Exhibit 2

American National Standard Guidelines for Handling and Disposal of Capacitor- and Transformer-Grade Askarels Containing Polychlorinated Biphenyls

1. Scope

This standard establishes guidelines for the safe use, maintenance, and disposal of askarel and askarel-soaked material used in capacitors and transformers.

2. General Information

2.1 General. The term "askarel" generally describes a broad class of nonflammable synthetic chlorinated hydrocarbon insulating liquids widely used in capacitors, transformers, reactors, and accessory equipment operated at power frequencies.

Askarels consisting of or containing polychlorinated biphenyls (PCBs) have been used in many applications for more than 40 years, but only recently was evidence discovered that PCBs are widely dispersed in the environment. Systematic investigations of the biological effects of PCBs have been undertaken within the past few years to establish the effects of specific formulations upon specific species. Some studies have shown that PCBs may be an environmental contaminant. Simultaneously, significant steps have been taken by U.S. industry to limit further releases of PCBs to the environment.

PCBs have been used in three broad types of applications for the past 40 years, as follows:

(1) "Open-ended" applications; for example, in paints, specialty inks, paper coatings, plastics, etc

(2) "Nominally closed" applications; for example, as the working fluid in hydraulic or heat-transfer systems

(3) "Closed electrical system" applications, specifically as the insulating fluid in certain kinds of transformers and capacitors[1]

[1] The Monsanto Company is the sole U.S. producer of PCBs. It has discontinued supplying the material for all applications given in 2.1(1) and 2.1(2).

Evaluations of the benefits, risks, and alternatives involved in the continued use of PCBs in closed electrical systems are summarized in 2.2 through 2.4.

2.2 Benefits. Askarel-filled transformers do not burn or sustain fire under conditions of internal electrical arcing.

Askarel-filled power and industrial capacitors are significantly smaller, more reliable, more durable, and safer than oil-filled capacitors. As a result, askarels have supplanted mineral oils in more than 90% of the power and industrial capacitors made today. Over the past few decades most of the equipment that incorporates such capacitors has been designed to take particular advantage of the size, safety, and reliability benefits of askarel capacitors (for example, many types are today less than 14% of the size of equivalent oil capacitors and have a life expectancy of 10 to more than 20 years).

Various federal, state, and local codes, therefore, require their continued use in or adjacent to public, commercial, and industrial buildings, which locations present the greatest potential danger to life and property.

2.3 Risks. In the United States, medical records over a nearly 40-year period show that the only adverse health effects experienced by U.S. workers exposed to askarels, either during the manufacture of these liquids or of electrical equipment containing these liquids, have been limited to occasional cases of nonchronic chloracne or other temporary skin lesions or irritations.

Askarel-filled transformers and capacitors are delivered to customers as sealed units from which there is no escape of askarel under normal operation. Although certain types of equipment failures can permit loss of some askarel to the environment, transformer failures are limited to approximately 0.02% of the units in service per year. With respect to capacitors, such losses are limited to approximately 0.02% of the askarel put into service per year. In addition, limited amounts of PCBs can get into the environment during the manufacture, delivery, improper use, maintenance, repair, and disposal of transformers and capacitors.

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Specific control measures have been instituted by individual manufacturers and are supplemented and strengthened by national standards and procedures such as this standard, which provides information to prevent the inadvertent loss of PCBs to the environment at all stages from initial askarel manufacture through ultimate disposal.

2.4 Alternatives. For technical and local and national code reasons, it would be impossible to replace most askarel-filled transformers now in service with oil-filled units of equivalent ratings without major construction changes that would be required to compensate for the fire resistance of the askarel-filled units. For certain applications and locations, dry-type transformers may replace askarel-filled transformers.

For new installations, although many of the foregoing limitations would still apply, building and installation design provisions could be made to accommodate the use of oil-filled, open dry-type, or sealed dry-type transformers, provided that necessary technical, code, physical size, and cost considerations are properly evaluated.

