



Property Risk Consulting Guidelines

A Publication of AXA XL Risk Consulting

PRC.5.4.5.1

DIELECTRIC FLUIDS CONTAINING PCBs

INTRODUCTION

For years, mineral oil was the primary dielectric fluid used in transformers and capacitors. The desire for noncombustibility and improved electrical properties led to the introduction of a synthetic insulating fluid widely known under the name of "Askarel" as a common alternate fluid. There are many more names under which this type of insulating liquid is known. A list can be found in PRC.5.4.5.1.B. These fluids contain polychlorinated biphenyls (PCBs).

When PCBs were found to pose a significant risk to human health and the environment, they became a toxic substance under the jurisdiction of the U.S. Environmental Protection Agency (EPA). PCBs are now being phased. Remaining askarel insulated transformers and capacitors are closely regulated. A general description of some of these regulations appears in this guideline under the heading "US Code of Federal Regulations – CFR 761"

During the period when Askarel units were acceptable, numerous oil insulated transformers became contaminated with PCB. The contamination was caused by then-accepted practices involving transformer testing, fluid sampling and fluid handling and delivery. Even today, new fluids used to refill PCB transformers are exposed to PCBs and can become contaminated.

Improved protection levels necessary for many of the older installations of PCB transformers and capacitors are necessary. The presence of PCBs can result in major increases in losses due to regulated cleanup requirements and life safety concerns. Old levels of protection must be supplemented to limit newly recognized loss potentials.

This guideline addresses the PCB hazard. It is not to be used for the interpretation of any code or law, nor does it address all federal and state requirements.

POSITION

Include PCB-containing equipment in Hazardous Materials Evaluation, Maintenance, Employee Training and Pre-Emergency Planning programs as discussed in *OVERVIEW*. Electrical equipment which may be involved includes PCB capacitors, PCB transformers and PCB-contaminated transformers. The items that follow address means to control PCB hazards involving such equipment.

Property owners and their designated representatives are responsible to keep informed of PCB regulations, hazards and loss potentials if materials containing PCBs are on their property. Additionally, PCB owners, users and handlers have federally-defined loss control responsibilities. Adequately train employees and provide them with sufficient resources to meet these requirements.

Review PCB equipment and exposures at least quarterly.

Develop a schedule to replace or retrofill and reclassify all PCB transformers to achieve “Non-PCB” status. Units creating a serious loss exposure should receive high priority.

PCB transformers, PCB capacitors and PCB-contaminated transformers pose similar contamination threats under fire conditions whether idle or in-service. Immediately remove idle units from the premises. If there must be a delay, move the equipment to a safe, low fire hazard location not subject to flooding. Follow appropriate EPA storage and disposal regulations.

Complete a hazard evaluation for each indoor PCB transformer. Take into account combustible materials exposing the unit, building ventilation arrangements that can spread PCB contaminants during a fire, and exposed property damage and business interruption values. Postulate that affected areas will not be habitable for at least one year. If a serious contamination threat is found, consider immediately replacing or retrofilling and reclassifying the involved unit.

Do not locate an indoor PCB transformer in the open to expose or be exposed by other occupancies. As a minimum, provide an isolated electrical equipment room meeting the following criteria:

- Room should provide a one hour minimum fire rated cut-off.
- Room should not be one that is normally occupied.
- Walls, floors and ceilings should be liquid-tight.
- Openings in walls should have one hour minimum fire rated doors.
- Openings in walls should have curbs of sufficient height to contain the contents of the largest enclosed transformer.
- Room ventilation should be direct to out-of-doors, totally independent of other ventilation systems, and should discharge at a location not likely to be drawn into other ventilation intakes.
- If floor drainage is provided, means should be included to provide for recovery of the PCB fluid.

Replace or retrofill and reclassify outdoor PCB transformers (other than those on roof-tops and those exposing but not part of the property) not meeting the following criteria:

- **Either**, detached a minimum of 30 ft (9 m) from buildings, **or** adjacent to a building wall having a one hour minimum fire resistance rating and no openings within 30 ft (9 m).
- Sufficiently remote from windows which can be opened, from ventilation air intakes, and from similar features, to preclude smoke entering buildings.
- A minimum of 30 ft (9 m) from combustible storage, including mineral oil insulated transformers.
- Arranged to confine released PCB liquids for subsequent disposal.

