Monsanto

FROM (NAME & LOCATION) J.R. Savage - B3NH

DATE February 3, 1976

SUBJECT Decontamination Procedure

REFERENCE

cc. ~~A.E. Leisy - 1740~~
R.A. Pohl - B2SB
D. Wood - B2SD

TO : J.J. Zeman
B2SK

One of my responsibilities re the PCB Emergency Plan was documentation of Manufacturing's Decontamination Plan for possible adaptation to customer needs. Here it is, in outline form:

I. For Equipment to be Scrapped:

A. Pump empty. If no use for contents, drum off for incineration.

B. Open up equipment and remove any solid accumulation with scrapers, shovels, etc.

1. Workers to wear air line masks, plastic gloves and aprons, etc., as needed.

2. Solids to be placed in drums, along with used gloves, rags, etc.

3. Drums to be disposed of in approved landfill.

C. Close up equipment and fill with hot water. Circulate or agitate as equipment design permits. Operate each valve, cock, pump, etc. Drain water to settling basin.

1. Allow water to cool before decanting to sewer.

2. Drum off any organic phase or "rag layer" for incineration. Organic layer will probably be at the bottom.

D. Fill with kerosene, circulate or agitate as equipment design permits, then drum off for incineration.

E. Repeat water wash, including cool down and drumming of any organic or "rag layer" for incineration. Organic layer will probably float on the water.

F. Dismantle, cutting or breaking each item to render it useless. Remove all gaskets and packing and place in drums for landfill. (See Item B)

G. Dispose of scrap through normal scrap dealer channels.

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II. For equipment to be reused in handling dielectric fluids:

A. Pump empty. If no use for contents, drum off for incineration.

B. Open up equipment and remove any solid accumulation with scrapers, shovels, etc.

1. Workers to wear air line masks, plastic gloves and aprons, etc., as needed.

2. Solids to be placed in drums, along with used gloves, rags, etc.

3. Drums to be disposed of in approved landfill.

C. Close up equipment and fill with hot water. Circulate or agitate as equipment design permits. Operate each valve, cock, pump, etc. Drain water to settling basin.

1. Allow water to cool before decanting to sewer.

2. Drum off any organic phase or "rag layer" for incineration. Organic layer will probably be at the bottom.

D. Fill with fluid compatible with new application (e.g. electrical grade isopropyl biphenyl), circulate or agitate as equipment design permits, then drum off for incineration.

E. Repeat water wash, including cool down and drumming of any organic or "rag layer" for incineration. Organic layer will proLably float on the water.

F. Apply vacuum to dry out system. (Not vital but will make it easier to clean up electrical properties.)

G. Remove and replace all gaskets from flanges, lids, etc. Remove and replace pump and agitator shaft packing. Tear down wet-end of all pumps to assure no PCB's pocketed behind impellers, etc. Similarly, tear down vacuum pumps, ejectors, valves, etc. Remove plugs from plug cocks, balls from ball valves, etc. and clean out if necessary.

H. Open major equipment and sand blast to bright finish. (This step may not be necessary if a few ppm PCB is acceptable in the first few batches, or if willing to take some risk of having to repeat part of the procedure.) Replace any piping that is not clean. Reassemble system.

I. Fill system with a fluid compatible with new application (e.g. electrical grade isopropyl biphenyl). Circulate or agitate as system design permits. Operate each valve, cock, pump, etc. Sample and analyze for PCB's. If not acceptable, drain to drums and repeat this step.

Analysis of the waste from each step can provide a valuable check on progress, and thus help determine how much of the remaining procedure must be implemented. For instance, if the first organic fill/drain were to analyze as 1% PCB, that would indicate that the prior steps had displaced 99% of the contents, and a repeat of those steps should get to $(.01)^2$ or 100 ppm, provided that there was no source of PCB from pockets, leaching of solid deposits, or gaskets, packing, etc. Thus, if the ratio remains the same between successive organic dilutions, such sources probably do not exist. This will not be true of water washes, because any PCB present will tend to remain with the organic layer.

J R Savage
J.R. Savage

/bh

Report on EIA-AHAM Seminar on AC Capacitors.

March 3, 1976 Meeting
Chicago Marriott Hotel
8535 West Higgins Road
Chicago, Illinois
9:00 AM

After an introduction of all those in attendance at the meeting, (see Appendix A) Mr. Weizeorick and Mr. Phillips welcomed the representatives on behalf of AHAM and explained the general guidelines for the meeting.