The principal alternative to askarels for capacitors is mineral oil, but such replacement would return capacitor technology to its pre-1932 level and would necessitate the redesign and replacement of such widely used equipment as fluorescent light fixtures and racks for power and induction-heating capacitors, which could not now accommodate the increased size of oil capacitors while maintaining their present ratings.

The cost of askarel liquids is about five to ten times more than mineral oil. Thus, long before there were any environmental concerns about PCBs, there was a strong economic incentive to find other, less expensive insulating liquids with the desirable characteristics of askarels. Since the 1930s at least ten major chemical or electrical companies have invested large amounts of time and money in this search, all with no success. Although potential substitutes that are more costly than askarels (such as fluorinated liquids) have also received some consideration, little is known about either their electrical performance or possible ill effects upon the environment. There are today no fluids that can be used as a direct replacement for askarels.

2.5 Interdepartmental Task Force on PCBs. An in-depth study of PCBs has recently been completed by five Executive Branch Departments of the federal government. This Interdepartmental Task Force on PCBs issued their report, entitled *Polychlorinated Biphenyls and the Environment,* in May 1972.[2] The following conclusion is quoted from page 4 of this report:

"The use of PCBs should not be banned entirely. Their continued use for transformers and capacitors in the near future is considered necessary because of the significantly increased risk of fire and explosion and the disruption of electrical service which would result from a ban on PCB use. Also, continued use of PCBs in transformers and capacitors presents a minimal risk of environmental contamination. The Monsanto Company, the sole domestic producer, has reported voluntarily eliminating its distribution of PCBs to all except manufacturers of electrical transformers and capacitors."

Reference should be made to the Interdepartmental Task Force Report for additional information and conclusions.

3. Capacitor Guidelines

3.1 General. The environmental effects of askarels are under in-depth study by governmental and other agencies. Askarels have been considered relatively harmless to humans based on about 40 years of safe industrial usage. There has been no known instance of human injury when they were used under the normally accepted precautions and conditions of handling in both manufacturing and user applications.

Traces of askarels are being found in the environment and in fish and bird life. The long-term genetic and ecological effects are not yet completely understood. For these reasons, care should be taken to contain askarels and minimize their entry into the environment.

There are two general classes of askarels used by the electrical industry. The higher chlorinated grades are the more persistent in nature. Because of their high degree of nonflammability, they are used in transformers where personnel safety is of paramount importance.

Capacitor-grade askarel has a lower degree of chlorination (composed primarily of the 3-chlorine isomers of biphenyl) and a higher degree of biodegradability. Generally, it has not been found in animal life. It is used in capacitors, where the extreme degree of nonflammability required in transformers is of less importance.

Although capacitor- and transformer-grade askarels both contain members of the PCB family, they do differ in composition, degree of biodegradability, persistence in nature, electrical stability, chemical stability, and degree of nonflammability (both are recognized as nonflammable). It is for these reasons that Section 3 of this standard is intended to apply to capacitor-grade askarel.

[2] Available from the National Technical Information Service, U.S. Department of Commerce, Springfield, Va 22151.

