THE PCB-POLLUTION PROBLEM
January 21 and 22, 1970
St. Louis Meeting With General Electric Co.

GENERAL ELECTRIC REPRESENTATIVES:

Mr. Edward L. Raab, GE Pittsfield, Mass., representing all GE locations

Mr. H. Gerade, GE toxicological consultant

Dr. K. Murphy, GE Schenectady, New York, Environmental Pollution Control

MONSANTO REPRESENTATIVES:

H. S. Bergen, D. A. Olson, E. P. Wheeler, Dr. W. R. Richard, Dr. R. H. Munch, Dr. R. Keller, Dr. S. Tucker, W. B. Papageorge, J. G. Bryant, P. G. Benignus

A. Presentation and Discussion of Published Articles About Chlorinated Aromatic Hydrocarbon Insecticides, (DDT etc.) and PCBs

Mr. Wheeler presented to Mr. Raab a booklet containing most of the pertinent publications, to date, and indicated that additional articles will appear shortly.

He mentioned that manufacturers of DDT and chlorinated aromatic hydrocarbon insecticides will tend to emphasize the finding and interference of PCBs as the Government hearings limiting or banning use of the insecticides are held.

This lead GE to seek understanding of the scope, reproducibility, reliability and validity of the analytical procedures used by various investigators who reported finding PCB in concentrations as low as parts per billion.

B. The Analytical Procedures

Drs. Keller and Tucker presented details of Monsanto's GLC - Mass Spectrometric analytical capability and apparatus, as portrayed in Table 1. The sophistication of our analytical capability was emphasized to assure that our approach is the ultimate and is not surpassed. On this basis our views of the validity of results given in various publications are indicated in the attachments to Table 1.

General Electric were impressed and completely satisfied with the scope of our analytical capability and work.

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C. Biodegradeability of PCBs

Mr. Wheeler related that while Aroclor 1254 and 1260 are being found, especially in aquatic environment, the lower chlorinated biphenyls are not being observed. It is anticipated that the lower chlorinated members may be largely biodegradeable.

Drs. Richard, Keller and Tucker discussed biodegradeability studies by Monsanto at Ruabon and elsewhere.

These studies appear preliminary and not conclusive. Much more needs to be done in this area to allow GE to draw conclusions.

Since the literature indicates that trichlorobenzene and tri-tetrachlorobenzene are not susceptible to biodegradation, GE are intrigued with the absence of reports about finding these materials in the environment. The obvious implication is that since these materials are used with the higher chlorinated PCBs found -- the source of the latter is not from dielectric fluids. However, it was reasoned that chlorobenzenes may not remain due to their relatively higher vapor pressure or may not be found to date because they have not yet been zeroed in to the analytical spectrum.

D. Status of Aroclor Studies At Industrial Bio-Test. Table 2.

In essence results reported by Mr. Wheeler on chronic animal toxicity tests and animal reproducibility studies underway are not as favorable as we had hoped or anticipated. Particularly alarming is evidence of effect on hatchability and production of thin egg shells regards white leghorn chickens. The studies involved Aroclor 1242, 1254 and 1260. Some of the studies will be repeated to arrive at better conclusions.

E. The Location of Askarel Transformers. Table 3.

Messrs. Raab and Benignus formulated Table 3 to portray the use and locations of askarel transformers throughout industry and our commercial and residential areas.

On discussing these askarel transformer applications Mr. Raab was most impelling and forceful about the non-replaceability of transformer askarel fluid and the critical or essential use and need for askarel transformers, which have safety from fire as their outstanding virtue. Without dwelling on details and instead carried to the ultimate, the concensus is that without availability of askarel transformers large cities like New York would be shut down with no power. Certain industries that rely mainly on askarel transformers would go down with no power. Without Aroclor capacitors most of the lights across our country would go out and motors in air conditioners and many industrial applications would not run.

Frankly, no one could think of a suitable replacement for transformer askarel fluid. Fortunately, Aroclor 1242 with promise about biodegradeability is used in most all of the Aroclor type capacitors. Moreover, possible favorable isomer rearrangements are foreseen in the case of Aroclor 1242.