Mr. Clifford Tuttle, President of Aerovox and Chairman of the Electronic Industries Association (EIA) Task Group on Polychlorinated Biphenyl (PCB) was introduced as moderator for the seminar.

Mr. Tuttle requested Mr. James P. Flynn, Environmental Protection Attorney, representing General Electric, to review the legal constraints of the meeting based on anti-trust considerations.

Mr. Flynn indicated that the meeting could not review items of a proprietary nature and items which apply specifically to an individual company. Discussions would be limited to technical subjects concerning the general characteristics of the application of capacitors to appliances and a general discussion of the PCB problem without reaching an agreement or conclusion. The meeting could not infringe on the customer-supplier relationship, and anything of a specific nature dealing with an individual company's application should be handled individually between the companies involved.

I. Present Status of PCB Capacitors.

A. Characteristics

Mr. Ray Clark, Vice President of Universal Manufacturing Corporation, reviewed the present status of PCB impregnated capacitors. Appendix B is a copy of Mr. Clark's remarks which include a review of the innate characteristics of the PCB (Aroclor 10-16) used in AC capacitors. He concluded that these characteristics have resulted in a highly reliable, proven product which is relatively small, reliable, and fire-resistant. This product has innumerable uses in a wide variety of domestic, commercial, and industrial equipment.

B. Monsanto's Position on PCB

Mr. David Wood, Manager of Dielectrics for the Monsanto Company, the only domestic supplier of PCB's reviewed the history of the environmental concerns of this material.

I. B. (Cont.)

He indicated that in the mid-sixties when the investigations of DDT were at their peak, PCB was identified as a material which was interfering with analysis identifying the environmental location of DDT. This led to additional investigations of PCB's. It was found that PCB is persistent in the environment and that it was accumulating in the food chain.

In 1970, Monsanto made the decision that PCB would be supplied only to those manufacturers that used it in a closed system. Other uses such as for carbonless paper were discontinued.

In the following four to five years a slight decline was noted in the environmental availability of PCB but it did not show the same decline that was attributed to DDT when it was placed under restrictive control. Mr. Wood interpreted this lack of proportional decline to the delayed introduction of the PCB bearing material into the environment from such products as carbonless paper which often was kept in files for several years prior to being destroyed. Governmental agencies, however, suspected that other sources of PCB were introducing the material into the environment. As a result, legislative pressure started to build toward the banning of PCB.

In January, 1976, Monsanto announced its desire and intent to phase out the manufacture of PCB when, and if, suitable alternatives are available from whatever source. Mr. Wood indicated that there has been no decision to close down the manufacture of PCB but rather there has been a statement of intent and desire on the part of Monsanto to phase out PCB production. It was noted that the Monsanto position includes the need to determine that suitable replacement materials are available.

C. Regulatory Considerations

Mr. Flynn reported that there presently are no statutes restricting the sale or use of PCB. However, on the Federal level, capacitor manufacturers are regulated by the Federal Water Pollution Control Act of 1972, and the Clean Air Act of 1970. The Federal Water Pollution Control Act regulates PCB discharge and sets levels which must be met at various times.

I. C. (Cont.)

The Clean Air Act has not been utilized to control PCB. However, it does empower the EPA to publish a list of air pollutants.

Mr. Flynn reported that on November 11, 1975 the EPA held a national conference on PCB and on December 20, 1975, Russell Train, head of the EPA, held a news conference announcing the EPA's "Action Plan" regarding PCB. It calls for a phase out of the material as a national goal. Mr. Train also called for an EPA-industry meeting to review PCB and the development of substitutes. The action plan also called for on-sight EPA inspection of facilities utilizing PCB, with the aim of developing control measures to eliminate PCB from waste.

Mr. Train's action plan calls for the utilization of the Federal Water Pollution Control Act's hazardous substance spill regulations to justify fines for spilling or discharging PCB into navigable waters. Mr. Flynn reported that at the present time he knows of 45 separate projects in the EPA concerning PCB. Mr. Flynn reported that future Federal legislation aimed at control of PCB includes the effluent standard scheduled for publication on April 1, 1976, the Toxic Substances Control Act and the Solid Waste Disposal Act.

The Senate version of the Toxic Substances Control Act, S776, was introduced by Hartke and was recently reported out of committee. It gives the EPA broad authority to limit, prohibit, or investigate virtually all chemical substances which present an unreasonable risk to the health and welfare. It also would require market clearance of any new chemical being introduced by manufacturers. The Senate bill would also require the EPA to issue a report on why no restrictions are required on a new chemical substance if it was determined that restrictions were inappropriate.