Table 1
Typical Properties of Aroclor 1016

Property	Test Method (See Note)	Typical Values
Color	APHA*	40, max
Condition	–	Clear
Specific Gravity at 25/15.5°C	ANSI C59.68-1965 (R1973) [2]	1.362–1.372
Acidity (mg KOH/g)	ANSI Z11.131-1964 (R1974) [3] ANSI Z11.59-1958 (R1971) [4]	0.010, max
Moisture	–	35 ppm, max
Refractive index at 25°C	ASTM D 1817-66 (1972) [5]	1.6215–1.6235
Inorganic (free) chlorides	ANSI C59.55-1963 (R1973) [6]	0.05 ppm, max
Pour point	ANSI Z11.5-1966 (R1972) [7]	–14°C or lower
Dielectric constant (1000 Hz at 100°C)	ANSI C59.22-1967 (R1973) [8]	4.70–4.90
Resistivity (500 V dc at 100°C, 0.1-inch gap)	ANSI C59.51-1965 (R1973) [9]	500×10^9 Ω · cm, min
Hydrolysis stability test (as chlorides)	ANSI C59.106-1970 [10]	0.5 ppm, max
Thermal stability test (as chlorides)	ANSI C59.111-1970 [11]	0.4 ppm, max
Distillation range (corrected)	ANSI A37.9-1974 [12]	
10% distilled by weight		323°C, min
90% distilled by weight		356°C, max
Higher-Boiling Homologues	ASTM D 3303-74 [1]	0.4%, max
Sulfates	ANSI C59.2-1974 [13]	None
Dielectric strength at 25°C	ANSI C59.19-1968 (R1973) [14]	35 kV, min
Flash point, Cleveland open cup	ANSI Z11.6-1973 [15]	338°F, min
Fire point	–	None to boiling point
Corrosion test (6 hours at 210°C with bright aluminum foil), change in weight of aluminum	–	0.0%
Viscosity at 100°F (SUS)†	ANSI Z11.2-1956 (R1971) [16]	71–81
Specific heat at 25°C	–	0.30
Coefficient of expansion	ANSI C59.57-1963 (R1973) [17]	0.00068 $cm^3/cm^3/°C$
Fixed chlorine	Carius	41.3 ± 0.5%
Power factor at 100°C, 60 Hz	Munch [18]	
Bulk		1%, max
Drums		4%, max

NOTE: Numbers in brackets refer to correspondingly numbered test methods in 5.1, References to the Text.

*American Public Health Association.

†Saybolt Universal seconds.

3.2 Capacitor-Grade Askarel. In September 1971 a new grade of capacitor impregnant, Aroclor 1016, was made available to the industry. This new grade contains a typical concentration of 0.4% by weight of the higher-boiling homologues of the chlorinated biphenyls. (See ASTM D 3303-74 [1].)[3] Aroclor 1016 replaces Aroclor 1242, which previously was the major capacitor impregnant and contained around 7% of the higher-boiling homologues (the more persistent in nature). This 0.4% level of the higher-boiling homologues should be the maximum concentration acceptable in any capacitor impregnant. Aroclor 1242 and 1254, previously used as impregnants, do not meet this requirement and should no longer be used in capacitors designed and manufactured for alternating-current applications.

Aroclor 1016 has the same Underwriters' Laboratories, Inc, nonflammability rating as Aroclor 1242. Its typical properties are given in Table 1.

3.3 Plant Housekeeping and Employee Safety. The procedures and limits given in 3.3 are intended to be minimum requirements to be met by manufacturers and users of capacitors containing askarel. Handling, control, and disposal procedures are given, together

[3] Numbers in brackets refer to corresponding numbers in 5.1, References to the Text.

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with exposure limits and indicated antidotes and clean-up procedures.

3.3.1 Material. Askarel for use in capacitors should consist of homologues and isomers of chlorinated biphenyl with the concentration of the higher-boiling homologues at about 0.4%. (See ASTM D 3303-74 [1].) Aroclor 1016 is considered to be the standard impregnant meeting these requirements.

Commonly used solvents include benzene, kerosene, acetone, trichloroethane, trichloroethylene, and perchloroethylene. Typical vapor pressure data for Aroclor 1016 are:

0°C = 0.001 mmHg
25°C = 0.006 mmHg
150°C = 4.3 mmHg
200°C = 29.0 mmHg

At 25°C and 760 mmHg pressure, saturated air contains approximately 0.09 mg/l.

