PCB BUSINESS PLAN BOOK - COPY #5

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Monsanto

FROM (NAME & LOCATION): J. J. Zeman - B2SK

DATE: February 3, 1976 CC:

SUBJECT: Dielectrics Business Plan

REFERENCE:

TO: R. G. Potter

Enclosed is the business plan for the replacement of PCBs in dielectric fluids. The basis of the plan is to develop Monsanto compounds which satisfy our customers' needs and protect our existing market position and profitability, if possible.

The timing of the plan changed from an initial goal of phasing out at the earliest feasible time to the present goal of phasing out in a planned and orderly manner. The plan is designed in such a fashion that it provides for a stair-step approach to go/no-go decision points for all facets of the capacitor and transformer dielectric businesses.

This document is also a working document and it is by no means intended to be in its final version. It is so constructed that as things change, the plan can be easily updated and still provide the basic control needed.

The key components of the plan are the strategic summary; the capacitor U.S.-, the capacitor Europe-, and the transformer worldwide - tactical approaches; and the potential problem analysis. All of the planning within this document is based on these items.

Each involved department should take this plan and prepare their own individual detailed work plans. The dielectric business plan is the instrument which provides the overall direction for this program.

J. J. Zeman

/bh
Enclosure

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BUSINESS PLAN FOR DIELECTRIC FLUIDS

The PCB Planning Task Force

Chairman: - J.J. Zeman
Coordinator: - J.R. Savage

Functional Representatives

Commercial Development	- R.J. Davis
Corporate Engineering	- C. P. Orr
Law	- T. H. Bottini
Manufacturing	- J. R. Savage
Marketing	- D. Wood
Patent	- W. H. Duffey
Planning & Control	- R. E. Beal
Prdt Acceptability	- J. C. Weber
	W. B. Papageorge
Public Relations	- D. R. Bishop
Research & Development	- M. J. Gibbs
European Input	- J. N. Haggart

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I. Business Plan

A. Strategic Summary

1. Withdraw from supply of chlorinated biphenyl dielectrics (PCB) in U.S.A./Canada when a suitable replacement is available, from whatever source. Date to be established by 8/1/76.

2. Establish MCS 1238 as the major replacement for PCB in capacitors in U.S.A. and Canada.

3. On the basis of (2), establish MCS 1238 as a major replacement for PCB in capacitors in Europe, Japan, and other major markets as they move away from PCBs. Discontinue production of PCB in Europe. Date to be established by 8/1/77.

4. Achieve worldwide performance income for total dielectrics of 4.4\bar{M}$ in 1976 and 4.5\bar{M}$ in 1979, which maintains the performance income through the transition period.

5. Continue transformer PCB replacement evaluation until late in 1976 and, if at that time no strong candidate can be supported, phase out PCB transformer fluids without a Monsanto replacement, at the same time as PCB capacitor fluids.

6. Resolve by mid-1976 the need for a second supplier for MCS 1238 in Europe, e.g. Prodelec or Bayer.

7. Investigate growth opportunities in dielectric fluids through developmental programs, such as cable dielectric/coolants and transformer oil modifiers.

B. Results and Goals

1. Results

   a. Phase out of PCB production when a suitable replacement is available, from whatever source.

   b. Replace our present PCB capacitor fluid with a non-PCB fluid (MCS 1238), and:

      1) Achieve in 1979 a P.I. of 4.5\bar{M}$ worldwide total dielectrics (4.05\bar{M}$ US-produced, 0.45\bar{M}$ Europe). Position the business for future growth beyond 1979.

      2) Achieve sales volume in 1979 of 19.5$\bar{M}$ pounds worldwide.

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c. If we have a viable product, replace present PCB transformer fluids with a non-PCB fluid generating a minimum of 32% PI on sales, and with a sales volume of 6-10M pounds per year by 1979 in U.S.A. and Canada.

d. Maintain Monsanto image as a responsible company during transition from PCBs and in the clean-up phase following discontinuation of PCB production; while recovering the costs for this involvement, e.g. perform incineration of waste fluids on a break-even basis.

e. Be in a position to supply MCS 1238 in Europe in 1980 from a local blending facility, earning 40% gross profit minimum.

(Note: Volume was estimated at 3M pounds per year, but Monsanto Europe requested a change to 5M to 6M pounds, which would adjust long range forecast in years 1979-85.)

2. Goals

a. Achieve a worldwide performance income in 1976 of $4.4M. ($4.0M US-produced, $0.4M European produced).

b. MCS 1238 blending facility in U.S.A. demonstrated at design rate (11M pounds/year) six months after G.E.'s commitment.

c. Obtain customer commitment to MCS 1238 early enough to support AR submission for project 3023 (non-PCB Dielectrics) by 12/1/77.

d. Reach a decision by late in 1976 on whether to continue a transformer fluid replacement program.

e. Obtain European customer commitment to support approval of an AR for European blending by January 1, 1978.

C. General Summary of Action Steps

1. Capacitors MCS 1238

   a. Complete environmental study on MCS 1238 (excl. 2-year feeding study) by July 1976.

   b. Obtain G.E. commitment to MCS 1238 sufficient to:

      1) Support an interim blending facility (in production six months after commitment).

