low of an expected 8 incidents per year to a high of 1,530 per year. In the preliminary study and cost-effectiveness analyses, the EPA consultant estimates that the number of expected annual catastrophic incidents will be between 0.6 and 11.[6]

6. The preliminary EPA cost-effectiveness analyses estimates the low probability of a catastrophic incident as 0 0005 percent, the high probability as 0.01 percent, and the beginning (1984) transformer population to which these rates apply as 114,469.

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Developing data comparable to these estimated frequencies is difficult because no clear definition of fire incident or catastrophic incident has been developed by EPA. In conducting the utility survey, a fire incident was defined as a fire in which a transformer has been directly exposed to a fire, either from within the transformer or an immediately adjacent source. Based on this definition, survey data indicate that one fire incident per every 7,787 askarel transformers can be expected each year. This suggests approximately 5 fire incidents per year involving utility transformers.

If the definition of catastrophic incident is related to cleanup costs as was done in the preliminary EPA cost-effectiveness analyses, only one incident involving a utility-owned transformer in the last three years would be classified as catastrophic. Another way to estimate the likelihood of a catastrophic incident is to determine the number of askarel transformers located in areas which might result in a Binghamton or San Francisco type incident, and estimate the likely frequency of a fire involving one of these transformers. Data obtained via the survey allowed reasonable estimates of these numbers. Approximately 2,700 transformers are located inside buildings, in areas adjacent to rooms with heating or ventilation system intakes. Another 1,300 are in sidewalk vaults immediately adjacent to building heating and/or air conditioning systems. These 4,000 transformers might be considered as potential catastrophic incidents if the definition relates to the type of incident occurring in Binghamton or San Francisco. Given the reported frequency of askarel transformer fires of 0.01 percent, a catastrophic fire incident of the Binghamton/San Francisco type involving a utility-owned transformer can be expected approximately once every 2.5 years.

3.3 Cleanup Costs

Insofar as fire incidents are concerned, the preliminary EPA cost-effectiveness analyses focuses solely on catastrophic incidents and assumes a cleanup cost of $20 million. Survey data indicate that the average cleanup cost for a non-catastrophic transformer fire incident outside a building is $27,700 and inside a building is $278,925. The single catastrophic incident reported in the survey was estimated to require $15 to 20 million in cleanup costs.

3.4 Comments Regarding EPA Cost-Effectiveness Analyses

A preliminary examination of the EPA cost-effectiveness analyses reveals four significant issues:

- The estimated frequency of catastrophic incidents may be overstated
- The methodology used for calculating phase-out costs may be inappropriate
- The assumptions underlying leakage rates used for calculating the quantities of PCBs released from askarel transformers may be inappropriate.
- When calculating PCB exposure, the benefits of spill cleanup are ignored, yet the costs of cleanup are considered. The net effect is to overstate the cost-effectiveness of additional regulation

3.4.1 Frequency of Catastrophic Incidents

The EPA analysis uses a low probability of a catastrophic incident of 0.67 incidents per year and high probability of 11 incidents per year. As indicated in section 3.2 of this report, survey data indicate a catastrophic fire incident involving a utility-owned transformer is likely to occur approximately once every 2.5 years (0.40 per year).

The EPA low probability estimate is reasonable, however, the EPA high probability estimate substantially overstates the apparent risks

3.4.2 Phase-out Costs

The methodology used by EPA for calculating phase-out costs is not clear. The preliminary study indicates the methodology used for the 1982 rule is used with minor modification. We criticized the 1982 methodology in comments submitted to EPA on May 24, 1982. To the degree the 1984 EPA analysis has not incorporated changes resulting from our previous comments, the EPA estimated phase-out costs are understated.

Estimating incremental phase-out costs should contrast normal utility equipment replacement during the phase-out period with replacement which would be required during the same period as a direct result of the mandated phase-out. The costs associated with the incremental replacement units are the incremental phase-out costs inasmuch as they reflect only those costs associated with the purchase of units phased out prior to the end of their useful life The 1982 EPA analysis estimated costs that would be incurred by utilities over a 30-year normal replacement period and compared those costs with costs incurred over a 6-year phase-out period. If the 1982 EPA methodology for calculating incremental phase-out costs was used in 1984, the EPA costs are understated

3 4 3 Askarel Transformer Leakage Rates

Again, the 1984 EPA methodology for estimating PCB releases from askarel transformers is not clear, but is apparently the same as that used for the 1982 rule If the same methodology has been used, it can be summarized as follows.

1 The percentage of askarel transformers expected to fail in a year is estimated.

2 The percentage of failures expected to result in PCB spills is estimated.

3 The percentage of askarel transformers expected to leak without failing is estimated.

4 The quantity of PCB fluid lost per spill is estimated

5. The quantity of PCB fluid lost per leak is estimated.

6. Using estimates from Steps 1-5 and an estimate of the number of askarel transformers in service, the total annual loss of PCBs is estimated.