NOTE:
1 mg/l = 90.0 ppm (v/v)
1 ppm (v/v) = 0.011 mg/l

3.3.2 Bulk Fluid Shipment, Receiving, and Transfer. Shipment of askarel from point of manufacture to point of receiving should be done in closed containers such as rail tank cars, truck tanks, marine or barge tanks, or sealed drums. Containers should be labeled as to contents and carry a label cautioning against loss of fluid to the open environment. Containers used to transport askarel should not be used for storage or to transport other material without being completely cleaned of all traces of askarel. (Cleaning procedures must take cognizance of precautions against excessive exposure and of the need for proper disposal of contaminated cleansing solvents and materials as set forth in 3.5). Transfer from shipping containers to processing systems should be through closed piping or tubing with appropriate valves, pumps, etc. Provision should be made for trapping and disposing of fluid lost by leakage or spills from the transfer system and from the storage containers.

Drums to be retired from use should be cleaned before crushing, delivery to scrap dealers, or other disposal. Contaminated cleaning fluids and materials should be disposed of as indicated in 3.5.

3.3.3 General Safety Precautions. Although it is generally accepted that exposure to capacitor-grade askarel is not hazardous provided that simple precautions are taken, exposure should still be avoided.

3.3.3.1 Vapors. The odor of askarel is noticeable well below the maximum air concentrations considered safe. Up to 1.0 milligram per cubic metre of air has been determined to be the maximum safe level of exposure during an 8-hour workday. (See reference [19].) The procedure for performing the necessary analyses is contained in Section B3 of Appendix B. This procedure or its equivalent should be used.

Breathing vapor or fumes from heated askarel should be avoided. Provisions should be made for adequate ventilation and regulation of manufacturing operations to avoid open exposure to askarel (especially at temperatures of 55°C or higher). The gases produced when askarel is decomposed by very high temperatures (such as that of an electric arc) in the presence of air or organic insulating materials contain a high percentage of hydrogen chloride, and small percentages of carbon dioxide, carbon monoxide, and oxygen. Minute concentrations of this combination of gases are very unpleasant and irritating, thus giving ample warning of their presence. If exposure to high concentrations of askarel is necessary under emergency conditions, an approved gas mask or self-contained breathing apparatus should be worn. Such exposure should be under the surveillance of other personnel capable of effecting rescue in case of an accident. If the odor of askarel is detected by the person wearing protective equipment, he should immediately go into fresh air. All gas masks, respirators, and replacement parts should have U.S. Bureau of Mines approval and be maintained on a regular schedule in accordance with the manufacturer's recommendation.

3.3.3.2 Liquid. In contrast to the situation in which mineral insulating oils are handled, there is virtually no fire hazard in handling askarel. A limited solvent action (similar to that for paint thinner) on the fats and oils of the skin with prolonged contact may lead to drying and chapping of the skin. As with insulating oil, some people are allergic to askarel, and continued exposure may result in skin irritation. Both the liquid and vapor are moderately irritating to eye tissue.

Operating procedures should be such as to minimize or eliminate contact with askarels. Use of eye protection is recommended. The use of porous gloves that can absorb and retain askarels is to be avoided. Barrier creams[4] or resistant gloves[5] should be used if contact is unavoidable. Use of enclosed transfer and handling equipment, processing equipment, and mechanical washers reduces direct contact.

Medicinal washes or mild detergents followed by the application of cold cream will reduce the irritation resulting from the contact of an open cut or abrasion with askarel.

Safety glasses with side shields or a face shield should be worn when handling askarels. If liquid aska-

[4] For example, PLY No. 9 Gel (Milburn Company, Detroit, Mich), or Kerodex No. 71 (Ayerst Laboratories, New York, N.Y.), or the equivalent.

[5] For example, Edmont – Solvit 5-352 (Mersick of Bridgeport, Bridgeport, Conn), or the equivalent.

rel contacts the eyes, the eyes should be irrigated immediately with large quantities of running water for 15 minutes and then examined by a physician. (A drop of castor oil has been found to reduce irritation.)

Persons developing a skin irritation or respiratory tract irritation while working with askarels should be placed under the supervision of a physician.

Ingestion or swallowing of askarels is not generally regarded as a problem of the industry. Should accidental ingestion occur, a physician should be consulted. Hands should be washed with warm water and soap before eating, drinking, smoking, or using toilet facilities.