      2) Justify a major plant (CEA 3023).

   c. Cooperate as needed with capacitor industry/ insurance groups to obtain approval for MCS 1238 capacitors - in terms of fire safety.

   d. Establish raw material supply sufficient for forecast volumes of MCS 1238 in interim blending facility; MCS 1238 supply to commence six months after G.E. Commitment.

   e. Complete construction of interim MCS 1238 blending facility and start up six months after G.E. commitment.

   f. Obtain AR approval for CEW 3023 project (MIPB/ TXS/blending) by December 31, 1977.

2. Transformers MCS 1866*

   a. Cooperate with G.E./Westinghouse to complete test transformer evaluation of MCS 1866 by June 1, 1976.

   b. Cooperate with G.E. and Westinghouse/insurance groups to establish fire resistance rating for MCS 1866.

   c. Establish by March 1, 1976 an environmental testing program which will completely evaluate MCS 1839 and MCS 1866 by March 1, 1977, (excl. 2-year feeding study).

   d. Make decision by late in 1976 whether to continue a transformer replacement fluid program.

* A blend of 60% MCS 1839 (alkylated biphenyl) and trichlorobenzene (TCB).

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C. General Summary of Action Steps (continued)

3. International Involvement

   a. Establish Canadian/Latin American MCS 1238 capacitor evaluation programs to support a request for their commitment in 1977 - June 1976.

   b. Establish agreement with 7-8 Key European capacitor producers to schedule MCS 1238 trials sufficient to make a commitment by October 1977 - May 1, 1976.

   c. Complete training of European technical personnel and provide technical documentation on MCS 1238 to support key customer and government activities in Europe - March 15, 1976.

   d. Set up a program for transformers only when we have a viable product.

4. Pricing

   a. Increase dielectric fluid domestic pricing March 1, 1976, and later in the year to cover the expenses of commitment and changeover from PCB.

   b. Increase U.S. export price by at least 10% March 1, 1976 to achieve 1976 P.I. of $0.70M.

5. Growth Programs

   a. Determine if there is opportunity for growth in new dielectric programs such as cable oils and transformer oil modifiers.

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D. Business Position Identification/Analysis - U.S. & ROW

1. Our current range of products serve two major markets:

   a. Dielectric liquids in capacitors (devices for storing electrical energy).

   b. Dielectric/coolant in special* fire resistant power transformers, e.g. those in the 500-10,000 KVA range commonly used in factory and residential installations.

      * Special - e.g., U.S.A. annual usage of PCB transformer fluids is approximately 1M gallons compared to usage of mineral oil transformer coolants of 90M gallons.

2. Capacitor Market

   a. The worldwide potential expressed as M pounds of Aroclor is:

1974	1975	1976	1977	1978	1979	1980	1985
50	37	43	46	47	49	50	56

   b. A geographic breakdown is given in Chart 1 in the Appendix V-12 (Capacitor Dielectric Fluid Potential)

   c. In 1975 Monsanto held 58% of worldwide market.

   d. Our major competitors outside of U.S.A. are:

      Prodelec (France) - Monsanto Relative Share 3.2
      Bayer (Germany) - Monsanto Relative Share 6.4

   e. U.S. market (40% of world market) is under pressure to convert to non-PCB dielectric.

   f. Other world markets are forecast to follow later because they are not under the same environmental pressure.

   g. We plan to progressively replace Aroclor worldwide with MCS 1238 (M pounds).

	1974	1975	1976	1977	1978	1979	1980	1985
MCS 1238			1.3	11.0	16.5	19.5	20.5	23.5
Aroclor	32.5	21.5	23.3	12.2	4.0	0	0	0

      Chart 2 in the Appendix V-13 shows details of Monsanto Capacitor Fluids Sales Forecast.

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D. Business Position Identification/Analysis (continued)

h. In converting to non-PCB replacement capacitor fluids, major competition will not be with other producers of identical products to MCS 1238, but with alternative technologies.

E.g., Dow Fluid XFS 4169L
Phthalate Ester
Metallized Plastic Film
Chloralkylene 12)
Bichlorobiphenyl) Europe

3. Transformer Market

a. The worldwide potential expressed as $\bar{M}$ pounds of Aroclor-Trichlorobenzene blends is:

1974	1975	1976	1977	1978	1979	1980	1985
51	53	50	47	56	59	62	76

(Note: Aroclor on average represents 60% by weight of the blend.)

b. A geographic breakdown is given in Chart 3 in the Appendix V-14 (Transformer Fluid Market).

c. In 1975 Monsanto held 42% of the worldwide market.

d. Our major competitors outside of U.S.A. are:

Prodelec (France) - Monsanto Relative Share 1.8
Bayer (Germany) - Monsanto Relative Share 4.9

(Note: Both of these are basic in chlorinated benzene, while Monsanto purchases.)

e. The U.S. market (30% of world consumption) is under pressure to convert to non-PCB replacements. The French market (30%) and other European markets (22%) are not under the same pressure.

f. We presently seek to replace PCBs with an alternative fluid in U.S.A. and Canada only.

