Title Change

Askarel (PCB) Dielectric Fluids

I. Historical

In 1929 ~~the General Electric Co.~~ it was discovered that poly chlorinated biphenyls possessed the same good electrical insulating values as mineral oil dielectrics and that these PCBs are very unusual organic liquids because they do not burn. Moreover, it was discovered that their electric arc formed gases do not support combustion and that the electrical capacitance of PCBs is twice that of mineral oil.

~~General Electric~~ This discovery was patented ~~their discovery~~ because the industry was in great need of fire safe dielectric fluids for special use in capacitors and transformers. The World Almanac documented the advent of PCB dielectrics as being one of the world's greatest discoveries.

PCBs are manufactured at reasonably low cost. Possessing twice the capacitance of mineral oil allows making capacitors half the size of mineral oil units and yet able to do the same work. This has proved to be an impelling economic advancement as the saving of materials and space are great.

The unusual combination of safety from fire - good electrical insulating properties - and strong economic advantages account for the fact that since their discovery over forty years ago those PCB fluids have been used exclusively for certain types of essential capacitors and transformers. Replacements are not at hand today and it is most unlikely that anything similar can be found without compromise

II. Essential Applications

A. Capacitors

PCBs are used exclusively for the following type capacitors:

1. Utility line power factor correction, including balance of all the EHV lines on down to power conservation at industrial and commercial sites. Absence of the PCB capacitors from these power and distribution lines would result in massive power failure and economic chaos.

~~Picture I is a typical PCB power line capacitor.~~

2. By law, all air conditioning apparatus must be fitted with PCB motor-run capacitors to conserve power. Similar PCB capacitors are used for the efficient operation of most large motors used for industrial purposes and for large appliances. Elimination of this product from these applications would lead to major power failures.

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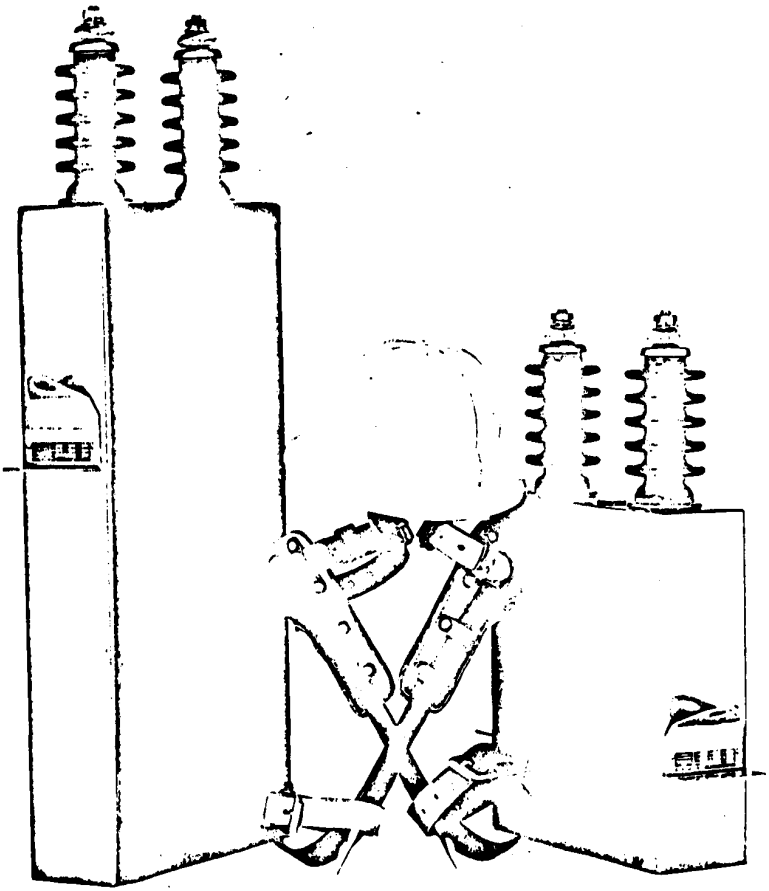