Need to control, accumulate and properly dispose of scrap askarels is unquestionable in light of the PCB pollution problem, and essential toward maintaining the use of askarel dielectrics. At GE alone apparatus in which askarel fluid is used represents 100 million dollars annually. About 60% is in the capacitor area and 40% represents transformers.

GE requested and we were pleased to give Dr. Murphy their Environmental Control man, a list of all GE and other locations receiving Pyranol shipments in 1969. This amounts to about 16 million pounds of askarel fluids with economic worth of near 2.5 million dollars. This listing included 244 different locations of which 115 were GE plants and service shops scattered throughout our country.

Of course in addition to dielectric use in hermetically sealed capacitors and transformers major amounts of PCBs are used as Plasticizers, Industrial Hydraulic Fluids and Heat-Transfer media.

F. Environmental Sources of PCBs From Dielectric Applications

1. Spills
2. Disposal of waste
3. Ultimate disposal of product -- for failed apparatus
4. Ventilation of operation for employe protection
5. Waste from containers
6. Field on service failures
7. Repair and return apparatus "service shops"

G. Considerations of Degradation Disposals

1. PCBs up to and including 3 chlorine atoms appear biodegradeable in preliminary laboratory work.
2. Thus far there is no evidence that higher chlorinated biphenyls will biodegrade.

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3. According to the literature TCB and TTCB biodegrade at a very slow rate.

4. Chemical, catalytic breakdown would probably require high temperatures.

5. Incineration will require 800°C. and 5 second sojourn time. HCl scrubbing would be required.

H. Estimated Annual Amounts of Contaminated and Scrap PCBs From The Electrical Industry

1. From The Transformer Industry:

a) In plant and field spills are small and controllable with adsorbents, which should be incinerated.

b) Near 2 million pounds a year of transformer askarels are sold to service and repair shops. These people do not manufacture new transformers, although on occasion they may fill new transformers sent into the field without fluid. As these service shops are devoted primarily to repairing faulty transformers, we can assume that as much as 1.0 million pounds annually of "scrap" is generated. Most of this has been dumped or disposed of in streams.

c) We estimate that probably 150,000 pounds of this is arced beyond reworking and needs to be incinerated. The remainder may be reworkable by distillation.

2. From The Capacitor Industry:

a) Collectable waste from normal capacitor impregnation operations amounts to about 850,000 pounds annually. Most of this should be reworkable via simple take-over distillation.

b) Scrap, badly contaminated with polypropylene, epoxides, solvents, oil, grease and "junk" is generated at not over 50,000 pounds a year. This material should be incinerated, along with the 150,000 pounds of scrap from transformers.

c) Power capacitors are designed to last over 30 years. Modern motor runs may last 10 years and the small lighting ballast usually last not over 10 years.

Eventually and cumulatively there is a large potential of field-failed capacitors. Fortunately Aroclor 1242 has been used almost exclusively since about 1950.

The failed units are disposed of in industrial dumps. In case of ballasts the Aroclor capacitor along with the transformer imbedded in asphalt or encapsulated in epoxy resin, all encased in a metal box are discarded as a unit. This is emphasized to indicate that incineration of such apparatus is not applicable.

3. From Containers:

Most askarel moves in bulk, tank cars or tank wagons, which do not present a problem.

It is questionable that drum shipments may present a problem. The drums can be used for returning scrap.

I. Monsanto's Program To Handle Scrap

1. GE asked what is Monsanto's plan about reclamation of scrap PCB from GE plants, service shops, utilities, industrial users, commercial users, etc.?

2. What is our view about a "Buy-Back" arrangement?

3. What arrangements will Monsanto make for incineration? Disposal in suitable land-fills? Reclamation by distillation at Monsanto?