To control exposures from outdoor PCB transformers that are not part of the property, discuss exposure-reduction approaches with the units’ owners to accomplish effective loss control as identified in this guide.

Arrange outdoor, roof-top, PCB transformers as follows:

- On curbed, drained pads.
- Drained to oil separators to recover all released PCB liquid for disposal.
- In open top, solid-sided enclosures, with side heights extending to the heights of the transformers to minimize chances for expulsion of PCB fluids beyond the enclosures. Care should be taken not to restrict cooling air circulation.

Provide a current-limiting fuse on the primary side of each PCB transformer. Alternately, provide differential relays having zones of protection that include primary side fuses and the circuit breaker(s) necessary for isolation.

Inspect PCB transformers and capacitors at least monthly to detect obvious leaks or problems before they become severe.

Do not exceed PCB transformer design loads. Provide temperature and current indicators to alarm when unsatisfactory conditions are reached.

Maintain combustibles at least 30 ft (9 m) from PCB transformers. Where this spacing is not possible for indoor equipment, provide automatic sprinkler protection.

DISCUSSION

History of PCB Use

Polychlorinated Biphenyls (PCB's) are organic compounds, which consist of biphenyl and Chlorine. This can be chemically represented as $C_{12}H_{(10-n)}Cl_n$. Typical characteristics are non-flammability, inertness, high dielectric strength and high heat resistance. This made them particularly attractive for use in transformers, capacitors, hydraulic fluids, heat transfer systems, fluorescent light ballasts, paints and printing inks.

PCBs have been used in many countries since the 1930's Monsanto Chemical Company was the sole licensed manufacturer in the USA.

Askarel contain PCBs as a major ingredient. Askarel fluids are used in liquid-insulated transformers and capacitors in order to avoid the fire hazard associated with a mineral oil dielectric. The original equipment manufacturer specified the exact mixture for the particular application but PCB content usually exceeded 45% (450,000 parts per million (ppm)) and could be as high as 80%.

In 1968 an incident occurred in Kyushu, Japan in which rice oil was contaminated with PCB. This oil was sold, consumed and resulted in adverse effects on many people. A similar incident occurred in Taiwan in 1978-1979

During the mid-1960s, the American "Food and Drug Administration" (FDA) labeled PCBs a potential danger to life and property after discovering their widespread distribution in the environment and having observed their adverse effects on certain forms of animal life. Specifically, PCBs are non-biodegradable and bio accumulative. When exposed to temperatures in excess of 1100°F (600°C) they form toxic Dioxin and furan decomposition products.

As a result of these findings and pressure from the federal government, Monsanto, in 1971, voluntarily limited production and restricted distribution of PCBs to manufacturers of electrical transformers and capacitors. By doing so, the output of PCBs was cut in half and its use restricted to that of dielectric and coolant.

Westinghouse Electric Corporation discontinued shipping transformers filled with INERTEEN (a PCB compound) after December 31, 1976. General Electric Company ceased the delivery of transformers filled with PYRANOL (another PCB compound) after April 30, 1977.

In 1976 Congress passed the Toxic Substances Control Act (TSCA), which generally prohibits the use of PCBs after January 1, 1978. The action was due to the perceived toxicity of PCB liquids and the highly toxic by-products resulting from incomplete combustion of PCBs. The statute allows the EPA to permit exceptions for PCB uses considered "totally enclosed" or those deemed not presenting an unreasonable risk of injury to health or the environment. The TSCA also forced manufacturers to tackle the problem of finding dielectric fluids having favorable characteristics similar to PCBs, but without the drawbacks.

Starting in May 1979, the EPA published rulings that clarified risks, defined terms and set policies that regulated the use and disposal of PCBs. A key ruling is that the use of transformers and capacitors containing PCBs is a reasonable risk where in conformance with EPA regulations. The 40 CFR part 761 code is continually revised and amended as new information is acted upon by the EPA. Proposals, actions and final rules are published in the Federal Register.