The companion House bill, HR-10318, has similar provisions and is presently under consideration by the Consumer Protection Finance Committee and the Interstate and Foreign Commerce Committee.

Mr. Flynn reported that if these bills are passed by the respective houses, it is likely they will be resolved in a conference committee and subsequently approved.

Mr. Flynn also reported that the federal solid waste legislation involved PCB and overlaps some with provisions of the Hazardous Substances Act.

I. C. (Cont.)

Mr. Flynn also reported that EPA guidelines on PCB are scheduled to be published in the Federal Register in March of 1976. He noted that these guidelines are not binding but could be useful for manufacturers.

Mr. Flynn indicated that state legislation could be much more concern to AHAM members than the Federal legislation. There are a number of bills that control or prohibit the manufacture, sale and use of products containing PCB in a number of states. Some of these bills exempt transformers and capacitors but others do not. Most allow for granting some type of an exemption.

Michigan Bill, HB-5619, has been passed by the State House but has not yet been passed by the Senate. It deals with reduction of allowable levels of PCB in parts per million. It allows for exemptions but has very stringent reporting and record-keeping provisions. It also requires labeling of items containing PCB, starting July 1, 1976. It has been reported that the Michigan Senate is working on an even tougher bill.

The Indiana bill is similar to Michigan, and has been passed by the legislature and is now waiting for the Governor's signature.

The Wisconsin legislation under consideration would prohibit the manufacture and sale of items containing PCB by February 1, 1977. This bill may provide exemptions if it is determined that the exemption is in the public interest.

New York and Oregon bills are similar to the Wisconsin legislation.

The Virginia bill is an omnibus bill which prohibits the use of toxic substances and could eventually effect PCB.

Mr. Flynn summarized that there is a distinct possibility of direct Federal legislation effecting the use of PCB and its use in other products. It is also quite possible that appliances using PCB capacitors will be required to be labeled with instructions for disposing of the product. During discussion, it was noted that the federal law may not stop states from passing more stringent laws. It was further noted that the EPA will not support the federal pre-emptive legislation.

It was also reported that there appears to be some concern now arising within the EPA on a complete ban on the use of PCB, particularly in such applications as capacitors,

I. C. (Cont.)

because of its benefits. Mr. Flynn suggested that manufacturers closely follow the reaction of the Federal Government in light of Monsanto's publicly stated position.

D. American National Standard C107.1 - Guidelines for Handling and Disposal of Capacitor and Transformer-Grade Askarels Containing Polychlorinated Biphenyls.

Mr. Lopes, Cornell-Dubilier Electronics, reported that the ANSI Committee C107 is actively pursuing changes to Standard C107.1 which are likely to be published later this year. He indicated that it appears that the revisions will be in the following areas:

1. Control of material in disposal.

   The Standard will recommend incineration of materials with absorbed PCB and disposal of components containing PCB in supervised dry landfill.

2. Spill control.

   The Standard will contain notification provisions for control of spills of PCB. Monsanto will probably coordinate this activity.

3. Control of finished capacitors in transit.

   The Standard will contain provisions for proper shipping and handling of PCB capacitors, and proper methods for cleaning ruptured capacitors.

4. Labeling.

   The Standard will recommend labeling of all capacitors containing two or more pounds of PCB. It will also recommend labeling of shipping containers containing PCB capacitors as well as labels on the outside of products that use PCB capacitors with instruction on how to dispose of the product.

During discussion is was noted that the standard could have an affect on AHAM members in the following areas:

1. If capacitor shipment contains leaking capacitors, the capacitor manufacturer would have to be notified for clean-up instructions.

I. D. (Cont.)

2. At EPA's insistence, the disposal of capacitors would have to be in a chemical landfill rather than in a sanitary landfill. This means that when products are disposed, the PCB capacitor would have to be removed and sent to a chemical landfill while the rest of the product was sent to a sanitary landfill.

3. It would require a label on the outside of the product stating the product contained a PCB capacitor, and instructions for disposing of it separately.

4. Mr. Rollins is to send a copy of the draft of ANSI C107.1 to AHAM for distribution to its members.

E. Differences in Toxic Qualities of PCB

It was reported that the toxicity of PCB differs markedly depending on its chemical constituents. However, this concept is a sophistication which was not recognized by environmentalists and regulatory agencies. The monochloro PCB material was identified as being less toxic than most other PCB's.