Conceptually, the approach is fine However, the methodology whereby estimates are developed by EPA for steps 1-3, i.e., the basis for determining the critical factors of failure, spill, and leakage rates, is not clearly defined in either the 1982 or 1984 EPA analysis. These data are cited as being based on data obtained from the 1981 EEI/USWAG survey and industry comments. No precise citations or methodology are provided.* The data collected by EEI via the 1981 utility survey do not provide any information on failure rates inasmuch as reliable data on this were not available from the utilities. Similarly, no specific data were collected and reported by EEI regarding the percentage of failed transformers which spill or the percentage of transformers which leak without failing. Although the EEI data may have been used in conjunction with other information to estimate these factors, the EPA analysis does not describe the methodology used Because the procedures whereby EPA estimated spill quantities are substantially undocumented, it is difficult to assess whether the benefits calculated are realistic

3.4.4 Spill Cleanup

A further problem with the EPA cost-effectiveness analyses is the treatment of PCB spill cleanup. Stated simply, although EPA recognizes that utilities clean up PCB spills and attributes costs to these activities, they ignore the effect of cleanup when calculating benefits (defined by EPA to be gross pounds of PCBs spilled).

In their 1982 analysis, EPA indicated that no empirical data were available which could be used to estimate the degree to which PCB spill cleanup is effective. EPA also indicated that cleanup costs were estimated by the utility industry to range from $100 to $1,000,000. Despite the fact that no empirical cost data were available except this broad range of estimates, EPA made assumptions regarding the cost of cleaning up a PCB spill. These assumptions are apparently also used in the 1984 analysis. Although the precise effects of these estimates on the EPA cost model cannot be determined, estimated phase-out costs are reduced by offsetting cleanup costs that are avoided as a result of phase-out, i.e., industry will avoid costs because equipment cannot spill if it is removed from service. Reducing estimated phase-out costs due to cleanup activities without considering the benefits (pounds spilled) due to cleanup, produces an artifically inflated estimate of the cost-effectiveness of phase-out.

Existing EPA regulations governing the cleanup and disposal of PCBs are sufficient to ensure that spill cleanup efforts by utilities remove in excess of 99% of all PCBs spilled from utility-owned equipment.[7] If EPA were to accept the effectiveness of existing regulations, the gross pounds of PCBs estimated to enter the environment without a phase-out would be 99% lower than current EPA estimates (EPA assumes cleanup has no effect on exposure). This would have the effect of substantially reducing the benefits attributable to phase-out, thereby substantially decreasing the cost-effectiveness of phase-out options

7. Assuming a reasonably timely cleanup response, cleanup to any level below 1,000 ppm should conservatively remove 99% of the volume of PCBs spilled.

APPENDIX A

LIST OF UTILITIES IN SURVEY

Alabama Power Company
Appalachian Power Company
Baltimore Gas & Electric
Boston Edison Company
Central Power & Light Company
Columbus & Southern Ohio Electric Company
Commonwealth Edison
Consolidated Edison Co. of New York
Delmarva Power & Light Company
Duke Power Company
Duquesne Light Company
Florida Power & Light Co
*Florida Power Corporation
Georgia Power Company
Idaho Power Company
Illinois Power Company
Indiana & Michigan Electric Company
Kansas City Power & Light Company
Kansas Gas & Electric Company
Kentucky Utilities Company
Los Angeles Department of Water & Power
Louisiana Power & Light Company
Louisville Gas & Electric Company
Memphis Light, Gas & Water Division
Metropolitan Edison Company
Minnesota Power & Light Company
New England Power/Massachusetts Electric Co.
Niagara Mohawk Power Company
Northern Indiana Public Service Company
Northern States Power Company
Ohio Power Company
Oklahoma Gas & Electric Company
Pacific Gas & Electric
Pacific Power & Light Company
Pennsylvania Electric Company
Pennsylvania Power & Light Company
Public Service Company of Colorado
Public Service Company of Indiana, Inc.
Public Service Company of Oklahoma
Public Service Electric & Gas Company
Sacramento Municipal Utility District
Southern California Edison
Southwestern Public Service Company
Tampa Electric Company
Texas Electric Service Company
Texas Power & Light Company
The Toledo Edison Company
Union Electric Company
Utah Power & Light Company
Virginia Electric & Power Company
West Penn Power Company
Wisconsin Electric Power Company

*Nonrespondent

APPENDIX B

SURVEY QUESTIONNAIRE

EDISON ELECTRIC INSTITUTE (EEI)
and
UTILITY SOLID WASTE ACTIVITIES GROUP (USWAG)
ASKAREL TRANSFORMER SURVEY

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Introduction

On March 23, 1984, the U S. Environmental Protection Agency (EPA) published an Advance Notice of Proposed Rulemaking (ANPR) regarding the use of PCBs in electrical transformers The ANPR indicates EPA concerns that inadequate consideration was given to the risks of transformer fires prior to issuance of the August 25, 1982, rule governing the use of electrical transformers containing PCBs. In order to determine whether additional regulation is required, EPA has requested a variety of information regarding transformers and fires USWAG has retained the services of Resource Planning Corporation (RPC) of Washington, D C , to accumulate the required data and assist in its presentation to EPA.