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I- POWER LINE CARRIER

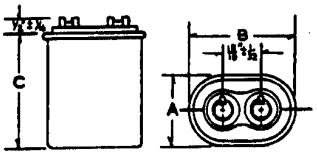
JORESCENT AND MERCUF

TYPE

70°C MAXIMUM CASE TEMPERATURE

TYPICAL CASE SIZE

CAPACITANCE (MFD.)	MAX. WORKING VOLTS – AC	BASE DIM. A ± 1/32"	BASE DIM. B ± 1/32"	HEIGHT C ± 1/16"
4	280	1 1/16"	2 5/32"	1 5/8"
12.5	280	1 1/16"	2 5/32"	3 1/16"
20	280	1 7/32"	2 7/32"	3 1/16"
27.5	280	1 7/32"	2 7/32"	4 5/8"
4	400	1 1/16"	2 5/32"	2 5/8"
12.5	400	1 7/32"	2 7/32"	3 1/2"
20	400	1 7/32"	2 7/32"	6 3/8"
27.5	400	1 7/32"	2 7/32"	7 1/4"
4	500	1 1/16"	2 5/32"	3 1/2"
7.5	500	1 7/32"	2 7/32"	3 1/2"
12.5	500	1 7/32"	2 7/32"	5 1/4"
17.5	500	1 7/32"	2 7/32"	7 1/4"
5	660	1 7/32"	2 7/32"	4"
10	660	1 7/32"	2 7/32"	6 1/4"
12.5	660	1 7/32"	3 5/32"	8"
15	660	1 7/32"	3 5/32"	9 3/4"

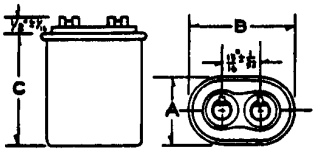


TYPE

85°C MAXIMUM CASE TEMPERATURE

TYPICAL CASE SIZE

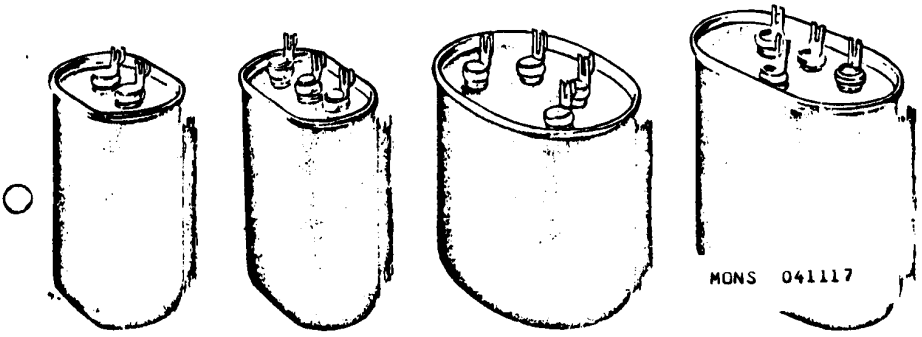
CAPACITANCE (MFD.)	MAX. WORKING VOLTS – AC	BASE DIM. A ± 1/32"	BASE DIM. B ± 1/32"	HEIGHT C ± 1/16"
4	280	1 1/16"	2 5/32"	2"
12.5	280	1 7/32"	2 7/32"	2 1/2"
20	280	1 7/32"	2 7/32"	4 1/2"
27.5	280	1 7/32"	2 7/32"	5 1/4"
4	400	1 1/16"	2 5/32"	2 1/2"
12.5	400	1 7/32"	2 7/32"	3 1/2"
20	400	1 7/32"	2 7/32"	6 1/4"
27.5	400	1 7/32"	3 5/32"	8 1/2"
4	500	1 1/16"	2 5/32"	3 1/4"
7.5	500	1 7/32"	2 7/32"	3 1/2"
12.5	500	1 7/32"	2 7/32"	5 1/2"
17.5	500	1 7/32"	2 7/32"	7 1/2"
6	660	1 7/32"	2 7/32"	4 1/4"
10	660	1 7/32"	2 7/32"	6 1/2"
12.5	660	1 7/32"	3 5/32"	8 1/2"
15	660	1 7/32"	3 5/32"	7 3/4"