During the discussion, it was noted that the Yusho incident in Japan, which led to the banning of PCB in that country in 1973, was the result of leaking of highly toxic (high Dibenzylfurans content) refrigerant directly into rice-oil, a material used in Japan as a cooking oil.

The leak resulted in high levels of PCB being directly ingested. It was pointed out that although the Japanese did prove harm there are no reported incidents of loss of life. Autopsy reports on those that have died since exposure indicate that they have died of other causes, not as a direct result of ingestion of PCB. It was reported that the only documented evidence of lasting effect on the people involved in the Japanese ingestion is that some of them are very small.

II. Future Consideration

A. PCB Alternatives and Characteristics for AC Capacitors

Appendix C is a copy of the information presented by Mr. Richard L. Rollins, Vice President Engineering, Jard Company, Inc., on PCB alternatives and their characteristics for AC capacitors. Mr. Rollins particularly stressed the required characteristics of PCB alternatives listed on page 3, Table 1, of the Appendix, and the characteristics of the proposed candidates for PCB

II. A. (Cont.)

substitution listed on page 4, Table 2 of the Appendix. He noted that these proposed candidates do not represent a complete list and were identified generically and therefore slight differences may exist from one manufacturer's material to another.

Mr. Rollins noted that dry metalized polypropylene film is often used in Europe instead of PCB impregnated capacitors. However, its basic application as a power factor correction device is usually connected across the line and is not used for improving equipment performance. There is no physical indication of capacitor failure because the equipment continues to operate but at a reduced power factor. These capacitors are usually less than 20 microfarad and 10,000 hours is considered mean life. In the U.S. 60,000 hours with 95% survival rate for a 70°C application is considered satisfactory for air conditioning applications. 100,000 hours with 70% survival rate for a 90°C application is usually considered satisfactory for lighting. Although there is a great deal of difference in the requirements between the U.S. and Europe, there is considerable experimentation being done for U.S. application of metalized polypropylene dry film capacitors.

Mr. Rollins explained that regardless of how well we think we understand the problems of a particular application, there always seems to be failures in that application. Past history indicates that capacitor manufacturers have difficulty equating life tests in the laboratory to field application. And therefore, any change in capacitors should certainly receive full field testing. He indicated that at the present time all known substitutes for PCB are going to result in a cost increase. However, there is no firm understanding of how much that would be at the present time.

B. <u>Environmental Consideration of Substitute Materials</u>

Mr. Roger Wills, Westinghouse Electric, explained that capacitor manufacturers do not have bench marks for environmental considerations of substitute materials. An evaluation of a class of compounds is needed in order to determine if there is anything within the family which is known to be detrimental from an environmental standpoint. This would identify suspect materials in compounds and allow more specific testing to be done. Due to a lack of information, capacitor manufacturers cannot presently rate candidate materials. Environmental experiments are very costly and time consuming and two of the proposed alternative materials are already on EPA's concern list.

II. B. (Cont.)

Mr. Wills estimated that within the time frame required for replacement of PCB capacitors, dry film capacitors will not be available. The development time of this particular concept removes it from the realm of a viable alternative and therefore the replacement must be an impregnated capacitor to satisfy the customer's needs.

Due to the environmental concerns, there will probably no longer be a single dielectric material used in capacitors, but there will be multiple systems. Each system will have to be evaluated for its application as well as for its effect on the environment.

III. Capacitor Manufacturers Meeting with Underwriters Laboratories (UL)

Mr. Richard Hauser, Electric Utilities Company, reported that the capacitor manufacturers had met the previous day with Messrs. Seelbach, Duffy, Bratbold and Yerkey of UL to review the PCB problem. It was noted that these persons were representing UL on a national basis. Mr. Hauser indicated that this was the initial meeting with UL and represented an exploratory session. UL does not have an official position regarding use or non-use of PCB in capacitors. It was the opinion of UL representatives that:

(1) the industry should not change to non-PCB capacitors without extensive engineering experience,

(2) there should be some effort to develop tests to compare hazards associated with non-PCB capacitors compared with the hazard or lack thereof associated with PCB capacitors,

(3) UL would be willing to work with capacitor manufacturers on a contract basis to evaluate the potential hazards, and particularly to evaluate the fluids for flammability. Capacitor manufacturers would have to pay for this work.