As with the 1981 survey of PCB usage conducted by RPC for USWAG, the study is designed to cover a significant portion of the relevant equipment universe by scientifically sampling a limited number of the largest utilities Since a relatively small number of utilities are being asked to provide data, it is imperative that you fully participate to ensure the validity of the findings ALL RESPONSES PROVIDED IN THIS SURVEY DOCUMENT ARE CONFIDENTIAL THE RESULTS OF THIS STUDY WILL BE REPORTED IN THE AGGREGATE AND UNDER NO CIRCUMSTANCES WILL INDIVIDUAL RESPONSES BE ASSOCIATED WITH AN INDIVIDUAL UTILITY.

To facilitate follow up for the purpose of clarifying responses, you are requested to indicate the name of your utility, and the name and phone number of a person to contact if there is some question in processing your responses

Name of Utility: ______________________________

Person to Contact: ______________________________

Phone Number: ______________________________

To meet the time requirements imposed by EPA, all responses must be received NOT LATER THAN MAY 15, 1984 Survey forms should be mailed to

EEI/USWAG Counsel
c/o Toni Allen, Esq
Wald, Harkrader & Ross
1300 Nineteenth Street, N W
Washington, D C 20036

All questions or inquiries regarding this survey should be directed to:

Rick Bell or Tom Florence
Resource Planning Corporation
(202) 797-1111

General Instructions

This questionnaire is comprised of four major parts

I GENERAL DATA
II FIRE INCIDENT DATA
III ASKAREL TRANSFORMER DATA
IV. RETROFILL DATA

Each major questionnaire part has its own instructions Please read all instructions carefully as you complete the questionnaire.

To ensure uniformity in the reporting of information, please use the following definitions:

Askarel Transformer:	Any transformer designed and built with an insulation system using askarel fluid
PCB Transformer:	Any mineral oil transformer that contains 500 ppm of PCB or greater
Distribution System Transformer:	Any transformer not located in a substation or generating facility
Transformer Fire Incident	A fire in which a transformer has been directly exposed to a fire, either from within the transformer or an immediately adjacent source. If the transformer was not fire damaged, then it should be considered a transformer fire incident only if there were visible signs of fire exposure to the inside of the transformer compartment or the exterior of the casing.

I. GENERAL DATA

This portion of the questionnaire is intended to obtain general information necessary to respond to the ANPR. Where information is not readily available, please provide the most complete response possible within the time limits of the study.

1. Indicate the number of askarel transformers owned by your utility as of March 31, 1984

Size--KVA (name-plate rating)	Distribution System Askarels	Substation Askarels	Generation Facility Askarels	Total Askarels
≤100				
101-500				
501-1,000				
1,001-5,000				
>5,000				

2. If available, indicate the number of transformers containing askarel substitutes (i.e., silicon, RTemp, etc.) owned by your utility as of March 31, 1984

Size--KVA (name-plate rating)	Distribution System Substitutes	Substation Substitutes	Generation Facility Substitutes	Total Substitutes
≤100				
101-500				
501-1,000				
1,001-5,000				
>5,000				

3. Have you conducted a risk-assessment inspection of your askarel transformers?
____ No ____ Yes
If yes, briefly describe actions taken or planned to reduce fire risk (attach additional sheet if necessary)________________________________
____
____

4. Do you now have an askarel transformer phase-out program in effect?
____ No ____ Yes
If yes, briefly describe the phase out methodology, i.e., priority of removal etc.:________________________________
____
What year do you anticipate completion of the phase-out program?________

5. Have fire departments in your service area been notified of the location of your askarel transformers? ____ No ____ Yes

6. Are there any warning signs for firefighters posted in the approaches to askarel transformers? ____ No ____ Yes

13. If known, give the approximate time lapse from:
a. the beginning of the fire to transformer de-energization ___ hrs
b. occurrence to fire department response ___ hrs
c. occurrence to extinguishment ___ hrs
(indicate tenths of hour if <1)

14. Approximately how old was the transformer involved ___ yrs

15. Did the switch, breaker, or fuse on the low voltage side of the transformer open as designed?
___ no
___ yes
___ no switch/breaker/fuse on the low voltage side

16. Did the switch, breaker, or fuse on the high voltage side of the transformer open as designed?
___ no
___ yes
___ no switch/breaker/fuse on the high voltage side

17. Was there any early warning device (alarm or sensor)?
___ no ___ yes If yes, what type? ______________
Did it function as designed? ___ no ___ yes

18. For incidents occurring inside a building, characterize the extent of smoke travel from the fire:
___ smoke was restricted to the transformer enclosure (e.g., vault or room)
___ smoke escaped the transformer enclosure and entered immediately adjacent areas, but did not enter entire building
___ smoke entered the entire building
___ other; describe ______________