$\bar{M}$ Pounds	1974	1975	1976	1977	1978	1979	1980	1985
PCB transformer fluid	21.5	20.7	17.2	10.2	2.2	0	0	0
Non-PCB transformer fluid	-	-	-	-	4.2	6.0	7.5	10.0

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D. Business Position Identification/Analysis (continued)

g. In the transition from PCB competition will be:

- Silicones
- High flash point oil distillates
- Air-cooled designs
- Redesigned fire protected oil systems

4. Based on our market in chemical base dielectric fluids, we can seek growth opportunities for non-PCB fluids in new dielectric market segments, which we expect to arise from a world shortage of naphthenic-based oils, e.g. cable dielectrics/coolants and transformer oil modifiers.

5. Price Trend

a. Capacitor Fluids

1) Prices domestically have tended to follow costs to yield a gross profit in the range 40-45% (see Chart 4a in the Appendix V-15 - Capacitor Fluid Sales, U.S. Produced).

2) Prices in export markets have in recent years been relatively lower reflecting specifically French attempts to move volume. (See Chart 4a)

3) The cost of Aroclor represents 4-5% of the total capacitor cost so that capacitor cost is comparatively insensitive to fluid price.

4) We plan to price MCS 1238 to yield a 25% minimum performance income return on replacement capital (45% G.P. minimum).

D. Business Position Identification/Analysis (continued)

b. Transformer Fluids

1) Prices domestically have tended to follow costs to yield a gross profit in the range 35-40% (see Chart 5a in the Appendix V-17 - Transformer Fluid Sales, U.S. Produced).

2) Prices in export markets have, while following costs, yielded relatively lower gross profits reflecting both the competitive edge of our competitors' basic position in chlorinated benzenes and the French intention to move volume. (See Chart 5a)

3) The cost of transformer PCB represents 20-25% of the cost of the transformer so that this market is much more sensitive to price change. Additionally, there is an ultimate ceiling on fluid price related to the cost of competing transformer installation designs.

4) To achieve the desired volume, our cost for any non-PCB replacement material must permit pricing no higher than 1.5 times 1975 PCB-blend price per gallon. At this level, we must be able to satisfy performance income criteria.

5) After product changeover to non-PCB fluids, there will not be the present relationship between capacitor and transformer prices because replacements are not from a common base stock.

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E. Critical Assumptions

1. The capacitor industry will design around the reduced fire resistance of MCS 1238.

2. There will not be any government ban on PCBs in U.S.A. for capacitor/transformer use through 1977.

3. Some level of fire resistance below that of PCBs is acceptable for replacement transformer fluids and MCS 1866 meets such standards.

4. There will be no ban on electrical use of PCBs in Europe through 1978, but that European governments will move to support non-PCB requirements.

5. There will be no major growth in capacitor fluid volume usage 1976-1980.

6. MCS 1238 priced for 32% margin on sales performance income minimum maintains a cost/performance advantage over Dow XFS 4169L.

7. Phthalates will not be accepted as functionally suitable dielectrics for wide scale use in capacitors.

8. No major capacitor design changes which would rule out use of fluids are within two years of commercialization.

9. The transition timetables given us by our customers are reliable.

F. Technical

1. Capacitor Fluids

a. Function. A capacitor is a device to store electrical energy. It consists of two electrodes separated by a dielectric medium. The functions of the medium are to store electrical energy between the two charged electrodes and to insulate one electrode from another. The ability to store energy is determined by dielectric constant (DK) and dielectric strength. The ability to insulate against complete electrical breakdown is measured by dielectric strength, against temporary breakdown by corona inception voltage, and against current leakage by dissipation factor (D_f). Dielectric constant varies over a range of 1 to 100 with molecular structure while dielectric strength and corona voltage are less sensitive to structure. Low frequency dissipation factor measures ionic impurities, present initially in the fluid or resulting from breakdown in use, which conduct current across the medium.

Fluid impregnated paper or plastics have been the dielectric medium of choice because of their much higher dielectric strength as opposed to gases and their much greater ability to completely fill the void between charged surfaces as opposed to solids.

Capacitor designers seek fluids optimizing high dielectric constant, high dielectric strength, high corona inception voltage and low dissipation factor with safety and low cost.

b. Industry Standard. Monsanto Aroclor 1016 with a high DK, high dielectric strength, low dissipation factor, historical low cost, and excellent fire resistance is the industry standard. It will eventually be replaced because of hazard to the environment.

c. Monsanto Replacement Fluid. MCS 1238 has the same high dielectric constant and strength as Aroclor and gives equivalent electrical performance in capacitors. Fire resistance is the only significant deficiency. Lack of fire resistance in MCS 1238 will be circumvented by capacitor manufacturers' use of fused designs. MCS 1238 biodegrades rapidly, does not bioaccumulate and has a low order of mammalian and aquatic acute toxicity, thus rectifying the environmental objections to PCBs. Chronic toxicity studies are underway. Accelerated life tests in our laboratories demonstrate substantially equivalent life to

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Aroclor based capacitors. These results have been duplicated at General Electric and Electrical Industries. Successful operation and performance has also been demonstrated in commercial processing equipment at GE, Cornell Dubilier and Electrical Utilities.