The contamination potential from PCB transformers and capacitors is a universal threat to property and related profits. A small business would very likely not survive the long term disruption of operations. Electrical arcing within a PCB fluid and exposure of a PCB fluid to fire can result in the formation and emission of highly toxic dioxins and furans. Equipment failures can result in widespread dispersion of these toxic emissions through entire buildings. Decontamination times can be extensive. Entire buildings may not be available for intended usage for months and even years. Examples of PCB contamination incidents are described in PRC.5.4.5.1.A.

US Code of Federal Regulations – CFR 761

The Code of Federal Regulations (CFR) Part 761 covers all substances that contain PCBs, and various applications including transformers, capacitors, heat transfer systems, hydraulic systems, pigments and research. The information extracted and paraphrased for this guide applies only to fluids used as dielectrics in transformers and capacitors. Some portions of the CFR require compliance by a specified date and within a specified time period, whichever comes first. Only the general requirements are specified here.

Definitions used in CFR 761

PCB TRANSFORMER OR CAPACITOR - Any transformer or capacitor containing 500 ppm (0.05%) PCB or greater.

MINERAL OIL PCB TRANSFORMER - Any transformer designed to contain mineral oil and which has been found to contain 500 ppm (0.05%) PCB or greater.

PCB-CONTAMINATED ELECTRICAL EQUIPMENT - Any oil filled equipment (e.g., transformer) whose PCB concentration is unknown; also, any unit containing 50 ppm or more PCB, but less than 500 ppm PCB, except transformers being reclassified must also demonstrate a stable concentration for a period of three months.

NON-PCB TRANSFORMER - Any transformer containing less than 50 ppm PCB, except units being reclassified, must also demonstrate a stable concentration for a period of three months. A transformer meeting this requirement is no longer regulated by the CFR.

SMALL CAPACITOR - One containing less than 1.36 kg (3 lbs) of dielectric fluid.

LARGE CAPACITOR - A large capacitor is one not qualifying as a small capacitor.

Where the fluid weight is unknown, a total capacitor volume less than 1639 cm³ (100 in.³) is assumed to contain less than 1.36 kg (3 lb) of fluid. When the capacity is between 1639 cm³ and 3278 cm³ (100 in.³ and 200 in.³) and weights less than 4.08 kg (9 lb) it is considered a small capacitor. A capacitor volume greater than 3278 cm³ (200 in.³) is assumed to contain more than 1.36 kg (3 lb) of fluid. For other capacitor volumes, if the total weight of the capacitor is 4.08 kg (9 lb) or more, then the weight of the fluid is assumed to be greater than 1.36 kg (3 lb).

IN OR NEAR COMMERCIAL BUILDINGS - In the parking lot of or within 30 m (98 ft) of nonindustrial nonsubstation buildings such as schools, churches, offices, theaters, stores, institutions, homes, transportation terminals and other places of public assembly.

RETROFILL - To remove PCB or PCB-contaminated dielectric fluid and to replace it with PCB, PCB-contaminated or non-PCB dielectric fluid. While the purpose of retrofill is to lower the PCB concentration in a fluid-insulated transformer, the process does not assure being able to reclassify the transformer when the process is complete. However, some services will guarantee this result.

POSING AN EXPOSURE RISK TO FOOD OR FEED - In any location where human food or animal feed products could be exposed to a PCB release, including all potential pathways to the food or feed, but excluding private residences. Typical locations include restaurants, grocery stores, food or feed warehouses, barns, bins, feedlots and open fields either cultivated or used for grazing.

FIRE-RELATED INCIDENT - Any incident involving a PCB transformer which involves the generation of sufficient heat and/or pressure to result in a rupture of the unit and release of PCBs.

Summary of CFR 761 PCB Rulings Relating to Transformers and Capacitors

Detailed protection, inspection, documentation, notification and reporting requirements are outlined in the CFR. Compliance is the responsibility of PCB owners, property owners, users and handlers. All questions should be resolved with the EPA. This guideline does not describe all requirements.