OTHER TERMINAL CONFIGURATION AVAILABLE UPON REQUEST

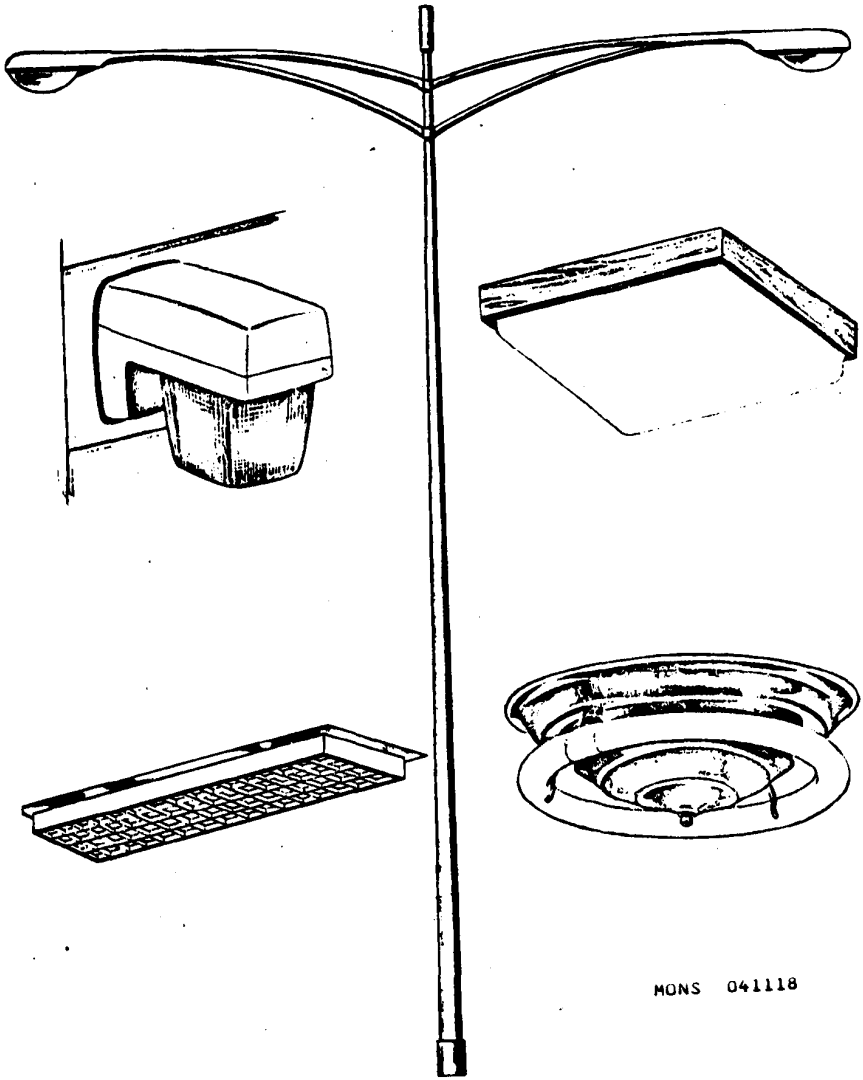
CAPACITORS FOR APPLICATIONS REQUIRING 90°C. MAXIMUM CASE TEMPERATURE DESIGN ARE AVAILABLE ON SPECIAL REQUEST. PLEASE CONTACT FACTORY.

IL – ASKAREL LIGHTIN BALLAST UNITS



MONS 041117

Y VAPOR LIGHTING



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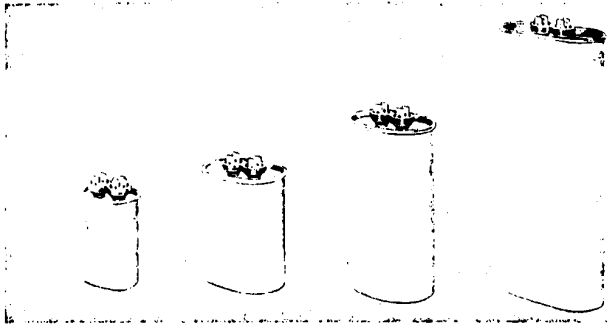
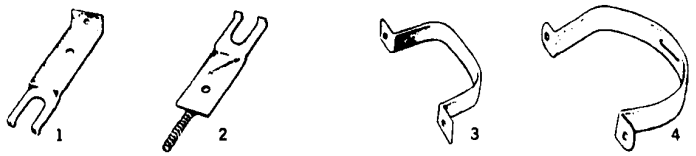
METAL ENCASED OIL
ASKAREL IMPREGNA

1Ø ASKAREL MOTOR-RUN CAPACITORS



Service	Alternating Current
Voltage	220 to 440 Volts AC
Temperature Range	−40°F. to +104°F. (−40°C. to +40°C.)
Dielectric	Low temperature Askarel
Winding Type	Inserted Tab (Inductive)
Terminals	Silicone rubber Feed-thru type bushings — Solder lug or single, 2, 3, 4 blade quick connect
Seal	Hermetic
Case Material	Drawn steel case
Finish	Lead coated steel, Tin coated steel, Electro-plated zinc chromate converted, regular single coat paint or Underwriter's Lab approved paint per customer specifications.