MCS 1238 is a blend of TXS (toylyl xylyl sulfone) and MIPB (monoisopropyl biphenyl). TXS is a very high dielectric constant material developed by us in sufficient purity to be usable in conjunction with stable low dielectric constant materials to give desired capacitor performance. We have use patent coverage which claims capacitors containing TXS with hydrocarbons. The biphenyl base of the IPB hydrocarbon is significant to our family tree viability which also involves heat transfer and encapsulent fluid products. Processes for the MCS 1238 blend and raw material have been demonstrated. Final definition for full scale design is nearing completion.

d. Competitive Fluids and Technology

1) DOP and DINP esters (dioctyl phthalate and diisononyl phthalate) have been actively promoted as PCB replacements and are low cost products, but have the following deficiencies which are preventing their acceptance: low dielectric constant (75% of MCS 1238 and Aroclor) tendency to hydrolyze with use increasing dissipation factor, low corona inception and extinction voltages, inability to be used at all in power capacitors (30% of total market).

2) Dow XFS 4169L, a chlorinated aromatic, is the only other replacement candidate being significantly promoted. Although it does have good corona inception and extinction voltages, its dielectric constant is also low (85% of MCS 1238); it has a 7% density penalty to the customer and does not biodegrade as readily as MCS 1238.

3) Technologies which could impact use of MCS 1238 include tight wound metallized polypropylene film construction requiring no fluid impregnant (for low voltage capacitors) and all film construction where fluid impregnation does not increase capacitance as much as for paper (for power capacitors). Both methodologies involve significant technical problems not resolved to date.

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2. Transformer Fluids

a. Function. A transformer is a device for converting power at one voltage to equivalent power at a different voltage. The functions of a transformer medium are to insulate the electrical components from each other and to remove thermal energy from power losses. Fluids have been widely used in power transformers because of their good dielectric strength and their superiority over gases and solids in transferring heat by convection. Dielectric strength and heat transfer properties, in particular viscosity at low ambient temperatures, are the most important functional properties. Other properties important in practice are resistance to oxidative or hydrolytic deterioration in use, fire resistance in case of a catastrophic failure and safety in the environment.

b. Industry Standards

1) Mineral oils are the most widely used transformer oils because of their good electrical and heat transfer properties, stability and low cost. They are not used in fire-risk areas because they are combustible.

2) Askarels (mixtures of Aroclors and tri- and tetrachlorobenzenes added to reduce low temperature viscosity) are used in fire-critical areas because they do not support combustion, in addition to having good electrical and heat transfer properties, excellent stability and reasonable costs.

c. Monsanto Replacement Fluids for Askarels. MCS 1866, a mixture of alkyl biphenyl and TCB (trichlorobenzene) which has dielectric strength and heat transfer characteristics similar to current Aroclor based products. Fire resistance is less than Aroclor/TCB, but slightly better than mineral oils. While biodegradation rate is slow, the acute toxicity is very low. Bioaccumulation and fish toxicity studies are underway.

General Electric has rated the fluids as promising based on laboratory tests, and we have supplied them with fluid for the next phase of testing.

We have a process for production of development samples and are progressing toward a process of engineering design.

d. Competitive Fluids and Technology

1) Mineral oil is used in the majority of applications where fire hazard is low and can replace askarels

3. Technical Programs (1976 Budget $960 M)

   a. Capacitors

      1) Provide development quantities of MCS-1238 at a rate of at least 40,000 pounds/month ($200 M).

      2) Complete process for engineering design of MIPB, TXS and MCS-1238 ($100 M).

      3) Obtain toxicity and environmental data required for approval of MCS-1238 by industry and government agencies ($100 M).

      4) Support commercial development of MCS-1238 ($200 M).

   b. Transformers

      1) Complete process and property optimization of MCS-1866 ($100 M).

      2) Provide development quantities and develop process for engineering design for MCS-1866 ($110 M).

      3) Evaluate alternates for TCB in blends with alkyl biphenyl ($50 M).

   c. Long Range

      1) Provide fundamental information leading to modified fluids of improved dielectric performance to solve future dielectric system problems ($75 M).

4. Risk Because of Voids

   Lack of accepted fire resistance standards for transformer fluids may lead to lack of acceptance of MCS-1866.

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G. Capital Program (1976-1980)

	List Projects	Location	Priority	AR Date	NFC $M
1976					
1) Over $2M					
2) 500M - $2M					
3) 0 - 500	Total NFC Only				650*
1977					
1) Over $2M	CEA 3023	Undecided	2	12/77	10,500
2) 500M- $2M	Europe MCS 1238 blending			12/77	600
3) 0-500	Total NFC Only				155
1978					
1) Over $2M					
2) 500M- $2M					
3) 0-500	WGK Historical Replacement				165
1979					
1) Over $5M (Only)					
1980					
1) Over $5M (Only)					

* Europe NFC incl.

