RISK MANAGEMENT OF PCBs IN THE UNITED STATES

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ABSTRACT

This paper describes four applications of risk analysis to the problems posed by PCBs. These applications include national and company-level management of in-use equipment and prioritization and site analysis of previous PCB releases. These four studies highlight the use of quantitative risk analysis tools and techniques to manage the complex health, ecological, and economic consequences of electric utilities' use of PCBs in the United States.

INTRODUCTION

This paper reviews several efforts by electric utilities in the United States to manage problems posed by PCBs—both the potential health and environmental risks and the economic costs. Of the 1.26 billion pounds of PCBs produced in the United States, electric utilities had 13% or 163 million pounds in-service as of 1982.[1] These PCBs were contained in nearly 40,000 askarel transformers, 2.8 million PCB capacitors, and over 20 million potentially contaminated transformers, voltage regulators, circuit breakers, and other equipment. The management of these PCBs is potentially a multi-billion dollar problem.

Because of the persistent nature of PCBs, they are perceived as possibly posing a risk both while they are contained in equipment that is in-service and after they have been released into the environment because of equipment failure or inadequate disposal. This paper discusses four applications of risk analysis to real-world PCB problems, two dealing with equipment still in-use and two dealing with the remedy of releases to the environment.

IN-USE: USWAG Askarel Transformer Rule Analysis

In 1984, the United States Environmental Protection Agency (EPA) issued an Advance Notice of Proposed Rulemaking (ANPR) seeking further information on risks to the public health and environment

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[1] The Utility Solid Waste Activities Group, *Comments and Studies on the Use of Polychlorinated Biphenyls in Response to an Order of the United States Court of Appeals for the District of Columbia Circuit*, (Washington, D.C., Resource Planning Corporation), February 1982.

posed by fire-related events in PCB electrical equipment. EPA had concluded based on limited data that "PCB-transformer fires pose relatively high risks, occur with unknown frequency and can result in relatively high cleanup costs," (49 CFR 11071).

In response to this ANPR, the Utility Solid Waste Activities Group (USWAG), an informal consortium of U.S. electric utilities, sponsored an analysis of the potential human health risks associated with fires involving utility-owned askarel transformers and compared the costs and benefits of a set of alternative regulatory policy options designed to mitigate these risks.[2] The analysis was carried out using the Transformer/Capacitor Risk Management (TRIM) model developed by Decision Focus Incorporated (DFI) for EPRI (RP 2595-1). Then current data on the number of transformers in use, planned voluntary phase-out programs, and the occurrence of fire-related incidents involving transformers were used, together with extensive information on spill occurrence, PCB releases, by-products of PCB combustion, human exposure, and health effects.

Four policy options were examined: (1) maintaining a normal end-of-useful-life replacement schedule for all utility-owned askarel transformers currently in service, (2) an accelerated phase-out leading to the removal of all utility-owned askarel transformers in or adjacent to buildings (including those in sidewalk vaults) by the year 1995, (3) a highly accelerated phase-out with the removal of all utility-owned askarel transformers in or near buildings by 1990, and (4) a risk reduction program designed to reduce the chances of serious incidents involving fire.

The key conclusions of the analysis were that the potential health risks from askarel transformers were extremely low (6×10^{-8} maximum individual risk) and no further regulatory action was merited on a cost-benefit basis. If some regulatory action were required, the risk reduction measures would be the most cost-effective. Although there were considerable uncertainties in many parameters, sensitivity analysis showed that these conclusions were robust, holding for a wide range of assumptions.

IN-USE: Management of Mineral Oil Transformers

A large western utility in the United States was concerned that a fire involving a PCB-contaminated mineral oil distribution transformer could result in high cleanup and liability costs, and was considering replacing contaminated units.[3] Although historical testing of units brought in for service showed that less than 4% of all distribution transformers were contaminated, there was no *a priori* way to determine which of the 550,000 transformers might be candidates for replacement.

A program of testing 8,200 mineral oil distribution transformers located in sensitive areas (in or near commercial buildings, schools, hospitals, and other potential high-exposure locations) was initiated. Based on test results, units with PCB concentrations above 50 ppm would be replaced. Since the cost of testing amounted to over $3 million ($400 per transformer), the utility wanted to evaluate whether continuation of the sampling program was worthwhile.

The utility used EPRI's PCB Contaminated Oil Economic Risk Management Model (COIL) to analyze the value of testing units to determine PCB concentrations. The analysis integrated data on transformer

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[2] The complete analysis is contained in, *Analysis of the Costs and Benefits of Alternative Askarel Transformer Regulatory Options*, Final Report and Supplement prepared by Decision Focus Incorporated for USWAG, December 1984.

[3] The complete study is documented in, *Decision Analysis of Potentially Contaminated Mineral Oil Transformers in an Urban/Suburban Distribution System*, prepared by Decision Focus Incorporated for EPRI, January 1986.

contamination, frequency of fire incidents, costs of cleanup and liability, and the costs of the sampling and replacement program. The results were an economic comparison of the total lifecycle costs of Sample versus Don't Sample, and Replace versus Leave in Service.

The analysis showed that the testing program was not economically advantageous, since replacement of transformers was not warranted under any realistic set of assumptions regarding fire incidents frequency and expected cleanup and liability costs. Based on these results, the utility terminated the sampling program after 1,509 units had been tested, resulting in a savings of $2.7 million.