STANDARD MOUNTING BRACKETS



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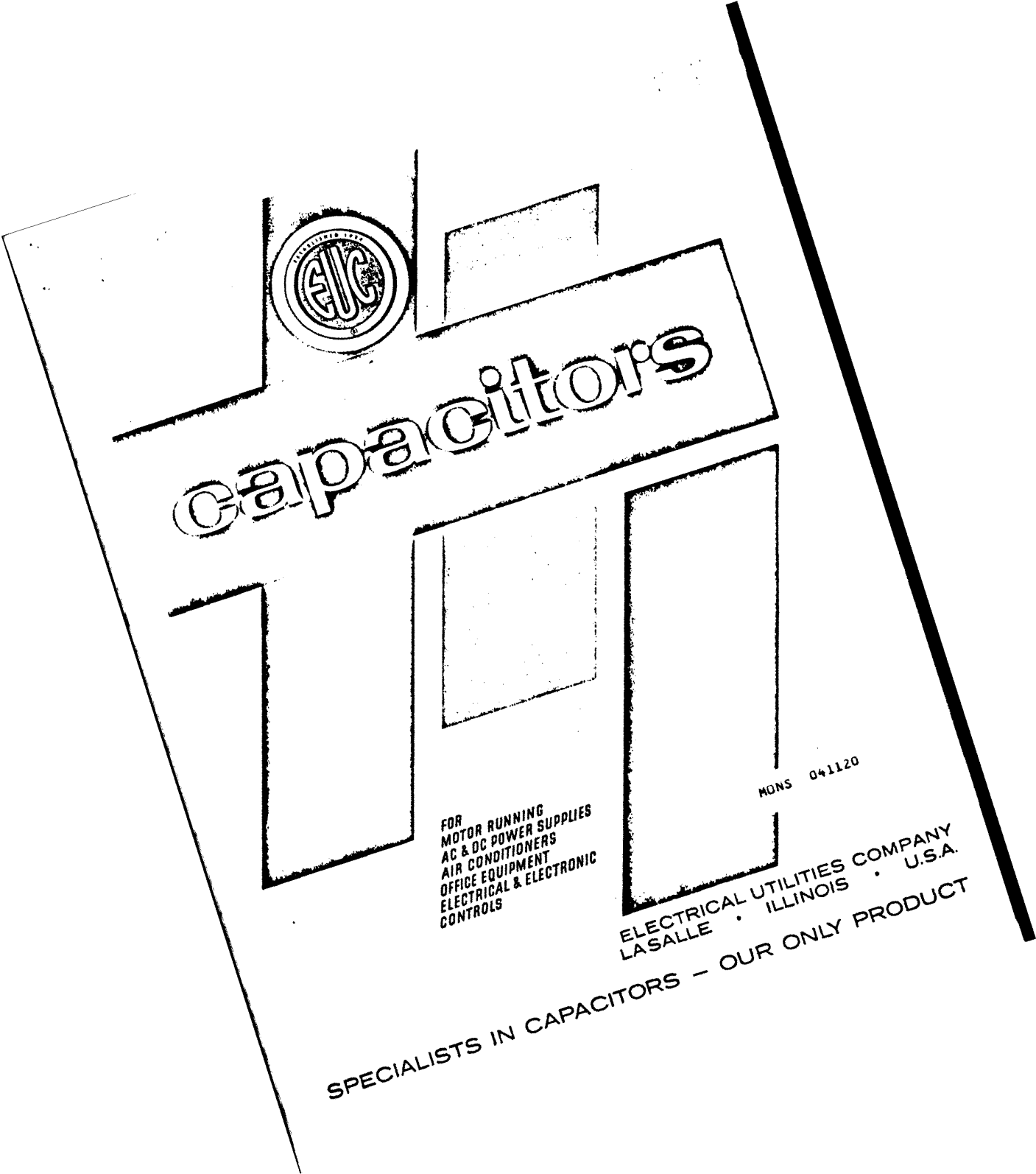
capacitors
FOR
MOTOR RUNNING
AC & DC POWER SUPPLIES
AIR CONDITIONERS
OFFICE EQUIPMENT
ELECTRICAL & ELECTRONIC
CONTROLS
MONS 041120
ELECTRICAL UTILITIES COMPANY
LASALLE • ILLINOIS • U.S.A.
SPECIALISTS IN CAPACITORS – OUR ONLY PRODUCT

Pidture II is a typical PCB motor-run capacitor.

3. All fluorescent and mercury vapor lighting ballasts for indoor and outdoor lighting operate with PCB capacitors.

   Picture III is a typical PCB ballast capacitor.

4. Other essential PCB capacitor applications include induction heating capacitors for steel production and metal working; voltage regulator capacitors for communication systems such as telephones, TV, radio and microwave, high energy storage capacitors for atomic fission, lasser operation, impulse testing of large electrical apparatus, special metal forming operations and a variety of space age related functions.

Over the forty years of existence of PCB type capacitors attempts at possible replacement have been made in various areas of application. None have been successful, with the exception of a case such as electronic circuits where it was possible to redesign the entire system to solid state. As already mentioned, absence of PCB capacitors from our power systems would create a national holocaust.

B. Transformers

Promptly following their discovery PCB fluids were employed to make fire-resistant type transformers for specialty applications in confined and populated areas to protect people and property from fire hazard.