Comments made by UL representatives during the meeting included the following:

1. No one knows what is an acceptable dielectric from an environmental point of view.

2. Labeling - What would be listed on the label? What does the toxic substance actually require?

3. Fire hazards are not the only problem to be considered.

III. (Cont.)

4. There are no current programs or expected programs on non-PCB ballasts.

5. There are no present requirements for non-PCB capacitors.

6. Capacitor manufacturers should not presume indifference on the part of UL with what is inside the capacitor. Judgment should be used before changing to non-PCB material.

7. UL will not establish standards that deal with permissible fires.

8. It would be difficult to simulate a whole range of possible failure modes. UL can undertake joint testing programs. UL could also serve as a collection point for information on how a capacitor might fail. This would de-sensitize the information from an anti-trust concern.

9. If UL gets a request from a manufacture for approval of a capacitor, it would have to provide the manufacturer with a program. Therefore, it could not ignore the situation.

10. Fire in itself is not the only item of importance. Burning intensity is influenced not only by the point of origin of the fire but also other combustibles in the vicinity of the fire.

11. EIA and manufacturers should begin a program to evaluate substitute materials because there is no similar test experience to call on.

12. UL would have to examine fluids which may escape from the capacitor due to puncturing with regard to its burning intensity. But other life characteristics may also be of interest.

13. All failure modes would have to be examined to determine their effect on safety.

In summary, UL was not overly disturbed with the problem, but indicated that it would have to be handled in a manner consistent with the needs of safety.

IV. <u>Meeting of Capacitor Manufacturers with Consumer Product Safety Commission (CPSC)</u>

Mr. N. Ray Clark, Universal Manufacturing Corporation, reported that after the meeting with UL the previous day the members of the capacitor industry met with representatives from CPSC. CPSC

IV. (Cont.)

representatives were Mr. King, Electrical Engineer from the Bureau of Engineering Sciences and Dr. McLaughlin, Director of the Division of Biological Sciences. Mr. Clark noted that Dr. McLaughlin served on an interagency task force looking at PCB's. He noted that the CPSC is sympathetic and understanding of the problem and proposed to initiate a review of the problem leading to resolution of the question of safety.

The CPSC representatives indicated they would report their impressions of the meeting to their directors and unless there was some other impetus to increase the priority of the PCB problem, there would probably be no further investigation.

Mr. Clark indicated that CPSC thinks in terms of trade-offs to improve safety. They are subject to petition for redress of existing problems, and are obliged to be responsive to those petitions. The CPSC could be forced to take action at a later time on non-PCB capacitors because of a petition from the consumer. The CPSC representatives recommended a contact with the new chairman of the CPSC which was expected to be named in the near future.

Mr. Clark noted that the CPSC representatives indicated that it would not be inconceivable for the CPSC to support use of PCB in closed systems in order to maintain safety.

V. Performance Requirements for Particular Applications

A. Life and Reliability

Mr. Rollins indicated that present capacitor requirements are for 95% survival at 60,000 hours of operation for air conditioners, and 70% survival at 100,000 hours for higher temperature applications. He questioned if this kind of reliability is necessary for appliance application.

It was noted that with the increase in heat pump applications the adequacy of the 60,000 hours life is now being challenged. It was also noted that in certain applications, lowered ultimate life may be acceptable provided there was no increase in initial failures.

As far as energy considerations are concerned, it is likely that at some future time more permanent split capacitor motors are likely to be used, thus putting additional pressure on the need for extended life and reliability characteristics.

V. (Cont.)

B. Voltage

Mr. Rollins asked if motor designs could be modified to provide lower voltage to the capacitors. It was noted that dry film capacitors would be more viable at 300 to 320 volts rather than the present 370 or 440 volt applications.

It was noted that there presently are 330 volt capacitor applications that could accept lower voltage capacitors. However 330 volt capacitors have been specified because this is the lowest voltage capacitor that the industry offers.

It was also indicated that the trend towards higher efficiencies generally requires lower voltage capacitors with higher microfarad capacity.

Mr. Rollins noted that on non-PCB impregnated capacitors lower voltage could be an important issue.

C. Temperature Range and Maximum Operational Temperature

Mr. Rollins questioned if present applications would allow a location change so the capacitor could be located in a lower environmental temperature.

It was noted that there have been some applications where the capacitor was located in the cold air stream of an air conditioner. While this is likely to provide the coolest environmental temperature possible, it was further noted that this type application is likely to be discontinued because heat sources will have to be removed from the cold air stream in order to improve product efficiency. Outside of this consideration there is likely not to be any drastic change in environmental temperature in the compartment housing of the capacitor.

