GEHRV 32786

EPA 560/6-76-005

PCBs IN THE UNITED STATES INDUSTRIAL USE AND ENVIRONMENTAL DISTRIBUTION

TASK I

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APR 3 1976
L.P. HART, JR.

FEBRUARY 25, 1976

FINAL REPORT

U.S. ENVIRONMENTAL PROTECTION AGENCY
OFFICE OF TOXIC SUBSTANCES
WASHINGTON, D.C. 20460

PLAINTIFF'S
EXHIBIT NO.
Kelly-18
DD 11-17-11

DEFEXP0011653

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Voltages listed cover the majority of askarel distribution transformers. Product scope includes up to 34,500 primary volts and virtually any secondary voltage, 34,500 and below.

Quantities of askarel used in this class of transformers are in the range of 500 to 5,000 lbs. in each unit depending on the rating and the size of the transformer.

A great majority of distribution type transformers have provision for venting. Many of these units are equipped with spring loaded venting devices which vent upon a pressure excursion, and diaphragm rupture discs are offered as a customer option.

B. Askarel Power Transformers

1. Secondary substation
   (a) Load center units
   (b) Secondary substation generation units
   (c) Switchboard units
   (d) Internal units
   (e) Motor control units

   These 5 comprise the largest group of askarel-insulated transformers and they find widespread application in the automobile, paper, chemical, textile, steel, nonferrous metal, cement, mining and petroleum industries. They are used in commercial and public buildings, such as schools and hospitals; in defense and nuclear energy installations; and by private and public utilities.
2. Master unit substation
3. Primary unit substation
4. Limited ampere substation
5. Industrial furnace

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Furnace transformers used in the hot, dirty atmosphere in proximity to glass melting and induction furnaces, which require high current, low voltage power supplies (receive up to 15,000 volts and contain 2000 to 4000 lbs. of askarel each). Existing technology does not permit construction of sealed dry-type transformers for these power ratings.

6. Rectifier

Rectifier transformers used for large rolling mills and DC industrial power supplies (receive up to 15,000 volts AC and deliver low voltage high amperage DC. Each unit contains about 19,000 lbs. of askarel). These units are covered by the same comments given for industrial furnace transformers.

7. Transportation

Railroad transformers used on-board in electric locomotives or multiple unit electric railroad cars (receive up to 25,000 volts and contain 700 to 2400 lbs. of askarel in each unit depending on the rating and size of the transformers).

(a) Third rail

These transformers are used for rapid transit systems, and are basically serving a rectifier function

(b) Locomotive

Prior to 1932, all on-board transformers were open dry type. Because of problems with them, railroads went to askarel-insulated transformers. The changes in locomotive design since the 1930's would not now accomodate open dry-type transformers as replacements for askarel units. A recent trend has been to replace askarel by oil units, and this will continue unless new Department of Transportation regulations require nonflammability.

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However, since a tunnel fire in 1940 caused by an oil filled locomotive transformer, Penn Central will not allow any oil containing transformer equipped locomotive into New York City.

(c) Multiple-unit car (MU)

These transformers are mounted under the flat-bed of passenger cars. They ride along in this location, about 8 inches above the rail, at speeds up to 150 mph. The transformer must be ruggedly built to withstand the impact of flying debris and constant vibration. Power to the cars is brought in through an overhead catenary and is fed to the underside of the car where the transformer, controls, and propulsion equipment are located.

Space and weight are critical in this application. There are only about 33 inches above the rail. The width of the transformer is limited by the width of the car.

Only oil- or askarel-insulated units would provide the required performance levels in the space available. As with locomotive applications, present Department of Transportation regulations do not restrict the use of flammable liquids, and the use of askarel units has been dictated largely by the economic considerations of fire insurance rates, and by Penn-Central safety regulations.

8. Reactors

These units provide reactance (receive up to 15,000 volts under normal operating conditions. During normal operating conditions, they deliver volts and current as received. During power surges they choke the voltage and deliver the normal output).

9. Grounding,transformers (receive up to 15,000 volts).

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Railroad locomotives which operate on high voltage AC power from overhead catenaries are used in the U.S. Northeast Corridor. Askarel-filled transformers are mounted in the engines or under the self-powered passenger cars, and reduce the catenary voltage to that required by the traction motors. These electric locomotives are mostly limited to passenger service on the Northeast AMTRAK routes and on the commuter lines around Philadelphia and New York. Large askarel-filled transformers are used in the old GG-I locomotives, under the Metroliner cars, in various commuter cars, and in the new E-60 locomotives. (Twenty-six E-60 locomotives are currently being delivered to AMTRAK by General Electric; each locomotive contains 710 gallons of askarel). Penn-Central Railroad operating rules require the use of askarels in all locomotives using the tunnels and stations in New York. This rule has been in force as a fire safety measure ever since an early GG-I locomotive containing a mineral oil-filled transformer was involved in a fire inside a tunnel early in the 1940's.

3.5 Present Alternates to the Use of PCBs in Transformers

Askarel-filled transformers are only used where considerations of fire safety, reliability, availability, and cost make such a unit preferable to an oil-filled transformer or to a dry type transformer. These alternative types of transformers are currently used in 95 percent of all applications, and could, with proper engineering design, be used to replace most of the remaining askarel-filled units. Consideration would have to be given to the specific limitations of these designs that presently make askarel-filled transformers preferable for certain applications.

3.5.1 Mineral Oil-Filled Transformers

If safety were not a consideration, there is no reason why oil-filled transformers could not be used in all applications. Askarel-filled transformers cost about 1.3 times as much as oil filled units of the same capacity, and thus most users prefer the oil-type where possible. The oil-filled transformers are the same size as the askarel units, and are considerably lighter in weight. In addition, mineral oil has somewhat better heat transfer characteristics than does askarel, and an electrical arc in mineral oil results in breakdown products that are non-corrosive.

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