The generic name askarel was assigned to PCB dielectrics and as manufacturer of these fluids Monsanto patented the trade name Aroclor. Transformer makers assigned their own names. Examples are Pyranol (General Electric Co.), Inerteen (Westinghouse), Noflamol (Wagner Electric), and Chlorextol (Allis Chalmers).

The askarel transformer is strictly a specialty type unit selected in place of mineral oil where judgements made about need for safety from fire warrant paying the askarel transformer unit premium cost. These judgements are made by individual industrial electrical engineers, or by individual electrical architects and by organizations such as the utilities, and Government agencies including the Army and Navy. The judgements

and requirement for fire safe transformer use are incorporated into various civic building codes and requirements by the Fire underwriters.

The popular size of askarel transformers ranges from about 350 KVA to 3,000 KVA. Accordingly they are quite small as compared against typical mineral oil filled power transformers which are usually located in remote areas.

In a number of instances the transformer selection is a matter of judgement of an askarel unit vs. an open dry type transformer. Here advantages of askarel units are their ability to withstand greater overloads, greater line surges, greater impulse resistance, satisfactory operation at higher voltage levels, lower heat loss, lower cost operation and lower noise levels.

Also as the askarel unit is hermetically sealed it can be used in areas of high humidity, or where water flooding may be expected. A good example of this is the use of askarel transformers by utilities along our coastal areas, and the fact that our east coast electric train systems operate with askarel units instead of dry type transformers which failed during the snow storms. Open dry units are also not well suited for many industrial sites where there is a dusty or corrosive environment. Maintenance of the open dry unit is excessive even when located in more favorable atmosphere.

Another important factor is that the size of an askarel unit for a given rating is usually significantly smaller than a comparable dry type transformer. As transformers like most everything else are usually fitted into the minimum space area it would be very difficult in many instances to replace existing askarel units with dry type units.

Due to all of these considerations representatives of the electrical industry advise that if askarel type units and PCB fluids were not available the result would be a blackout of the entire North East section of our country and some other areas.

Again, as in the case of capacitors there are no known satisfactory fire resistant fluids available as replacement for transformer (PCB) askarels.

There are several types of askarel transformers:

1. Industrial load -- small to medium power center transformers.

   These power centers are used by the steel

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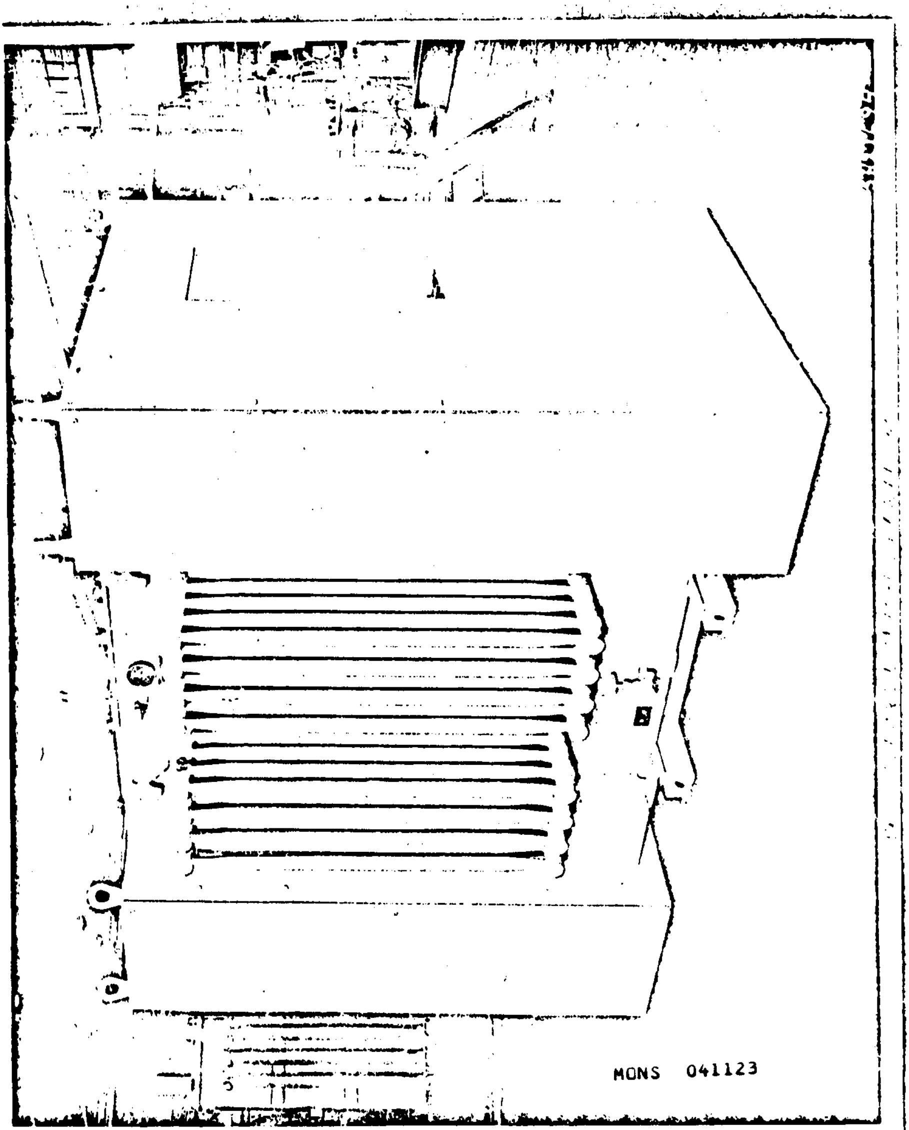