D. Maximum Permitted Variation of Capacitance and Dissipation Factor With Temperature and With Life

Mr. Rollins asked if 0.6% dissipation factor is still the number which is likely to be used for appliance application. He noted that non-PCB capacitors tend to have higher dissipation factors. Comments on this problem indicated that it was a very difficult situation and it would have to be examined in terms of other complicating factors. It may be advantageous to consider all losses at the same time.

It was noted that metalized polypropylene dry film capacitors would have less loss but not by orders of

V. D. (Cont.)

magnitude.

Another comment indicated that the appliance manufacturers would have to have some information of the variation in capacitance over the operating temperature range and over the life of the product.

Another comment indicated that it is likely that tolerance on capacitors may be getting tighter due to energy considerations, possibly even leading to matching of capacitors. The 10% tolerance on capacitors presently does not cause any problems but appliance manufacturers cannot predict what future requirements will be.

It was also noted that if federal requirements for efficiency do not consider the life of the product it is likely that appliance manufacturers will not be too concerned with a small change in capacitance over the life of the product. But this would not be so if product life must be considered.

E. Physical Size Versus Cost

Mr. Rollins indicated that non-PCB capacitors are likely to be ten to twenty percent longer than present capacitors. Comments on this aspect of the problem indicated that some present applications do not provide sufficient room for longer capacitors. However, size consideration is unique to each application. When the cost of keeping the capacitor small is more of a burden than the appliance manufacturer is willing to pay, it is likely these manufacturers would then consider retooling and redesigning the chassis.

F. Failure Mode

Mr. Rollins indicated the capacitor manufacturers would like to know the characteristics within the failure mode. That is, how much current is available and what are the other characteristics during failure?

Comments during discussion indicated that all the characteristics are available during failure to create a fire hazard, including unattended product, dust and dirt in the vicinity of the capacitor, and arcing contacts.

V. F. (Cont.)

It would be most helpful if all could be assured that the capacitor would not puncture during or after failure. However, with most appliances now being grounded another electrical path is now provided which could lead to can rupture.

Respectfully submitted,

Jack Weizeorick

John T. Weizeorick
Technical Director

JTW:dc
Attachments

Approved by:

Clifford Tuttle

Clifford Tuttle
EIA Chairman

Approved by:

Richard L. Rollins

Richard L. Rollins
Vice President Engineering
Jard Company

Report on EIA-AHAM Seminar on
AC Capacitors
March 3, 1976 - Mtg.
Appendix A

AHAM-EIA PCB Seminar
March 3, 1976
Attendance

NAME	COMPANY	TITLE
'red Brehm	Addison Products Co.	Electrical Engineer
:lifford Tuttle	Aerovox	President
'urtis L. Lopes	Cornell-Dubilier Electronics	Manager, Plant Engineering
'yler Nourse	EIA	Staff Vice President
:ichard Hauser	Electrical Utilities Co.	President
(ilman Flowers	Friedrich Air Cond. & Ref. Co.	Project Engineer
'ames P. Flynn	General Electric	Attorney, Env. Protection
'. A. Williamitis	Frigidaire (GMC)	Supervisor, Mat. Engineering
:ichard Rollins	Jard	Vice President, Engineering
:ichard Cheeseman	Litton Microwave	Senior Product Engineer
'. P. Carrier	Mallory	Director of Engineering
ud Dibble	Mallory	General Manager
:oger Hatton	Monsanto Co.	Technical Service Manager
'avid Weed	Monsanto Co.	Manager, Dielectrics
'erb Skarbek	Amana (Raytheon)	Senior Design Engineer, RAC
:obert Wagner	Admiral (Rockwell Intl.)	Project Engineer
'avid C. Howe	Sprague Electric	Engineering Manager
om Lamb	Tappan	Research Engineer
om Jacoby	Tecumseh Products Co.	Assistant Director of Eng.
. Ray Clark	Universal Manufacturing Corp.	Vice President
'. L. Beard	Whirlpool	Director, RAC Engineering
'. R. Titzer	Whirlpool	Product Engineer
oger E. Wills, Jr.	Westinghouse Electric	Attorney
ill Snowman	White-Westinghouse (Edison)	Senior Design Engineer
erbert Phillips	AHAM	Vice President Engineering
ack Weizeorick	AHAM	Technical Director

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