19. For incidents occurring outside a building, characterize the extent of smoke travel from the fire:
___ smoke was restricted to the transformer enclosure (e.g., vault or room)
___ smoke escaped the transformer enclosure, but did not enter any public buildings
___ smoke entered nearby public buildings
___ other; describe ______________

20. Excluding fire fighters and utility personnel, approximately how many people were exposed to smoke/soot from the fire? ___ people

21. Approximately how many firefighters and utility personnel were exposed to smoke/soot from the fire? ___ firefighters/utility personnel

22. Indicate the results of any testing:

	PCBs		PCDDs		PCDFs	
	Before Cleanup	After Cleanup	Before Cleanup	After Cleanup	Before Cleanup	After Cleanup
Trf. Fluid						
Soot						

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II FIRE INCIDENT DATA

This portion of the questionnaire is designed to obtain data on ALL FIRE INCIDENTS INVOLVING ASKAREL TRANSFORMERS, PCB TRANSFORMERS OR TRANSFORMERS CONTAINING ASKAREL SUBSTITUTES DURING THE LAST 3 YEARS (APRIL 1 1981-MARCH 31, 1984) A fire incident is defined as a fire in which a transformer has been directly exposed to a fire, either from within the transformer or an immediately adjacent source If the transformer was not fire damaged, then it should only be reported if there were visible signs of fire exposure to the inside of the transformer compartment or the exterior of the transformer casing Complete questions 7-25 for EACH fire incident. Make additional copies of this form as necessary

7 Indicate the size and type of transformer involved in the incident ____ KVA
____ askarel ____ PCB (>500 ppm) ____ askarel substitute (high fire point)
If askarel substitute, specify fluid type ____________________

8 Indicate the approximate time, day of the week, and date of the incident
time day (Mon Tue etc) month/day/year

9 Location of incident
- ___ Inside building
  - ___ Residential (condo, apt., hotel)
  - ___ Institution (school, hospital, church)
  - ___ Office
  - ___ Industrial/manufacturing
  - ___ Storage (warehouse)
  - ___ Other public (store, mall)
  - ___ Other, specify ____________________
- ___ Sidewalk vault
- ___ Other; specify ____________________

10 If the incident occurred inside a building, indicate:

a age of building
- ___ years
- ___ unknown, can't determine

b location within building:
- ___ basement
- ___ roof
- ___ other, specify ____________

c. no. of floors in the building: ___ floors

d environment of transformer:
- ___ vault
- ___ room
- ___ open area
- ___ other; specify ____________

11. Cause of fire:
- ___ within transformer
- ___ outside the transformer; specify if known ____________________

12. Was transformer fluid released and exposed to the fire as a result of damage to the transformer, a leak, or rupture? ___ no ___ yes
If yes, approximately how much fluid was exposed: ___ gals
(Indicate tenths of gallon if <1 gal.)

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23 Briefly describe the area cleaned and method of cleanup. i e , wall, floor ceiling area, HVAC system, etc (attach additional sheets if necessary)

Area	Method of Cleanup

24. In the table below indicate approximate cleanup costs. When estimating cleanup costs be sure to consider manpower, equipment, transportation and any relevant overhead charges:

Cost Type	Cost Estimate
Analysis/test costs:	
Site cleanup/decontamination:	
Disposal	
Vault/transformer/equip costs:	
Other (describe)	
:	
:	
:	
TOTAL.	

25 Have there been any lawsuits filed against your company as a result of this incident? ___ no ___ yes
If yes, briefly describe nature and amount of damages claimed ________

III. ASKAREL TRANSFORMER DATA

In responding to the EPA data requirements, it is necessary to develop information regarding the location and environment of askarel transformers. UNLIKE THE FIRE INCIDENT PORTION OF THIS SURVEY, THIS PORTION REQUESTS THAT YOU EXAMINE AND REPORT ON A SMALL, SCIENTIFICALLY SELECTED SAMPLE OF YOUR DISTRIBUTION SYSTEM ASKAREL TRANSFORMERS, i.e. ASKAREL TRANSFORMERS NOT LOCATED IN SUBSTATIONS OR GENERATING FACILITIES. Based on data provided in the 1981 PCB survey, we have identified the specific askarel transformers on which you are to report. Please follow these instructions in identifying those units:

- Prepare a list of all your askarel transformers that are not located in substations or generating facilities. This list can be in any sequence, i.e., by serial number, location code, etc.

- Beginning with the ___ transformer on the list, select every ______ transformer until you have identified a total sample of _____ transformers. (When you reach the end of the list, go back to the beginning and continue your count until you identify the required number of transformers.)

- Proper selection of these transformers is critical to the study. If you have questions or problems in performing this task, call Rick Bell or Tom Florence (RPC) at (202) 797-1111.