MONS 041123

mills, textile mills, paper mills, [illegible] mills, automotive manufacturing, air craft manufacturers, chemical manufacturers, petroleum refiners, copper mines and in general by over all industry.

The Government is a large user of askarel transformer load centers at all the space centers and atomic energy centers, such as Cape Kennedy, Houston, Los Alamos, Oak Ridge, Hanover, etc.

The Army and Navy use askarel unit power supplies, not only domestically but around the world. Examples are at ship docks and communication power supplies as for example the Dew-line early warning system.

Askarel power supplies are used by all of the Government's mints.

2. Distribution Type Transformers

Many utilities use askarel distribution type transformers, especially for underground networks.

Examples of large users are Commonwealth Edison, Con Ed., Boston Ed., Fla. Power, Fla. Power and Light, Pacific Gas and Electric, Kansas City Power and Light, American Electric Power, TVA, Bonneville, The Bureau of Reclamation and many others.

Also under the heading of distribution transformers are the many installations at airports, office buildings, schools, hospitals, shopping centers, stores and many Government buildings and institutions.

3. Other important uses include rectifier transformers, metering transformers, instrument transformers, electric railroad transformers, subway transformers, as the new Metro system being built in Washington, D.C.

Picture IV shows a typical askarel type transformer.

III. Annual Consumption of Dielectric PCBs

In the states the annual pounds of electrical PCBs used is divided nearly equal between capacitors and transformers.

Including the pounds of transformer PCBs blended by General Electric Co. the total pounds of PCB-containing dielectric fluids used in the states over the years 1955 through 1970 are shown in the attached tabulation prepared as confidential information for certain Government people.

The world-wide use, including the USA domestic quantity is somewhat over double the use in the USA.

Around the world, starting about 33 years ago the same essential uses for PCBs in capacitors and transformers developed rapidly in Canada, Germany, France, Belgium, Switzerland, Britain, Spain, Italy and Scandinavian countries. This was followed by strong use in Mexico and So. America, in Japan, Australia, India, Russia and in other iron curtain countries. Today these fluids are employed world-wide including remote areas where some of the applications involve critical defense uses.

In addition to their manufacture in the USA the PCBs are now produced in:

England	Russia	Spain
Germany	Japan	Czechoslovakia
France	Italy	Rumania (contemplated)

The many millions of pounds of PCB have been produced for over forty years with no unusual health hazard to humans, nor known environmental damage.

IV. Steps Already Taken to Avoid Environmental Pollution

PCBs are highly stable, non-corrosive, inert, high boiling, essentially water insoluble materials. Because of their high stability and inertness they had not been thought of as potential environmental pollutants, and the most widely used PCBs were known to be practically non toxic orally to animals.

Accordingly PCBs had rather large use in a variety of non-electrical systems open to the environment. Also special precautions had not been taken to prevent scrap from the electrical use of PCB from entering the environment. Some entered sewers and streams and some of the scrap found use to oil roads.

On learning of the pollution problem prompt steps were taken by Monsanto in collaboration with the electrical industry and others.

A. An early step was to eliminate the sale of PCB for plasticizer, sealer, hydraulic fluid and in fact all non-electrical use, with the exception of heat transfer regarded as a closed system.

Because of essential use and lack of replacements and because PCB capacitors and transformers are hermetically sealed metal apparatus the electrical use of PCBs is continued.

This is essentially the same posture taken by the Swedish Government where PCB environmental pollution in sea birds was first noted and where strict attitudes toward environmental pollution are held.

delete The Swedish Government has banned all non-electrical use of PCBs, but allows continued use for capacitors and transformers, hermetically sealed apparatus.

C. Since it has been the more highly chlorinated (more refractory) PCBs that have been found, in general, in the environment, Monsanto developed Aroclor 1016 which has these materials removed. This is now supplied as total replacement for Aroclor 1242 used by the capacitor makers.