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G. Capital Program (continued)

	Project	AR No.	AR Date	NFC ($M)
1976				
1) 0-500	WGK Blending Plant	Req. 8683	*	450
	WGK Blending Expansion	-	**	100
	Newport Effluent/ Waste Handling	-	76	25
	WGK Misc. Aroclor Projects	-	76	75
				$650M

* After receiving commitment from G.E.

** 6 months after the initial blending project

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H. Manufacturing Capacity (Product Mix Basis)

	1975	1976	1977	1978
Location 1				
Aroclor WGK				
M Lbs. Capacity	59,800	59,800	50,200	50,200
M Lbs. Sales	30,700	29,800	12,100	-
% Occupancy	51.3	49.8	24.0	0
Location 2				
Aroclor Newport				
M Lbs. Capacity	13,200	13,200	13,200	13,200
M Lbs. Sales	7,500	7,400	7,500	5,500
% Occupancy	56.8	56.8	56.8	41.7
Location 3				
MCS 1238 Interim WGK				
M Lbs. Capacity	-	2,360	13,500	20,000*
M Lbs. Sales		1,300	11,000	16,500
% Occupancy		55	81	82

* After completion of the $100M Expansion Project.

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I. Business Position Identification/Analysis - Europe

1. Our current range of products serves two major markets, namely dielectric liquids in capacitors and special dielectric coolants in transformers.

2. Capacitor Market

   a. The European potential for dielectric liquids in capacitors expressed as M pounds Aroclor is:

1974	1975	1976	1977	1978	1979	1980	1985
21	17	20	20	21	21	21	21

   The growth is negligible because improvements in capacitor design which reduce the amount of liquid used are absorbing the normal growth of 5-10% p.a.

   b. The split between Western and Eastern Europe is given in Chart 1 in the Appendix V-12 (Capacitor Dielectric Fluid Potential).

   c. In 1975 Monsanto held approximately 25% of the European market.

   d. Our major competitors in Europe are Prodelec, France (Monsanto relative share: 0.64); Bayer, Germany (Monsanto relative share: 1.25); with minor competitors, Caffaro, Italy and Coquisa/ Flix, Spain.

   e. Use of our product in Western Europe (70% of the total European market) is limited by OECD recommendations, but there is no immediate pressure to convert to a non-PCB dielectric. Events in the U.S.A. however, together with pressure that can be brought into the OECD by the U.S. government, is likely to create the need for conversion.

   In Eastern Europe, there is concern over worker safety and an increasing use of Western technology; to the extent that Western capacitor technology will in the future be based on non-PCB dielectric fluids, the same demand should be present in Eastern Europe.

I. Business Position Identification/Analysis - Europe (cont'd)

f. We plan to progressively replace Aroclor with MCS 1238 (M pounds):

	1974	1975	1976	1977	1978	1979	1980	1985
MCS 1238*	-	-	-	0.2	1.0	5.7	6.0	6.5
Aroclor	6.8	5.5	5.9	6.0	4.0	-	-	-

g. In converting to replacement fluids for capacitors, major competition will not come from products identical to MCS 1238, but from alternate technologies.

E.G., Prodelec's Chloroalkylene 12 (Alkylated Dichlorodephenyl, which might be ruled out because of its similarity to a PCB).

Dow Fluid XFS-4169L (Butylated Monochloro Diphenyl Oxide and Esters.

3. Transformer Market

a. The European potential expressed as $\bar{M}$ pounds of Pyroclor (Aroclor + Trichlorobenzenes) is:

1974	1975	1976	1977	1978	1979	1980	1985
28	27.5	25	23	25	26	28	30

b. Our market is in Western Europe, as the Eastern bloc is self-sufficient with locally manufactured askarel.

c. In 1975 Monsanto held approximately 10% of the European market.

d. Our major competitors in Europe are:

Prodelec, France	-	Monsanto relative	share	0.19
Bayer, Germany	-	"	"	0.27
Caffaro, Italy	-	"	"	0.44
Coquisa/Flix, Spain	-	"	"	0.47

e. The European market is not under the same pressure as the U.S. market to convert the non-PCB replacements. However, events in the U.S.A. will affect Europe, both via the media and the OECD.

* Volumes do not agree with business group results. See note on page I-2.

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I. Business Position Identification/Analysis - Europe (cont'd)

f. We will decide whether to seek to replace our current PCB business with an alternative only when replacements acceptable to the U.S. market are defined.

There are already higher cost alternative safety transformer systems, e.g., dry type transformers, cast resin transformers, specially protected mineral oil filled transformers, etc. Any new replacement fluid must be able to compete on a cost/performance basis with the existing systems.

4. Profit Trends

a. Traditionally this business yielded 25-30% gross profit (see Chart 5b), but in the last two years, price controls and competitive activity have kept market prices low.

b. The cost of Aroclor represents 5-10% of the cost of most capacitors. The impact of fluid cost is minor. However, in the case of transformers, the fluid cost is 25-35% of the cost of the transformer and there is a limit on fluid price since alternative safety transformer systems already exist.

c. Non-PCB Capacitor Fluids

MCS 1238 to yield 30% G.P. and P.I. minimum 20% on replacement capital.*

d. Non-PCB Transformer Fluids

Position to be defined.