Once you have identified the specific transformers for which data is required, answer questions 26-40 for each transformer selected. Note that if your sample requires data on ten transformers, you must complete ten sets of questions 26-40. Sufficient copies of this form have been included for your sample.

Answer the following questions for each transformer selected in your sample

26 Of the ___ transformers in your sample, where in the order was this transformer selected (1st selected, 2nd selected, etc) Selected ___

27 Indicate the nameplate rating of the transformer: ________ KVA

28 Indicate the askarel fluid capacity: ________ gals

29. Specify the transformer location.
- ___ Inside building
  - ___ Residential (condo, apt., hotel)
  - ___ Institution (school, hospital, church)
  - ___ Office
  - ___ Industrial/manufacturing
  - ___ Storage (warehouse)
  - ___ Other public (store, mall)
  - ___ Other; specify ________________________
- ___ Sidewalk vault
- ___ Other, specify ________________________

30 If transformer is inside building, indicate:
- a. age of building: ___ years
  - ___ unknown, can't determine
- b. location within building: ___ basement
  - ___ roof
  - ___ other; specify ____________
- c no of floors in the building: ___ floors
- d environment in which located. ___ vault
  - ___ room
  - ___ open area
  - ___ other; specify ____________

31 Check the response which applies to the transformer drainage path
- ___ fluid would be contained, i.e., no drain, or drain has been sealed
- ___ fluid would drain to contained catchment area
- ___ fluid would drain to sewer system
- ___ fluid would drain to surrounding soil
- ___ other, specify: ________________________

32. Are vault drains required by local building codes? ___ no ___ yes

33. Check the response which applies to the transformer cooling ventilation system:
- ___ no ventilation; transformer in sealed room or vault
- ___ ventilation through grate in wall/ceiling to outside area
- ___ ventilation through grate in wall/ceiling to indoor area
- ___ other; describe: ________________________

____

34 Is the transformer cooling ventilation system forced or natural?
___ natural ___ forced ___ none
If forced, is it designed to stop in the event of a fire? ___ no ___ yes

35. If this transformer is located inside a building, characterize the potential spread of smoke and soot in the event of fire (answer a-d)

a. Is there an air conditioning or heating system intake inside the transformer enclosure (e.g., vault or room where transformer is located)?
____ no ____ yes ____ transformer not enclosed

b. Is there an air conditioning or heating system intake in the area immediately adjacent to the transformer enclosure (e.g., vault or room)?
____ no ____ yes ____ transformer not enclosed

c. Other than a yes answer to 35a or 35b above, would smoke/soot have other indirect access to the building air conditioning or heating system
____ no ____ yes
If yes, describe access ________________________________
____

d. Would smoke/soot have direct access to the air conditioning or heating system of any other building?
____ no ____ yes
If yes, describe access. ________________________________
____

36. If this transformer is located outside a building, characterize the potential spread of smoke and soot in the event of fire (answer a & b)

a. Is there a building air conditioning or heating system intake immediately adjacent to the transformer enclosure? ____ no ____ yes

b. Other than a yes answer to 36a, would smoke/soot have any other access to the air conditioning or heating system of nearby buildings?
____ no ____ yes
If yes, describe access: ________________________________
____

37. Is the transformer protected on the low voltage side by a fuse, switch, or breaker? ____ no ____ yes
If yes, is the device oil-filled? ____ no ____ yes

38. Is the transformer protected on the high voltage side by a fuse, breaker, or switch at the transformer location (exclude protection at the substation)?
____ no ____ yes
If yes, is the device oil-filled? ____ no ____ yes

39. Is there a smoke or fire alarm or other early warning device or sensor near the transformer? ____ no ____ yes
If yes, describe the device ________________________________
____

40. Is the transformer protected by a sprinkler system or other fire retardant system?
____ no system
____ sprinkler system
____ other system; describe ________________________________
____

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IV RETROFILL DATA

This portion of the questionnaire is designed to obtain data on each askarel transformer you have attempted to retrofill To the extent data are available, please complete questions 41 and 42 for each transformer Make additional copies of this form as necessary

41 Indicate the number of askarel transformers your utility has retrofilled ___ transformers

42. The table below provides space for recording data on two transformers Please record the requested information for each transformer your utility has retrofilled (or is retrofilling) If space is required for more than two transformers, please make additional copies of this form

When reporting costs please include all associated costs, including labor, materials, disposal, and any additional fire protection costs resulting from use of the new fluid. If additional fire protection was required, please describe and provide specific cost estimate in the comments section

	Transformer 1	Transformer 2
a Transformer KVA (nameplate rating)		
b Fluid capacity		
c. Beginning PCB level (prior to retrofill)		
d Retrofill process (flush/refill or filtering)		
e Retrofill fluid		
f. Flush solvent		
g. PCB level after 1st refill (or 1st cartridge change if filtering process)		
h. PCB level after 2nd refill (or 2nd cartridge change if filtering process)		
i. PCB level after 3rd refill (or 3rd cartridge change if filtering process)		
j. Time elapsed from initial draining to last refill (or cartridge change if filtering) (months)		
k. Approximate costs to date (consider labor, materials, equipment, transportation, overhead)		