D. Obvious initial steps taken were improvement of Monsanto's plants and those of the capacitor and transformer makers to virtually prevent any PCB from entering the environment.

E. Monsanto has built a large capacity incinerator capable of proper destruction of all PCB scrap fluid. Monsanto accepts all scrap PCB for incineration at three cents per pound. Several incinerators are available at locations other than Monsanto plants.

F. Monsanto's Environmental Group has in operation a machine capable of incinerating small PCB capacitors such as ballast and motor-run units.

G. In collaboration with Government agencies, Monsanto developed sophisticated analytical procedures used to probe for very small amounts of PCBs in plant effluents and from the general environment and from fish, birds and animals.

E. Arrangements have been made for users to return spent dielectric fluid for regeneration or incineration at our St Louis plant.

MONS 041126

H. Monsanto is continuing extensive studies to determine the biodegradability of the various common PCB isomers and related materials.

V. Future Steps Underway

A. Judgements and guide lines will be formulated about the proper disposal of solid scrap impregnated with PCBs and generated by the electrical industry.

Examples are failed capacitors from ballast, motor run and power correction applications, and scrap core and coils from askarel transformers.

The guide lines for disposal of both liquid and solid scrap must reach many end users, beyond the reach of Monsanto and the electrical manufacturers.

B. To proceed with this and all aspects of PCB pollution as related to the electrical industry Committee C107 has been formed at ANSI. Working sub committees will be formed at a meeting to be held in Washington, D.C. on Sept. 14 at the National Bureau of Standards.

C. Composition of ANSI - C107

The broad representation at this group is indicated by the following respondents and the list of people invited to participate:

1. Respondents

Certified Ballast Manufacturers Association

Dr. A. Pozefsky
General Electric Company
Industrial and Power Capacitor Products Dept.
John Street
Hudson Falls, N. Y. 12839

N. R. Clark
Universal Manufacturing Company
902 Crescent Ave.
Bridgeport, Conn. 06607

Institute of Electrical & Electronic Engineers, Inc.

E. L. Raab, Manager - Insulation Systems Section
General Electric Company
Power Distribution Division
100 Woodlawn Avenue
Pittsfield, Mass. 01201

National Electrical Manufacturers Assn.

D. E. Allen, Manager, Marketing Services
Power Distribution Division
Allis-Chalmers Corporation
Columbus & Preble Avenues
Pittsburgh, Pa. 15233

J. F. Kuzela, Engineering Manager
Power Capacitors
Sangamo Electric Company
P.O. Box 359
Springfield, Ill. 62705

R. D. McClain
Westinghouse Electric Corporation
P.O. Box 341
Bloomington, Ind. 47402

W. C. Reinhardt, Manager, Res. & Dev.
Central Moloney Transformer Division
Colt Industries
P.O. Box 101
St. Louis, Mo. 63166

H. R. Rowe, General Manager
Lighting & Capacitor Products
McGraw-Edison Power Systems Division
P.O. Box 160
South Milwaukee, Wis. 53172

Department of the Army

David M. Crabtree, Chief of the Electrical
Eng. Section
Facilities Engineering Division
Office of the Chief of Engineers
Department of the Army
Washington, D. C. 20314

Environmental Protection Agency

Earl Pershing Floyd
5555 Ridge Avenue
Cincinnati, Ohio 45213

General Services Administration

Reuben T. Morgan
Federal Supply Service, Room 507
General Services Administration
Washington, D. C. 20406

Aaron J. Woloshin
Office of Environmental Affairs
General Services Administration
Washington, D. C. 20405

National Bureau of Standards

Dr. Stanley P. Wasik
Research Chemist
National Bureau of Standards
Room A145 Chemistry Building
Washington, D. C. 20234

Rural Electrification Administration
Department of Agriculture

Dr. John Leutritz, Jr.
Timber Products Specialist
Distribution Engineering Branch
Power Supply, Management and
Engineering Standards Division
Rural Electrification Administration
Washington, D. C. 20250

Tennessee Valley Authority

William R. Nicholas
Asst. Chief of the Water Quality Branch
In the Div. of Environmental Res. and Dev.
Office of Health and Environmental Science
Tennessee Valley Authority
Chattanooga, Tenn. 37401

Chem-Trol Pollution Services Inc.

Louis E. Wagner, President
4818 Lake Avenue
Blasdell, N. Y. 14219

Doble Engineering Company

A. L. Rickley, Vice President
32 Locust Street
Belmont, Mass. 02178

Electrical Utilities Company

A. O. Hauser, President
2427 St. Vincent Avenue
La Salle, Ill. 61301

Monsanto Company

W. B. Papageorge, Mgr. Environmental Control
800 N. Lindbergh Blvd.
St. Louis, Mo. 63166

P. G. Benignus, Marketing Manager, Dielectric Fluids

Rollins-Purle Inc.