* These targets, as supplied by Monsanto Europe, must reconcile with Corporate goals. These are under discussion with Europe and will be resolved before the final European plan is published.

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PCB-ARCH0021339

J. Financial

(To be provided)

II. CAPACITOR
ACTION PLAN

PCB-ARCH0021341

II. Capacitor Action Plan - U.S.

A.1 - Tactical Approach

The detailed events on the following pages are premised upon the "main line" course of action. At certain points in the program there are alternative routes that may prove better and, if they are taken, then some of the detailed action plans must be modified.

The "main line" can be summarized as follows:

1. Our choice of product for replacing PCBs in capacitors is MCS 1238, a blend of monoisopropyl biphenyl (MIPB) and tolyl xylyl sulfone (TXS).

2. We will move rapidly to establish an interim blending and treating operation at Krummrich Plant within 6 months of a customer commitment. This project could readily be debottlenecked to permanently serve our needs, but may prove to be a temporary installation if another site is chosen for self-manufacture of MIPB and TXS.

3. We will complete and sign contracts for toll manufacture for MIPB and TXS blend components in time to begin shipments within time parameters defined by major customers.

4. The Monsanto pricing plan will be completed by March 1, 1976 detailing interim and long-term pricing for MCS 1238, as well as an escalation schedule for PCBs as phase-out approaches.

5. We will determine the target date to cease manufacture of PCBs by August 1, 1976.

6. Documents and activities leading to self-manufacture of TXS and MIPB will be timed to postpone major capital commitments until results of 2-year medical studies can be foreseen with greater evidence.

   Tentaive Dates: PIR 6/77; AR 12/77.

Alternative courses and circumstances which might lead to considering adopting them are discussed under "Alternatives - U.S."

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II. Capacitor Action Plan - U.S.

A.2 - Alternatives

1. Products

From a technical standpoint, there probably a number of hydrocarbon base stocks that could serve the role of MIPB, which was selected because it will be low in cost and supports the polyphenyl investment. The role of TXS as an enhancer of dielectric constant is more unique. There may be slightly different sulfones that would work, but all should be covered by our patent. Another area of chemistry which has not been fully explored is in aromatic ketones, but they would be much more expensive.

From the standpoint of meeting our timetable for commercialization, we must remain with MCS 1238, if some unforeseen weakness is found in the product, at least one year will be lost in changing to something else. Therefore, if MCS 1238 fails, we would question the viability of a continuing effort in capacitor fluids.

2. Plant Sites

Most of the site evaluation work has concerned adaptation of Aroclor equipment at Krummrich Plant and phosphate ester/Santosol 100 equipment at Delaware River Plant, which was rejected because of lack of capacity in existing equipment. Capital requirements and available time favor Krummrich -- but at Krummrich we are faced with a potential problem of PCB contamination of at least the first few batches. The "main line" plan has assumed that the contamination can be held to a level that is low, temporary, and acceptable, and a blending project using PCB equipment is underway using pre-approved authority funds.

A third alternate, using potentially idle Silica and plasticizer equipment at Everett, is under evaluation. MIPB manufacture and MCS 1238 blending could be done in this equipment. This could be the lowest capital route to in-house manufacture of MIPB and without any question of PCB contamination. Based on preliminary capital estimates, it has been decided to have both raw materials, TXS and MIPB, made by converters. However, Everett remains a potential site for blending. A decision is expected by mid-March.

3. Timing of Major Investments

The main line plan calls for deferral of commitments to major investment until interim results of two year feeding studies are known, specifically the Master List calls for approval of a $10.5M project in December 1977. However, if evaluation shows that capital for the Queeny site for TXS is low (<$1M), then earlier implementation should be considered. To get adequate quantities of TXS at acceptable cost through toll manufacture, we must commit to a lump sum of $600M to set up facilities. If the capital for internal manufacture is not much more, it seems more desirable to spend the money to build our own unit rather than someone else's, provided payback time on the increment is short. A recommendation on this point is scheduled for February on the Events Chart.

A similar situation may exist in an Everett project for MIPB. If both these possibilities materialize, no Master List project would be needed.

The European capacitor action plan starts on II-14.