Comments: ____

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Exhibit 3

EPRI

Technical Newsletter

Electrical Systems Division

PCB TECHNICAL REPORT FROM EPRI

NUMBER 8

ELECTRIC POWER RESEARCH INSTITUTE

EPRI
PCDF PROJECTS

SOURCE		COMPLETION DATE
2028-3	Removal of PCBs from Transformer Oil	June 85
1263-14	PCB Disposal Manual (2nd edition)	September 1984
2028-4	Pyrolysis and combustion products of PCB, tri-, and tetra-chlorinated benzene	November 1984
2028-5 to 10	Analysis of PCDFs in insulating fluids	March 1985
1263-11	State-of-the-Art Review: PCDDs and PCDFs in Utility PCB Fluid (CC 3308)	Complete December 1983

MITIGATION

1263-20	Documentation of building clean-up techniques (Binghamton and San Francisco)	October 1984
1263-21	Engineering options for PCB transformer risk reduction	October 1984

RISK ASSESSMENT AND MANAGEMENT

1826-13	Exposure assessment for PCB spills and fires	December 1984
1826-15	Risk mangement of PCB fires and spills	December 1984
2595	Decision framework for PCB decisions	July 1984

HEALTH EFFECTS

2374	Health effects assessment of PCBs	mid year 1985

SUBSTITUTE INSULATION

1499-4,-5	Arc and spark byproducts of perchloroethylene	August 1984
2028-11	Partial and complete combustion of transformer insulating materials	December 1984
2028-12 (pending)	State-of-the-Art Toxicological Reviews of PCB Substitutes	December 1984

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Title: Removal of PCBs from Transformer Oil

Contracts: * RP2028 - 3

Contractors: Peter Way (-3)

Project Manager: Gil Addis

Purpose: The objective is to develop and demonstrate on a pilot scale a process capable of reducing PCB contamination in transformers below the then EPA acceptability level of 50 ppm.

Scope of Work: In an earlier project, RP2028-1, General Electric, after testing in the laboratory chose the solvent extraction process for scale-up. Other processes tested were: sodium reaction, not selected because significant commercial activity was under way; electron-beam irradiation; and critical-fluid.

The latter two were found to be impractical in the laboratory. A relatively safe and economical solvent extraction process was successfully scaled up to a 10 gallon per hour pilot plant, and plans made to design a full scale plant (RP2028-3).

Expected Results: Successful operation of a large-scale solvent extraction plant for removal of PCBs from contaminated mineral oil would provide an alternative, economical means for decontamination.

Status: A 500,000 gal/year plant has been designed and costed. The proposed host utility for this plant has completed site plans. The project is presently on hold to evaluate the EPA's recent interpretation requiring a level of 2 ppm PCB in the treated mineral oil.

Completion Date: 1985

Title: PCB Disposal Manual, Second Edition

Contract: RP1263-14

Contractor: SCS Engineers

Project Manager: Ralph Komai

Purpose: This project will update the reference manual prepared in 1979 as a guide for utilities in evaluating disposal options

Scope of Work: The Contractor will prepare discussions of the available disposal requirements and disposal options, including the chemical treatment technologies which have beeen developed since the first edition. Chemical treatment will include both destruction and retrofill. There will be an update of the estimated PCB inventory. Management of PCBs also will be addressed

Expected Results: A revised manual will be available to the utility industry to assist in evaluating and planning management options.

Status: A draft report has been prepared and is in the process of being revised. The second draft will be distributed to selected industry people for technical review prior to finalization and publication.

Completion date: September 1984

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Title: Pyrolysis and Combustion of PCB Contaminated Dielectric Fluids

Contract: RP2029-4

Contractor: New York State Department of Health

Project Manager: Gil Addis

Purpose: To determine the extent of formation of PCDF/PCDD as a product of pyrolysis or combustion of both 100% askarels and askarels at 5% and 0.05% contaminants in mineral oil or several retrofill fluids.

Scope of Work: The observation that PCBs under conditions of pyrolysis or combustion can be converted to much more toxic polychlorinated dibenzofurans (PCDFs) has led to heightened interest in the possibility of retrofilling currently in-use PCB transformers with a dielectric unlikely to undergo such transformations. However, even the most careful retrofilling process will leave a residual amount of PCB in the new dielectric fluid. A priori, there is no reason to expect that such low concentrations of PCBs would produce disproportionately high concentrations of PCDFs on pyrolysis or combustion. However, since the details of the mechanisms by which this conversion occurs are not well established, it is clearly desirable to test this possibility experimentally before launching a major retrofilling program. In a second aspect of this work, the level of formation of PCDFs from mineral oil contaminated with PCBs at a low level is of even more importance because of the large number of contaminated transformers involved.