3.3.4 Manufacturing Housekeeping. Manufacturing equipment and operating procedures should safeguard against loss of askarels to the environment through proper containment and disposal procedures.

Enclosed systems of sealed piping, properly gasketed joints, valves, containers, and processing chambers should be used for any portion of the operation where askarel temperatures may exceed 55°C. Enclosure should preferably extend to all other portions of the system insofar as practicable.

Containment provisions should be established around all askarel processing areas to ensure against inadvertent loss to sewer systems by spillage, leakage, or other uncontrolled conditions or events.

Spills of askarel should be removed promptly by means of absorptive material, such as sawdust, or trapped and removed by pumping or other suitable means.

Waste fluids containing askarel not suitable for reconditioning or reuse should be collected (by means of traps, drip pans, trays, etc) from the various parts of the manufacturing and processing area (including washers or other cleaning devices). Disposal should be made in accordance with 3.5.

Wiper rags, clothing, and other extraneous materials saturated with askarels should be collected within the containment area for properly controlled laundering or disposal (see 3.5).

3.3.5 Disposal of Askarel Wastes. Methods for disposal of liquids and saturated solids generated by the manufacturing operation should be in accordance with those outlined in 3.5, and should include (but not be limited to) the following wastes:

(1) Contaminated liquid askarel that is unsuitable for reclaiming as a dielectric fluid

(2) Liquid askarel from solvent operations or water and detergent type washers

(3) Saturated earth or other absorbent media from filtering operations

(4) Saturated sawdust or other absorptive materials from spills

(5) Saturated filters from vapor-control devices and other filters

(6) Saturated wastes (paper, rags, etc)

(7) Saturated, spent gasket materials

(8) Askarel-contaminated vacuum pump oils

(9) Askarel-contaminated stream jet vacuum system condensates

3.3.6 Miscellaneous Procedures. Other safety considerations include the following:

(1) Spills by leakage from finished capacitors should be cleaned up promptly by means of absorbent media, which should then be moved to containers provided for that purpose within the containment area, and later disposed of properly.

(2) Askarel wastes should never be disposed of down effluent drains or sewers. The utmost care must be exercised to prevent accidental loss by these avenues to the environment.

(3) Capacitors failing tests or otherwise designated for disposal must be controlled and handled in accordance with the intent of the procedures given in 3.3.6(1) and 3.3.6(2), finally being disposed of by one of the means outlined in 3.5.

3.4 Control of Water Effluents. The industry goal is to eliminate askarel in plant water effluent streams. However, it is recognized that existing drain systems in capacitor manufacturing plants are probably contaminated as a result of past practices, and askarel traces may continue to show up in effluent streams for some time. However, the level should continue to decrease with the proper containment of askarel wastes and no further discharges into drain systems. Other sections of this standard provide that no askarel wastes of any kind be disposed of in any water effluent streams and that accidental spills be prevented from getting into such streams.

3.4.1 Concentration Limits. The 1972 Environmental Protection Agency proposals are to keep PCB levels in rivers and lakes below 0.01 part per billion. This is currently under review by the EPA and standards are expected to be promulgated in 1974. Plant effluent streams should be managed and controlled in a manner anticipating these government standards.

3.4.2 Monitoring Streams. On a regular basis consistent with plant situations, all effluent streams should be analyzed. The procedure for performing the necessary analyses is contained in Section B4 of Appendix B. This procedure or its equivalent should be used.

3.4.3 Methods for Minimizing Effluent Stream Contamination. The ideal approach is to isolate totally all effluent streams that could be contaminated with askarels during manufacturing processes and prevent them from being discharged from the plant. Carbon adsorption, limestone beds, and solvent extraction are techniques that can be applied to reduce the askarel content of effluent streams. These techniques may be most useful in cleaning up water used in plant processing and to permit recycling.