- Compliance with regulations is the responsibility of all persons who manufacture, process, distribute in commerce, use or dispose of PCBs or PCB items. Noncompliance may result in civil penalty and criminal prosecution. Generally, responsible parties are the owners of the PCB equipment and the facility or designated agents.
- The use and storage of PCB transformers posing an exposure risk to food or feed are prohibited.
- Use of network PCB transformers in or near commercial buildings:
 - having a secondary voltage **equal to or above 480 volts** and including 480/277 volt systems is prohibited
 - having secondary voltages **below 480 volts** in sidewalk vaults is prohibited. All others must have electrical protection to avoid transformer ruptures caused by high current faults. To meet this requirement, the CFR suggests use of current limiting fuses installed in accordance with good engineering practices.
- Use of radial PCB transformers in or near commercial buildings:
 - having a secondary voltage **equal to or above 480 volts** and including 480/277 volt systems must have electrical protection to avoid transformer ruptures caused by sustained low current faults. To meet this requirement, the CFR suggests using pressure and temperature sensors and disconnect equipment installed in accordance with good engineering practices. In addition, provide protection against high current faults as outlined in the below paragraph.
 - having secondary voltages **below 480 volts**, must have electrical protection to avoid transformer ruptures caused by high current faults. To meet this requirement, the CFR suggests use of current limiting fuses installed in accordance with good engineering practices.
- The reuse of PCB transformers that were placed into storage is prohibited except where the unit is a mineral oil PCB transformer and has been retrofilled and is being placed into service to qualify for reclassification.
- All PCB transformers including those in storage must be registered with the EPA.
- All owners of PCB transformers in use in or near commercial buildings must register the PCB units with these commercial building owners. All owners must maintain records and follow reporting responsibilities.
- Combustible materials are not allowed to be stored within a PCB transformer room, vault, or partitioned area, or within 5 m (16 ft) of such an area, or within 5 m (16 ft) of an unenclosed PCB transformer.
- A visual inspection of all PCB transformers is required quarterly. CFR provisions decrease this requirement to yearly, or increase it to weekly for specified conditions.
- Where any quantity of PCBs are running off or are about to run off the surface of a PCB transformer, the leaking unit is to be repaired or replaced, and CFR disposal requirements are to be followed. Cleanup must be initiated as soon as possible and within 48 hours of discovery.
- The owner of a PCB transformer must immediately report fire-related incidents to the National Response Center, and must initiate measures to contain and control releases as soon as possible.

- Records of its inspection and maintenance history must be maintained for at least three years after disposing of a PCB transformer.
- Where an oil insulated transformer assumed to be PCB-contaminated is tested and found to be a PCB transformer, all PCB transformer requirements of the CFR apply except that a separate schedule for compliance is provided. This includes registering the unit within 30 days of discovery.
- PCB transformers can be serviced as long as such servicing does not require removing the transformer coil from the transformer casing.
- The exterior of all PCB transformer locations excluding grates and manhole covers must be marked "PCB" by a large, easy-to-read sign, 15cm (6 in.) on each side or larger.
- All PCB spills regardless of size must be cleaned following EPA guidelines. Spills involving 1 lbs (0.45 kg) or more of PCBs in a fluid concentration of 50 ppm or more must immediately be reported to the National Response Center. Additionally, spills involving water supplies, grazing lands and cultivated land must be reported to the EPA regional office within 24 hours of discovery.
- Processing and distribution in commerce of PCBs for the servicing of transformers is permitted only for persons granted an exemption by the EPA.
- Fluids cannot be diluted for the purpose of changing a classification except as permitted by the CFR.
- The use and storage for reuse of PCB Large Capacitors is prohibited unless located in a restricted access outdoor electrical substation or within a restricted access indoor location having a roof, walls and floor that will contain any release of PCBs.
- The use and storage for reuse of PCB Large Capacitors posing an exposure risk to food or feed is prohibited.