Expected Results: We expect to determine the linearity of formation of PCDF as a pyrolysis or combustion product with decreasing PCB concentration in a host

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liquid, either mineral oil or retrofill fluid.

Status: Pyrolysis and combustion techniques have been developed. Sample clean-up methods, particularly for pyrolyzed or combusted contaminated mineral oil, are nearing success. Analytical results will be available in the near future.

Completion Date: November 1984

Title: PCDF and PCDD in Askarel and Contaminated Oil Equipment

Contracts: RP2028-5,-10

Contractors: Radian (-5), Battelle (-6), New York State Health Dept. (-7), General Electric (-8), IITRI (-9), Research Triangle Institute (-10)

Project Manager: Gil Addis

Purpose: To improve the state of the art of analysis for PCDFs To determine under what conditions, if any, PCDFs and related compounds are found in utility equipment.

Scope of Work: Better analytical separation between 2,3,7,8,X PCDF and other less toxic congeners will be made by synthesizing and spiking with added ^{13}C 2,3,7,8,X congeners. PCDF content of utility equipment under various operating and contamination scenarios will be determined. Laboratory arcing and corona tests will be made on askarel and contaminated samples.

Expected Results: Improved analytical protocol for separating 2,3,7,8,X PCDF and other congeners. Determination of PCDF content of a range of utility equipment.

Status: ^{13}C spiked samples for analysis will be ready around July 1, 1984. A sampling plan for utility equipment has been prepared. Sample collection will start shortly.

Completion Date: March 1985

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5

Title: State-of-the-Art Review: PCDDs and PCDFs in Utility PCB Fluid

Contract: RP1263-11

Contractor: SCS Engineers

Project Manager: Ralph Komai

Purpose: To examine and summarize the state of the art of knowledge regarding PCDDs, PCDFs and other cyclic hydrocarbons in utility PCB fluids. The study also is to determine what conclusions could be made about formation conditions and to define gaps in experimental data.

Scope of Work: See Purpose

Expected Results: Compilation and critical analysis of information available in the literature.

Status: Complete (CC 3308)

Completion Date: December 1983

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Title: Case Studies of PCB Transformer Fires. San Francisco, California, and Binghamton, New York

Contract: RP1263-20

Contractor: IT Corporation/W. Corey Trench

Project Manager: Ralph Komai

Purpose: (1) to document remedial clean-up techniques which have been successfully and unsuccessfully applied to askarel fire contamination,

(2) to generally document the technical and decision-related factors arising from an askarel fire, and

(3) to define areas of future research relating to decontamination.

Scope of Work: The project may be summarized as collection and review of written documentation, development of an interview questionnaire, interview of key personnel involved with clean-up issues at the two fires, data organization and review, and report preparation.

Expected Results: Summary case studies will be published which provide utilities with information on what clean-up techniques have been successfully used, the levels of allowable residual which were established for the respective buildings, how they were arrived at, if understood, the basis of the incident, and operational changes which have been instituted to reduce the impact of future incidents.

Status: Contract has been sent for execution.

Completion Date: October 1984.

Title: Design Manual for Reduction of Airborne PCB Contamination

Contract: RP1263-21

Contractor: West and Hansen/YEI/Fenner

Project Manager: Ralph Komai

Purpose: This project will develop a manual to assist utility personnel in identifying contamination causes and pathways, selection of risk reduction techniques, and preparation of isolation designs.

Scope of Work: The development of this manual will proceed through a study of historical airborne contamination, the pathways of contamination, establishment of isolation criteria consistent with high voltage operation, design techniques for airborne isolation, cost factors and cost estimates, sensing systems, and the actual preparation and review of the manual.

Expected Results: A manual will be made available to the utility industry to aid them in planning risk reduction engineering measures for PCB transformers.

Status: Contract has been sent for execution.

Completion Date: October 1984.

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Title: Exposure Assessment Methodologies for PCB Spills and Fires

Contract: RP1826-13

Contractor: Anderson Nichols West

Project Manager: Abe Silvers

Purpose: To develop methodologies to estimate exposure levels in soil, air and water of PCB from PCB spills and to estimate exposure levels of fire products from utility transformers containing PCB involved in fires.

Scope of Work: A fate model will be developed to estimated exposure levels of PCBs from PCB transformer spills. A compartmented model will be developed to estimate PCB fire products exposure levels.

Expected Results: Code and documentation to estimate exposure levels.

Status: In progress.

Completion Date: December 1984 for draft of final report.

Title: A Risk Assessment Model for PCB Fire and PCB Combustion Products in Electrical Equipment

Contract: RP1325-15

Contractor: Resource Planning Corporation

Project Manager: Abe Silvers

<u>Purpose</u>: To estimate the probability of a utility transformer being involved in a fire in commercial, residential and public structures.

<u>Scope of Work</u>: Information will be developed from surveys to estimate the probability of a transformer being involved in a fire.

<u>Expected Results</u>: A final report with information on the risk of a transformer fire.