H. A. Alsentzer
P.O. Box 2349
Wilmington, Delaware 19899

C. W. Hart

P. Williamson

2. List of National and Government Groups Invited

American Public Power Association
2600 Virginia Ave. N.W.
Washington, D. C. 20037

Alex Rodin, General Manager

American Society for Testing and Materials
1916 Race Street
Philadelphia, Pa. 19103

William T. Cavanaugh, Managing Director

Association of American Railroads
1920 L Street, N.W.
Washington, D. C. 20036

Thomas M. Goodfellow, President

Assoc. of Edison Illuminating Companies
51 E. 42nd St.
New York, N. Y. 10017

W. Floyd-Jones, Secretary

Automobile Manufacturers Association, Inc.
320 New Center Building
Detroit, Michigan 48202

Thomas C. Mann, President

Certified Ballast Manufacturers Assn.
2120 Keith Building
Cleveland, Ohio 44115

M. R. Davies, Secretary-Treasurer

Edison Electric Institute
750 Third Avenue
New York, N. Y. 10017

W. Donham Crawford, Managing Director

Institute of Electrical & Electronic Eng., Inc.
345 E. 47th St.
New York, N. Y. 10017

Donald G. Fink, General Manager

Manufacturing Chemists Assoc.
1825 Connecticut Ave., N.W.
Washington, D. C. 20009

William J. Driver, President

National Electrical Manufacturers Assoc.
155 E. 44th St.
New York, N. Y. 10017

A. M. Salazar, Executive Secretary, Power
Equipment Division

National Fire Protection Association
60 Batterymarch St.
Boston, Mass. 02110

Charles S. Morgan, General Manager

Underwriter's Laboratories, Inc.
207 E. Ohio Street
Chicago, Ill. 60611

Baron Whitaker, President

Water Pollution Control Federation
3900 Wisconsin Avenue, N.W.
Washington, D. C. 20016

Robert A. Canham, Executive Secretary

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Atomic Energy Commission
Washington, D. C. 20545

Glenn T. Seaborg, Chairman

Department of the Army
The Pentagon
Washington, D. C. 20310

Lt. General E. J. Clarke, Chief of Engineers

Department of Interior
C Street Between 18th and 19th Sts. NW
Washington, D. C. 20240

James R. Smith, Assistant Secretary - Water
and Power Development
Ellis L. Armstrong, Commissioner of Reclamation
Henry R. Richmond, Administrator Bonneville
Power Administration
Carl L. Klein, Assistant Secretary - Water
Quality and Research

Environmental Protection Agency
1626 K St. N.W.
Washington, D. C. 20460

William D. Ruckelhaus, Administrator

Food and Drug Administration
Department of Health, Education and Welfare
5600 Fishers Lane
Rockville, Md. 20852

Charles C. Edwards, Commissioner of Food and Drugs

General Services Administration
Federal Supply Service
Washington, D. C. 20406

A. F. Sampson, Commissioner
C. C. Travis, Director Standardization Div.

National Bureau of Standards
Washington, D. C. 20234

Lewis M. Branscomb, Director

Rural Electrification Administration
Department of Agriculture
14th St. and Independence Ave. S.W.
Washington, D. C. 20250

David W. Hamil, Administrator

Tennessee Valley Authority
New Sprankle Building
Knoxville, Tenn. 37902

James F. Watson, Manager of Power

Chem-Trol Pollution Services Inc.
4818 Lake Avenue
Blasdell, N. Y. 14219

Lewis E. Wagner, President

Doble Engineering Co.
P.O. Box 105
Belmont, Mass. 02178

R. I. Lowe, President

Electrical Utilities Co.
2427 St. Vincent Avenue
La Salle, Ill. 61301

A. O. Hauser

Monsanto Company
800 N. Lindbergh Blvd.
St. Louis, Mo. 63166

W. B. Papageorge, Manager Environmental Control
P. G. Benignus, Marketing Mgr., Dielectric Fluids

Rollins-Purle Inc.
3208 Concord Pike
Wilmington, Delaware 19803

John E. O'Brien, President

D. The Scope of Committee C107

Procedures and guides for safe use, maintenance and disposal of askarel and askarel-soaked materials used in electrical equipment

E. Proposed Objectives

In addition to developing the procedures and guides referred to in the scope, above, it shall be the objectives of the ANSI Committee to:

1. Serve as a source for technical information and advice for Federal, State and local authorities and for the information of all others concerned.

2. Encourage the development of suitable disposal facilities and maintain a list of their capabilities and locations, for the information of all concerned.

3. Serve as the advisory group for U.S. participation in CEE, IEC, COPANT, SEGRA and other international organizations.

P. G. Benignus
9/3/71