REMEDIES: Prioritization of Pole Spill Sites

Because of the ubiquitous use of PCBs before their manufacture was banned in 1978, most American utilities have a very large number of sites that are potentially contaminated with PCBs. Because PCBs are considered to be harmful by the public and most regulators, current regulations to a large extent demand that such contamination must be cleaned or otherwise mitigated. Management of PCB-contaminated sites requires a careful plan of action to minimize risks from these sites as efficiently and quickly as possible. However, utilities may lack the staff and resources to fully investigate, analyze, and remediate all of their sites at once. Priority-setting can help ensure that potentially high risk sites are dealt with first, before the situation can worsen. It also helps avoid significant commitments of resources to low risk sites.

The PCB Spill Priority-Setting Model (PSPM) was developed by EPRI to help utilities establish priorities for action at PCB-contaminated sites based on the level of health risk at each site. The PSPM ranks sites according to predictions of the dose levels for those exposed. Dose estimates are based on any site-specific information that is available combined with general knowledge of the chemical characteristics and transport and fate of PCB spills. Using PSPM, utilities can efficiently target their management efforts at the sites with the most risk. Although the PSPM was originally developed for application at transmission pole spill sites, it has been generalized to be applicable at almost any type of PCB spill.

The first application of the PSPM model was at a utility that, under pressure from a state environmental agency, had recently decided to perform soil investigations at each of their known PCB pole spill sites. This involved more than 300 sampling programs, followed by soil excavation and more sampling wherever soil concentrations exceeded regulatory guidelines. The political situation made the project even more complicated. Because of the utility's size, its service region included a large number of cities, towns, and counties. Many of these local governments were actively involved in the PCB issue and wanted the pole spills in their region to be sampled and cleaned first. However, because of the total number of sites and the utility's manpower and equipment limitations, it was impossible for the utility to complete the project in less than three years.

The utility used PSPM to analyze its sites and established priorities for each of those sites based on the risk that they posed to the communities that surrounded them. Once the data were collected, data entry and analysis using PSPM averaged less than 15 minutes per site. By setting priorities this way, the utility was able to reduce exposure to PCBs as quickly and as efficiently as possible.

The PSPM also had considerable benefit as a tool for communication. The utility found that having a formal ranking program helped justify the order it chose for investigation: the sites that received attention first had been analyzed and were found to pose higher risks than other sites. Having a formal ranking program also helped the utility demonstrate that it was active and concerned not only about PCB sites as a group but about all of its sites individually. This helped a great deal in appeasing the communities surrounding pole sites that were not to be immediately investigated.

REMEDIES: Risk Analysis of Residual PCBs at a Substation

This 1989 study examined the potential human health risks posed by residual PCB contamination at a utility substation. The goals were to characterize contamination levels, human health and environmental risks, and remediation costs for an electric substation where PCB spills were known to have occurred, and to demonstrate and test transport and fate models and risk assessment tools developed for use by the utility industry. The study was co-sponsored by EPRI, the host utility, and USWAG.

PCB equipment at many utility substations has been replaced with non-PCB units. But, because electrical equipment containing PCBs were used at substations for a number of years, leaks or ruptures in the past may have spilled PCB fluid. In past years, common practice after a spill was to remove visible staining and backfill with clean dirt and stone. While removing a large amount of the spilt material, this procedure may have left some residual PCB contamination that remains today.

A comprehensive risk analysis requires extensive data to accurately evaluate the potential health risks from residual PCBs at or near the substation. The scope of this analysis went beyond an assessment of PCB contamination; it included a determination of how PCBs could reach potentially exposed population groups, and how the doses received could affect human health.

The EPA acceptable risk range is between 1-in-10,000 (10^{-4}) and 1-in-a-million (10^{-6}) individual lifetime risk.[4] Through Proposition 65, the State of California has defined the 10^{-5} level as the boundary between significant and insignificant risks.[5] The overall human health risks of residual PCB contamination at this substation fall into the insignificant risk range. The expected value risks (i.e., the probabilistic-weighted average risks accounting for all the uncertainties) for all exposed populations are less than the low end of the acceptable risk range (i.e., 10^{-6} lifetime individual risk). Even the upper bound estimate, compounding all the most conservative assumptions (which would only occur with an estimated probability of 0.002), results in lifetime individual risks of only 1-in-a-million (10^{-6}) for the highest risk group.

The total expected population risk is approximately a 2-in-a-million (2×10^{-6}) chance of a single case of cancer. From a health risk perspective, the site before remedial action did not pose a significant risk and no remedial action can be justified by avoiding possible cancer incidents.

SUMMARY

This paper has reviewed a number of risk management analyses of PCB problems in the United States. These studies included both national and company-level management of in-use equipment and prioritization and site analysis of PCB releases. Related to risk management of PCBs, EPRI has a number of software products available and is currently developing new tools for the risk analysis of sites contaminated with PCBs and petroleum products.

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[4] U.S. Environmental Protection Agency, *1990 National Oil and Hazardous Substances Pollution Contingency Plan*, 40 CFR 300 (Washington, D.C., Office of Emergency and Remedial Response), Final Rule, signed February 6, 1990.

[5] State of California, Safe Drinking Water and Toxic Enforcement Act of 1986, *Emergency Regulations*, Section 12703(8)b, February 16, 1988.