3.5 Scrap-Disposal Procedures. The manufacture and use of capacitors involve processes that produce askarel-saturated solids and liquids containing or composed entirely of askarel, which should be disposed of as wastes. Specific sources of these materials are described throughout this standard. They may be placed into three categories:

(1) Capacitor units impregnated with askarel, production and field rejects

(2) Manufacturing process liquid wastes containing askarel

(3) Solid waste purposely or accidently saturated with askarel

Disposal should be done in a manner that is consistent with proper concern for the environment and minimizes any release of askarels to the environment.

3.5.1 Disposal of Capacitor Units. Scrap capacitor units can be generated during manufacturing processes or during field service.

Production rejects are those capacitors that are rejected after the impregnation process in the course of production by the capacitor manufacturer. They may be rejected for mechanical or electrical reasons, or because of obsolescence.

Field rejects are those units that are rejected or, for other reasons, are to be scrapped after shipment from the plant where they were manufactured.

3.5.1.1 Production Rejects. Rejected capacitors in capacitor manufacturing plants represent a concentration of askarel. It is important that their disposition be made in a manner consistent with proper concern for the environment. Therefore, capacitors should be disposed of only in supervised dry landfill sites that meet all applicable state requirements.

Care should be exercised to ensure that no loss of liquid will occur during transportation to the disposal site.

Incineration of scrap capacitors in facilities designed to accept such solids should provide an alternative means of disposal as such services become available in the future.

3.5.1.2 Field Rejects. Small capacitors (defined as containing less than 2 pounds of askarel) are practically always used as components in other electrical or electromechanical equipment. Typical examples of large quantity usage of such capacitors are in fluorescent lamp ballasts and residential air conditioning equipment. Failure of such capacitors may result in scrapping of the device of which it is a part (as in a fluorescent ballast) or replacement and scrapping of the individual capacitor (as in a room air conditioner). However, the majority of such capacitors do not fail in service, but are scrapped as a result of wearing out or obsolescence of the devices in which the capacitors are used as components. Thus, the matter of disposal is characterized by a low concentration of small quantities of askarel throughout the country and, indeed, throughout the world. Fortunately, the nature of the devices and equipment in which such capacitors are used is such that they are normally disposed of in dry landfills as a matter of convenience. Since it is impractical at present to exercise any meaningful control over the disposition of the bulk of such devices and equipment, it is imperative that askarel used for impregnating small capacitors be limited to the recently introduced type, which contains a typical concentration of 0.4% of the higher-boiling homologues. (See ASTM D 3303-74 [1].)

Large capacitors (those incorporating more than 2 pounds of askarel) should be disposed of according to the procedure for production rejects (see 3.5.1.1).

3.5.2 Disposal of Liquid Wastes. All waste askarel or liquid wastes containing askarel should be disposed of in accordance with one of the procedures given in 3.5.2.1 through 3.5.2.3.

3.5.2.1 Incineration. Present knowledge indicates that proper incineration must involve a suitable balance between dwell time and temperature in the incinerator plus oxygen availability and, finally, suitable scrubbers to remove the HCl that will be formed; for example, 2-second dwell time at 2000°F and 3% excess oxygen in stack gas, or 1.5-second dwell time at 2700°F and 2% excess oxygen in stack gas.

These facilities should meet the applicable requirements of the state in which they are located, and should control effluents within the limits set forth in this standard.

3.5.2.2 Toxic and Hazardous Waste Disposal Sites. Certain landfill sites have been classified by state governments and the federal government as suitable for the disposal of toxic and hazardous liquids. Where such approved sites exist, they may be used for the disposal of liquid wastes described in this standard. (See Appendix A.)

3.5.2.3 Packaging and Shipment

3.5.2.3.1 Transportation to the disposal facility should be in containers that will prevent leakage and accidental loss of askarel to the environment.

3.5.2.3.2 Containers should be labeled as to contents and precautions relative to loss to the environment.

3.5.2.3.3 Containers used for this purpose should not be used for any such materials or retired from service until they are completely cleaned. Any