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PCB-ARCH0021344

II. A.3 - Capacitor Action Plan (Events Chart - U.S.)

TIMING	ACTIONS	DECISIONS/APPROVALS
Jan. 1976	1/31 Research geared to 40M pounds/month production	
Feb. 1976	2/11 Presentation completed on medical/ environmental package 2/17 Visit to G.E. to quote price for research volumes of MCS 1238 2/28 Detailed storage trials underway	

0022180

PCB-ARCH0021345

TIMING	ACTIONS	DECISIONS/APPROVALS
March 1976	3/1 Complete pricing study for both short and long term, based on replacement capital	
	3/8 Visit to G.E. to quote interim and long term pricing	3/15 Decision on location for interim MIPB and TXS
	3/22 Potential visit to Westinghouse on transformer blend grade change to facilitate interim blending (if WGK is selected)	3/15 Decision on site for interim blending
April 1976	4/1 Present test data and protocol to federal agencies	4/1 Decision from G.E. Need favorable response
	4/1 Recommendation to Management on potential in-house interim manufacture of TXS and MIPB (assumes low capital)	4/15 AR approval of WGK or Everett project
	4/15 Complete contract signing for toll manufacture (MIPB and TXS)	4/15 Decision on sites for in-house manufacture of MIPB and TXS and companion blending facility
	4/15 Complete business/economic review for go/no-go recommendation to CAC	4/22 Favorable CAC decision
	4/15 Issue report on various acute toxicity tests	

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PCB-ARCH0021346

TIMING	ACTIONS	DECISIONS/APPROVALS
May 1976	5/1 Final shipments of 100-42 to Westinghouse (if WGK chosen)	
June 1976	6/1 Approved PED's for TXS and MIPB to CED	
	6/15 Decontamination of used equipment for MCS 1238 blending complete (if WGK chosen)	

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PCB-ARCH0021347

TIMING	ACTIONS	DECISIONS/APPROVALS
July 1976	7/1 Results of various feeding studies 7/15 Determine need to debottleneck blending	
Aug. 1976	8/15 Complete AR to debottleneck blending to 20M lb/yr (if needed) 8/15 Establish patent licensing policy	

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PCB-ARCH0021348

TIMING	ACTIONS	DECISIONS/APPROVALS
Sept. 1976	9/1 Start up toll manufacture of TXS and flashed MIPB 9/1 90 day feeding test results on MIPB and TXS 9/15 Release tank cars as needed from Aroclor 1016 service for decontamination and conversion to MCS 1238 service	9/1 AR approval for debottlenecking of blending system (if needed)
Oct. 1976	10/1 Start up WGK blending 10/15 Demonstration of rate and quality at WGK 10/15 Begin shipments from WGK	

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PCB-ARCH0021349

TIMING	ACTIONS	DECISIONS/APPROVALS
Nov. 1976		
Dec. 1976		

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PCB-ARCH0021350

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TIMING	ACTIONS	DECISIONS/APPROVALS
1st Qtr '77	3/1 Demonstrate debottlenecked blending rate at WGK.	
2nd Qtr '77		5/77 Customer long-term commitment to 1238. 6/77 PIR approval on project for in-house manufacture of MIPB and TXS. 6/77 90-day results from chronic feeding study.

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PCB-ARCH0021351

TIMING	ACTIONS	DECISIONS/APPROVALS
3rd Qtr '77	8/77 ARDT from CED to Roger Beal. AR grade sales forecast to Roger Beal.	
4th Qtr '77	11/77 Final draft AR complete. 12/77 CED begin Project Definition Report. 12/77 Final shipments of Aroclor 1016. Begin final decontamination of equipment and tank cars.	12/77 AR approval for in-house manufacture of MIPB and TXS.

0022187

PCB-ARCH0021352

TIMING	ACTIONS	DECISIONS/APPROVALS
1st Qtr '78	3/78 Decontamination work complete.	1/78 6-month inhalation study results.
2nd Qtr '78		4/78 Results of 2 year chronic studies on MIPB & TXS.
3rd Qtr '78		
4th Qtr '78		

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PCB-ARCH0021353

TIMING	ACTIONS	DECISIONS/APPROVALS
1st Qtr '79	1/79 Begin field construction of MIPB and TXS facility	
2nd Qtr '79		
3rd Qtr '79		
4th Qtr '79	12/79 Start up in-house manufacture of MIPB and TXS	
1st Qtr '80		2/80 Demonstrate rate and quality

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PCB-ARCH0021354

PCB-ARCH0021355

J. R. Savage
B2SL

II. Capacitor Action Plan - Europe

B.1 - Tactical Approach

The European plan targets the same result as the U.S. plan -- complete withdrawal of PCBs from the market -- but differs in tactics because of the existence of major competition and a less emotional regulatory climate. The "main line" plan for Europe can be summarized as follows:

1. Create a climate for regulatory action against PCBs by making MCS 1238 visible as a viable replacement.

2. Supply European requirement for MCS 1238 (3M pounds in 1979) from the U.S. to build market share pending local manufacture.

3. Decision by July 1976 on need to establish a licensed 2nd supplier in Europe.

4. Submit A.R. for local blending (and potentially MIPB manufacture) by January 1978.

5. Cease manufacture of PCBs in Europe by a target date of 1/1/79.

6. Supply solely from local manufacture (but using TXS ex-U.S.) by 1/1/80.

A discussion of potential modifications of this course is given under "Alternatives".

PCB-ARCH0021356

II. Capacitor Action Plan - Europe

B.2 - Alternatives

1. Products

Monsanto will totally follow the U.S. technical route in Europe.

2. Market Approach

We have two major competitors in Europe.