Retrofilling to Obtain Reclassification

Originally, retrofilling of existing askarel transformers was not advocated because of the lack of experience with the newer liquids, the fact that all the PCBs could not be flushed out of the transformer (and the concern that any spill would still have to be treated as a PCB spill) and the potential fire and contamination hazards that existed during the retrofill operations. Later developments and field experience have changed this attitude.

Many retrofilled askarel transformers now have a PCB level below 50 ppm, the threshold established by EPA for non-PCB units. After such reclassification, EPA restrictions are removed. More importantly, the low levels of PCBs drastically reduce the potential for serious contamination. Some companies that perform the retrofill also provide full service including removal, transportation and destruction or disposal of askarels, PCB-contaminated materials and PCB equipment.

Because of these developments, management should establish a program for the replacement or reclassification of all PCB transformers, with priorities given to those units that expose sensitive occupancies or are themselves subject to significant fire exposures. Replacement may be the better solution, particularly if the transformer has been experiencing difficulty or is in its last 10 years of service life.

The original transformer manufacturer should be consulted as to recommended or acceptable retrofill fluids, and the need for changing gaskets, derating of the unit and other modifications dependent upon the fluid selection. The fluid should be a less flammable or nonflammable liquid, as defined in the *National Electrical Code*® (NEC), and should be "listed" as defined in the NEC. PRC.5.4.5 describes these fluids.

Retrofilling should be done by a qualified experienced contractor. Not all retrofill processes can be done in every transformer. Long term effects on an askarel transformer cannot be predicted. And some units may be in such a condition that retrofilling would not be advisable. Warranties, maintenance requirements, performance expectations and possible adverse effects should be documented.

The contract should arrange for the disposal of all askarel fluid, PCB-contaminated absorbents, cloths, rags and other materials, following EPA regulations. Such items should not be stored on site, but if temporary storage cannot be avoided, they should be placed in EPA approved drums and located in a secure, low fire hazard area meeting the EPA criteria.

An action plan should be established with the contractor. A mutually agreeable schedule should be established. Each location should be reviewed and proposed steps evaluated in the event of an accidental spill. Arrangements should be made beforehand to contain, entrap and absorb any leaks or spills. Particular attention should be given to any building drains in the immediate area. If there is any possibility that an accidental spill could reach the drain, it should be sealed off during the draining and flushing phases of retrofill.

If the flushing fluid is combustible, suitable hand fire extinguishers should be readily available to handle the potential Class B fire. All unnecessary combustibles should be excluded from the working area.

The area around the transformer should be permanently curbed. The height of the curb and the area enclosed should be sufficient to contain the fluid contents of the largest transformer. In any case, the curb should be at least 4 in. (100 mm) high.

The retrofilled transformer should be immediately and clearly labeled to identify the use of a new fluid. Following retrofill, testing to determine the new PCB level cannot be completed until after a 90 day minimum waiting period. Upon testing, the transformer should be labeled as PCB-contaminated if the PCB concentration is below 500 ppm. If below 50 ppm, the transformer is considered a non-PCB unit.

Handling and Disposal of Askarel-Impregnated Materials

Handling and disposal of askarels and askarel-impregnated materials should be accomplished following the EPA-prescribed methods. Final placement or destruction of the PCBs is regulated by the PCB concentration, type of fluid, type of equipment and construction and ignitability. Approaches include chemical waste landfill, incineration, combustion boiler and approved facilities for burning. Detailed requirements are identified in the CFR. Loss control managers should review the advantages and disadvantages of PCB destruction verses burial.

In the event of an askarel spill or a rupture of an askarel-insulated transformer or capacitor, the EPA should be immediately notified. They will supervise the accident to see that proper procedures are followed and appropriate handling and disposal methods are implemented. However, where there are problems in contacting regional EPA representatives, unless the Emergency Response Office assumes responsibility for notifying them, decontamination should progress and records should be kept of all telephone notification attempts.