4. To date Monsanto's posture is:

a) We have taken "good quality" scrap from GE's capacitor plant at Hudson Falls and had it reworked by simple filtration at Findett. This Findett arrangement is not practical nor economical. We paid GE 1 ¢/lb. for this "quite good" Aroclor, plus 1.9 ¢/lb. freight. Findett charged 2.1 ¢ to filter this material, making our cost 5 ¢/lb.

b) 130,000 pounds of somewhat lower quality scrap from Westinghouse capacitor plant has accumulated at Findett for lack of distillation equipment.

c) Scrap from GE's Ft. Edward plant appears to need reprocessing by distillation.

d) About ½ million pounds of "bad scrap" from GE Hudson Falls, has been disposed to a land-fill in New Jersey. Monsanto paid half of the freight cost.

e) A car load of scrap transformer askarel from Westinghouse, South Boston, Virginia is being sent to W. G. Krummrich for reprocessing.

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f) We advised Westinghouse, Sharon to incinerate 12,000 gallons of oil contaminated askarel.

g) We talked with Sangamo, Picken, S. C. and strongly urged them to discontinue present disposal.

5. The above "take-back" arrangements have been made on an individual and experimental basis. We have no fixed "buy-back" arrangement, regards answering GE's question.

6. We have no established process for reclaiming either capacitor or transformer scrap.

7. We have no incinerator for disposal of totally unreclaimable material.

8. To date and for the foreseeable future our only effective disposal is to a land-fill. While this is not desireable, it is better than indiscriminate dumping.

J. Transformer Askarel Blends Discussed With GE. Table 4.

Table 4 lists the transformer askarel blends reviewed with GE.

1. GE Rome has discontinued use of Blend A due to combustibility of arc formed gas. For this same reason, as dictated by their legal people they will not use Blend B.

2. Today both GE, Pittsfield, Mass. and Rome, Ga. use Blend C (Pyranol A13B3B), which they mix themselves.

3. Blend D optimizes the Aroclor concentration in conformance with GE's requirements for non-combustibility of the arc formed gas and with the pour point requirements. The price is in direct conformance with our previous quotation for Aroclor 1242, when GE was using this at a concentration of 80% by weight.

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Accordingly Blend D meets GE's requirements, although containing 71.6% of the higher chlorinated Aroclor it does not conform with Monsanto's concern with the PCB pollution problem.

4. For all practical purposes Blend E (Inerteen 70-30) is identical properties with Blend D, which latter GE, Rome, Ga. proposes to use. In the interest of standardization, we seek to have GE, at Pittsfield and Rome, Ga. use Blend E, which is used by Westinghouse for low temperature applications and is used by many other askarel transformer manufacturers for general application.

5. Although Westinghouse USA uses Blend F (100% Aroclor 1242) for all applications, except for low-temperature application, GE does not accept this use of 100% Aroclor 1242 in transformers.

   GE will not accept Aroclor 1242 or any other blend with less than a 1 to 1 ratio of chlorine to Hydrogen atoms. A ratio significantly lower than 1 to 1 tends to yield combustible arc-formed gasses. GE feels strongly that this does not conform with the original definition of an askarel. Accordingly their legal people stress that this presents potential liability in case of an accident for which various precedents have already been set in court actions.

   Mr. Raab points out that this precedent for liability regards combustibility is already set, in contrast with the PCB pollution situation which thus far is void of legal actions. He reiterated that the pollution problem thus far is a source of technical publications and warnings and emphasized that in the case of electrical applications which involve only hermetically sealed apparatus, adequate control should be possible.

K. Facts As Agreed By Those In Attendance

1. Cl_5 - C_{6-8} Biphenyls -- found in aquatic eco system in populated and industrial areas.

2. DDT + Cl hydrocarbon insecticides have effect on fish-eating birds (reproduction) leading to possible extinction of some species.

3. PCBs (some) are definitely suspected along with polychlorinated hydrocarbon insecticides.

4. Research data being developed seems to confirm incrimination of PCBs subject to rechecking.

5. Public, political and government pressures stopping some uses of chlorinated hydrocarbon insecticides (PCHI).

6. PCBs have been brought into hearings proposing restrictions or elimination of DDT, PCHI.

7. As manufacturer of PCHI's fight for their life, attention will be directed to PCBs.

8. To our knowledge PCBs are not being found in terrestrial birds or animals, but DDT and PCHI's are found.

9. PCBs are not being found in the eco system without the presence of DDT or PCHI's.

10. PCHI's residue are found without PCBs.

11. We have no evidence that anyone has found lower PCBs except that Dutch researchers found PCBs in roaches.

12. There is no evidence of natural sources of PCBs nor any source other than industrially produced and used.

13. PCBs in a single dose have a low order of acute toxicity and are no significant problem to rats, dogs, chickens, fish and humans.