<u>Status</u>: In progress.

<u>Completion Date</u>: December 1984 for draft of final report.

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Title: Decision Frameworks for Industry Level PCB Decisions

Project No.: RP2595

Contractor: Decision Focus, Inc.: Dean Boyd and David Cohan are the principal investigators.

Project Manager: E. Victor Niemeyer

Purpose: To develop and test tools that utilities, industry groups, and other interested parties can use to gain insights about PCB risk management issues.

Scope of Work: An analytical framework is being developed that can trace the health and environmental effects stemming from alternative PCB risk management policies. The framework, implemented in the form of a computer model, links equipment management policies with the number of accidental releases, the number of people in different categories (such as office workers, utility personnel, emergency workers) exposed to PCBs and contaminants (such as TCDFs, TCDDs), to estimate the expected number of health effects. It also estimates the costs of the policy alternatives so that the extra health benefits can be compared to the extra costs. Parameters that are uncertain can be treated in either a sensitivity analysis or with a full probabilistic treatment.

Expected Results: A complete, documented and tested computer model that can be used in analysis of risk management alternatives for electric utility PCB-containing equipment.

Status: The computer code implementing the framework has been implemented in prototype form.

Completion Date: The model will be available in final form later in 1984. The prototype of the model is available now with the assistance of the developing contractor.

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Title: Health Effects Assessment of PCBs and Contaminants

Contract: RP 2374

Contractor: Clement Associates, Arlington, VA

Project Manager: W. Weyzen

Purpose: A comprehensive assessment of the potential health risk associated with occupational exposure to PCBs and contaminants, based on available information.

Scope of Work: There are three parts to the study. Part one deals with extracting from the literature data on human and animals on health effects associated with exposures. Part two involves characterization of the utility work environment. Part three involves extrapolation of the health risks for persons exposed to PCBs and contaminants, for selected endpoints.

Expected Results: See objective.

Status: Part 1 has been completed. Part 2 is delayed but will be completed in about one month. Part 3 depends on information collected in 1 and 2 has not started.

Completion Data: Midyear 1985

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Title: . Arc & Spark By-products of C_2Cl_4

Contracts: RP1499-4,-5

Contractors: Springborn Labs, Westinghouse

Project
Manager: Gil Addis

Purpose: To determine arc by-products of perchloroethylene filled transformers.

Scope of Work: Equipment, procedures, and associated rationale have been developed at Westinghouse for the study of arced products of C_2Cl_4 from the point of view of toxicity hazards. Springborn will make use of the equipment and techniques to arc and to analyze the arc products from various combinations of C_2Cl_4, electrodes and solid insulation material. Measurement of arc energy is provided.

Expected Results: Levels of potentially toxic arc products generated under varying operating conditions and using a number of materials combinations will be determined. Among the arc products are Cl_2, HCl, and $COCl_2$.

Other products, such as carbon tetrachloride, hexachloroethane, carbon monoxide and carbon dioxide, will also be included in the analyses.

Status: Arcing trials are being run on a regular basis and analyses proceeding accordingly. Most results will be ready by late June 1984.

Completion Date: August 1984

Title: Partial and Complete Combustion of Transformer Insulating Materials

Contract: RP2029-11

Contractor: Westinghouse

Project Manager: Gil Addis

Purpose To examine the products formed from either complete or partial combustion of liquid dielectrics other than PCB.

Scope of Work: The contractor will initially conduct a theoretical thermodynamic evaluation of combustion reactions utilizing available data. These calculations will then be experimentally verified at selected key points and thus provide a continuum of information applicable to all situations. The investigation will include both theoretical and experimental effects at varied combustion temperatures and varied oxygen levels. The combustion reactions of insulating materials will be performed in the chamber of a thermo-gravimetric cell, which will allow monitoring of weight loss, rate of rise of temperature, reaction conditions, and oxygen content. The combustion products will be trapped for subsequent analyses or directed into a detection device for on-stream analyses. The laboratory studies will use whatever sophisticated analytical techniques are appropriate (gas chromatography, mass spectroscopy, infrared spectroscopy, etc.), to determine qualitatively and quantitatively each type of significant combustion product.

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Expected Results: Improved knowledge of the partial and complete combustion products of liquid dielectrics.

Status. Starting

Completion Date. February 1985

Title: State-of-the-Art Toxicological Review of PCB Substitutes

Contract: RP2028-12 (pending)

Contractor: SCS Engineers

Project Manager: Gil Addis

<u>Purpose</u>: To critically review the literature on toxicology of PCB substitutes. This information is needed to avoid, some time in the future, a situation similar to the current PCB phaseout.

<u>Scope of Work</u>: Literature search on toxicology of PCB substitutes including pyrolysis and combustion products.

<u>Expected Results</u>: A critical review of the toxicology literature of PCB substitutes.

<u>Status</u>: Contract being prepared.

<u>Completion Date</u>: December 1984