Federal Notification and Assistance

In the US, the Code of Federal Regulations requires telephone notification to the NATIONAL RESPONSE CENTER for certain events. The telephone numbers for the National Response Center are: 800-424-8802 or 202-267-2675. Their web site can be reached at: <http://www.nrc.uscg.mil/nrchp.html>

The Code of Federal Regulations also requires notification to the U.S. Environmental Protection Agency (EPA) regional office for registration of equipment and PCB spills. The EPA web site can be reached at: <http://www.epa.gov/>

The EPA publishes a listing of its ten regional offices, including the name, address and phone number of the EPA representative to contact. Those responsible for management of loss control programs should maintain current information in their files for use in emergencies. Because the regional office information is subject to frequent changes, it is not being reproduced in this guide. Current information can be found at: <http://www.epa.gov/opptintr/pcb/ordin.html>.

The TSCA Assistance Office, Office of Toxic Substances, EPA, Washington DC 20460, can provide further information. It's hotline telephone number is 202-554-1404.

The EPA also publishes “PCB DISPOSAL COMPANIES - COMMERCIALY PERMITTED.” The categories in the listing include incinerator, alternate thermal, chemical, physical separation, biological, pipeline removal and chemical waste landfills. Updated information on approved companies may be available through regional offices or can be found at <http://www.epa.gov/opptintr/pcb/waste.html>. Disposal and retrofilling contracts should be obtained directly with an approved facility.

PCB Transformer Replacement Alternatives

In lieu of retrofilling an askarel transformer, several dry and liquid types of transformers are available for use as replacements. The terms retrofit and changeout also refer to replacement of a transformer. For any given location, one or more types of replacement units may not be suitable or practical. Each location and alternative must be evaluated for its fire and corrosion loss potential. PRC.5.9.0.1, PRC.5.9.1, PRC.5.9.2, PRC.5.9.3 and PRC.5.9.4 describe these alternatives and various considerations.

The possibility of toxic residuals from any of these alternatives, as from retrofilling, is an ongoing consideration. Over the 30 to 40 year life of a typical transformer, products that were originally considered safe may be deemed unsuitable. Acceptance of replacements is based on an assumption that there is no viable threat for regulatory actions as were taken with PCBs.

PCB CONTAMINATION INCIDENTS

The following incidents are described to show the severity of the PCB problem. As noted, losses need not be fire-related to cause considerable property damage and interruption to business.

Improper Handling and Disposal

- A utility company hired a contractor to remove and dispose of a PCB transformer. The contractor supposedly performed the work according to the codes. When a decontamination site used by the contractor was later found to be contaminated, the contractor went out of business and filed for bankruptcy. The utility company and other former customers of the bankrupt contractor were required to pay a significant portion of cleanup costs, even though there was no way to determine whose equipment caused the contamination.
- In 1995, a Pennsylvania steel mill was fined \$70,000. The citation was for inadequate PCB recordkeeping and improper use of PCB transformers.

Spills

- In 1995, a 10,000 kVA transformer containing 1500 gal (5680 L) of askarel spilled into a field in Tennessee. The cleanup involved transferring the contaminated soil in over 10,000 55-gal (208 L) drums which were shipped to and buried in approved landfills in Robstown, Texas and Model City, New York. The cost was over \$2 million.
- A 500 kVA askarel-filled transformer, located on the roof of a tire manufacturing plant, ruptured from an internal electrical fault. Although most of the askarel that spewed from the transformer tank was removed by roof drains, sufficient askarel permeated the built-up wood roof to become a health hazard to employees. Only after the entire roof was replaced was the EPA satisfied that the hazard had been eliminated.
- Also in 1995, a 75 kVA transformer containing 250 gal (946 L) of PCBs was dropped while being loaded upon a commercial barge in an important navigational channel within the city of Seattle. According to the EPA, all of the heavier-than-water material inside the transformer settled to the river bottom, contaminating a 200 ft × 500 ft (68 m × 152 m) area. The cleanup of the river bottom involved extensive dredging and disposal, and took over eighteen months to complete. Approximately 210 gal–240 gal (795 L–908 L) of PCBs that spilled into the channel were recovered at a cost of \$500,000.
- In 1996 a PCB contamination in Michigan's Manistique River caused cleanup costs of over \$48 million.