14. Based on six months of chronic studies in rats and dogs some PCBs are "moderately" toxic and more so than DDT, but less toxic than some of the other chlorinated hydrocarbon insecticides.

15. Some PCBs affect rat reproduction, (10 ppm. apparent no effect levels).

16. Some PCBs affect leghorn chicken reproduction (100 ppm.). PCBs have no affect level for chickens, estimated 10 ppm.

17. Some environmentalists are claiming that the PCBs pose a threat to humans, are so "philosophizing" in publications.

18. One published page indicates that PCBs are as bad (or worse) than DDT in microsomal enzyme effect. What is significant? Since many chemical compounds react similarly!

19. Human experience in production of PCBs and their use has been favorable. Less than 20 instances of illness known to Monsanto Company since 1940-45. Proper precautions were not always followed.

20. GE Company's use of PCBs as dielectric fluids, has been extremely favorable without illness throughout 40 years.

21. Monsanto Company is convinced that analytical techniques and data from some laboratories investigating PCBs are reliable and that conclusions being formulated are valid.

22. Monsanto Company has not run duplicate analysis on samples reported in the literature.

L. What GE Desires

1. GE seeks that Monsanto take no precipitous reaction to the PCB problem that would result in withdrawing supply of Aroclor 1254 or 1260 to GE.

2. The consensus is that no suitable replacement for transformer askarel fluid is foreseen.

3. In event of development of a suitable fire-resistant fluid replacement for askarel, Mr. Raab emphasized that a minimum of 2 years testing work would be required before commercial use could be adopted.

4. In reply to Monsanto's legal question whether with continued use of Aroclor 1254 and 1260 GE would assume sole and complete liability -- Mr. Raab answered, No! To substantiate his reply, Mr. Raab cited case examples involving GE where damages were sought and collected, even though GE was only the third party. He further stated that any arrangement seeking to delegate and confine liability to GE relative to the PCB problem would be worthless.

5. GE seeks to know the magnitude and time of Aroclor price increase that would result if Monsanto discontinues sale of Aroclor for non-electrical uses, or if pollution control expenses warrant a price increase (as anticipated).

6. GE seeks to send a letter to their plants and service shops and major users of transformer askarel, such as the utilities giving notice of the PCB problem and guidance about the most suitable controls.

7. In the case of GE service shops scattered throughout our country it is unrealistic that these people would assume any expense to return scrap to Monsanto.

   The minimum we can expect is that Monsanto pay the freight charges, and reimburse for a suitable container to avoid additional and excessive contamination.

   This emphasizes need for Monsanto to have an effective reclaiming process. Otherwise, the best we can expect from service shops and many other users is to continue to dump in a land-fill and stop discarding into the sewers.

8. GE realizes that Monsanto is caught between the explosiveness of arc-formed gasses problem and on the other hand the PCB pollution problem. Realizing possible unfavorable outcome of the arc-formed gas problem, GE desires to withhold the PCB problem from involvement at NEMA, ASTM, IEEE, EEI and ASIA at this time, (making it an industry-wide problem) pending better in-depth understanding of the PCB problem.

9. GE strongly seeks to continue manufacture of askarel type transformers, because in many applications this apparatus cannot be replaced with mineral oil nor open dry, nor seal gas dry type units.

   Mineral oil burns. Open dry accumulates dust, lint, moisture and can then fail with explosion and burning. Sealed gas dry types are very expensive, space consuming and very difficult to maintain sealed.

   Transformer design and application is governed by National Electric Code, by local building codes, Fire Underwriters, NEMA, IEEE, ASTM, IEC, ASA, Insurance companies and others. Because of the diversity of organizations involved a directive to discontinue askarel transformer manufacture would assume highly complex proportions.

P. G. Benignus
January 26, 1970