Fires

- 1981: Heat from a switchgear fire cracked a ceramic bushing on a nearby askarel transformer in a state office building in Binghamton, New York. Leaking askarel was decomposed by the heat of the fire, forming chlorinated dibenzofurans, chlorinated dibenzoparadioxins and other substances. The toxic products were picked up and distributed throughout the 18-story building by the air conditioning system. Contamination forced the closing of the building and resulted in a costly and lengthy decontamination effort. Nearly 14 years after the incident, the state and its unions' workers finally agreed the building could be reopened. Over \$70 million was spent on litigation and decontamination procedures. The cost of having the tallest building in the city stand vacant for nearly 14 years includes the loss of business for neighboring downtown concerns. Most noticed a drop in customers and sales following the disaster. The psychological impact on the community cannot be measured.

- In 1990, smoke and fumes from a fire in an outside underground vault entered a fresh air intake duct and infiltrated six floors of an adjacent office building in San Francisco. The affected areas were uninhabitable for 10 months and the cleanup costs were in excess of \$20 million.
- In 1991, a fire in a 30 ft × 50 ft (9.1 m × 15.2 m) electric switchgear building involved three capacitors, each containing three gallons of a PCB dielectric fluid. The direct fire damage was \$75,000. The decontamination expense was approximately \$2.5 million.
- An incident in 1991 at a campus site caused a number of electrical faults and ensuing fires in several PCB filled transformers. The total cleanup cost exceeded \$50 million.
- An fire incident in 1994 at a Department of Transportation Building in Pennsylvania caused PCB contamination. The bulding was finally demolished and rebuild. Total estimated cost over \$100 million.

COMMONLY USED NAMES FOR ASKARELS

The following is a list of commonly used names for Askarel type fluids including, but not limited to transformer and capacitor liquids.

Trade Name	Manufacturer	Country of Origin
Aceclor	ACEC	Belgium, France
Apirolio, Apirorio	Caffaro	Italy
Arochlor, Aroclor	Monsanto	USA, UK
Arubren		
Asbestol	American Corporation	USA
ASK		
Askarel		USA
Auxol		
Bakola 131	Monsanto	USA
Chlorextol	Allis Chalmers	USA
Chlorinol, Clorinol	Sprague Electric	USA
Clophen, Clophenharz	Bayer	Germany
Cloresil		Italy
Delor, Delorene		Czech Republic
Diaclor	Sangamo Electric	USA
DK	Caffaro	Italy
DP		
Ducanol		UK
Dycanol, Dykanol	Cornelle Dubilier, Federal Pacific Electric Co.	USA
Educarel, Eucarel	Electrical Utilities	USA
EEC-18		
Elaol		
Electrophenyl		France
Elemex	McGraw Edison	USA + UK
Elinol		
Fenchlor, Fenclor	Caffaro	Italy
Fenocioro		
Gilotherm		

Trade Name	Manufacturer	Country of Origin
Hexol		
Hydol		USA
Hyrol		USA
Hyvol	Aerovox	USA
Inclor		
Inerteen, Inertenn	Westinghouse	USA
Kanechlor, Kanaclor	Kanegafuchi	Japan
Kennechlor, Kenneclor	Mitsubishi	Japan
Leromol, Leromoll		Germany
Magvar		
MCS 1489		
Montar		USA
Nepolin		
No-Flamol, NoFlamol, Non-Flamol	Wagner Electric	Japan, USA
Olex-sf-d		
Orophene		
Pheaclor		
Phenaclor, Phenochlor, Phenoclor		France
Plastivar		UK
Pydraul		USA
Pyralene	Prodelec	France
Pyranol	General Electric	USA
Pyroclor	Monsanto	UK
Saf-T-Kuhl	Kuhlman Electric	France, USA
Santosafe		
Santosol		
Santotherm	Misubishi-Monsanto	Japan, France, UK
Solvol		Russia
Sorol		
Soval		
Sovol		Russia
Sovtol		
TCB		

Trade Name	Manufacturer	Country of Origin
Terphenylchlor		
Therminol		
Therminol	Monsanto	USA, France
Turbinol		
Ugilect		