Bayer produce in multi-purpose equipment and will be relatively unscathed by a withdrawal from dielectric supply. If they withdraw, protection of their Diphyl (Biphenyl/Diphenyl Oxide) heat transfer fluid supply may be required.

Prodelec have a much larger proportion of their total income dependent on a dielectric future. They will seek to protect this by promotion of lower chlorinated biphenyl technology, and by typifying Monsanto withdrawal as a U.S over reaction to political pressures which Europe should not follow.

An offer to Prodelec of some form of participation in the dielectric future as a second supplier licensee could lead to a more rapid and successful achievement of our European objectives.

3. Sites/Sources

Since biphenyl is made at Newport, it seems logical to consider installing dedicated facilities there for MIPB, although our lower-overhead Antwerp site also merits consideration. We should first determine justification vs. possible toll conversion. Justification may include credibility as a true local source in addition to economics. TXS volume is relatively small and probably should be supplied from the U.S. Blending in existing PCB equipment at Newport is probably feasible, but raises the same potential contamination problem as at Krummrich and should be similarly resolved. One alternate blending site would be an idle Pydraul blending unit at Antwerp.

4. Timing

European competitors are unlikely to abandon PCB's unless there is a governmental regulation to force the issue. European customers have done little testing of non-PCB fluids and G.E. has not released 1238 data to their licensees. For these reasons, we do not believe that Europe could be accelerated to the U.S. timetable by unilateral Monsanto action on PCB withdrawal without jeopardizing our ability to attain the preliminary sales forecast. Therefore, our timing considerations should be premised entirely on the rate of progress toward regulation by OECD.

PCB-ARCH0021357

II. B.3 - Capacitor Action Plan - (Events Chart - Europe)

TIMING	ACTIONS	DECISIONS/APPROVALS
Jan. '76		
Feb. '76	2/20 Recommendation on European approach to OECD March 15 meeting. 2/15 Complete Europe product evaluation plan.	2/28 Approval of European product evaluation plan.

II-16

0022192

PCB-ARCH0021358

TIMING	ACTIONS	DECISIONS/APPROVALS
Mar '76	3/7 Completed action for OECD March 15 meeting. 3/15 -Complete technical training of European personnel. -Support technical documentation. -Including 3 sets of slides of environmental presentation.	
Apr '75		

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PCB-ARCH0021359

TIMING		ACTIONS	DECISIONS/APPROVALS
May '76	5/1	Evaluation program agreed with 7 key capacitor producers.	
	5/12	Development forecast MCS 1238 requirements for Europe for balance 1976.	
June '76			

002194

PCB-ARCH0021360

TIMING		ACTIONS	DECISIONS/APPROVALS
July '76	7/1	Recommendation on USSR approach and required resources (and Rumania).	
	7/30	Environmental data presented to European Agencies.	
Aug. '76			

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PCB-ARCH0021361

TIMING		ACTIONS	DECISIONS/APPROVALS
Sept '76	9/1	Key customers have capacitors on test.	
Oct '76			

II-20

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PCB-ARCH0021362

TIMING	ACTIONS	DECISIONS/APPROVALS
Nov. '76		
Dec. '76	12/15 Complete evaluation of government attitudes towards PCB replacements.	

II-21

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PCB-ARCH0021363

TIMING	ACTIONS	DECISIONS/APPROVALS
Jan. '77	Report completed results and confirm schedules for capacitor trials.	
Feb. '77		

II-39

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PCB-ARCH0021364

TIMING	ACTIONS	DECISIONS/APPROVALS
Mar '77		
Apr '77		

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TIMING	ACTIONS	DECISIONS/APPROVALS
May '77		
June '77		

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PCB-ARCH0021366

TIMING		ACTIONS	DECISIONS/APPROVALS
July '77	7/1	Source evaluation complete for MIPB/TXS	
Aug. '77			

0022201

PCB-ARCH0021367

TIMING	ACTIONS	DECISIONS/APPROVALS
Sept. '77		
Oct. '77	10/1 Key Customer Commitment. 10/7 Volume forecast for Ex-U.S.A. sales.	

002202

PCB-ARCH0021368

TIMING	ACTIONS	DECISIONS/APPROVALS
Nov. '77		
Dec. '77		

II-77

002203

PCB-ARCH0021369

TIMING	ACTIONS	DECISIONS/APPROVALS
1st Qtr. '78	1/1 European inventory (3 mo. sales) in place.	1/1 AR approval for European blending plant
2nd Qtr. '78		

0022204

PCB-ARCH0021370

TIMING	ACTIONS	DECISIONS/APPROVALS
3rd Qtr. '78	7/1 Issue shutdown and decontamination plan for Newport PCB.	8/1 Approval of shutdown and decontamination plan.
4th Qtr. '78	12/31 Newport UK Aroclor production ceased.	

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PCB-ARCH0021371

TIMING	ACTIONS	DECISIONS/APPROVALS
1st Qtr. '79		
2nd Qtr. '79		

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PCB-ARCH0021372

TIMING	ACTIONS	DECISIONS/APPROVALS
3rd Qtr. '79		
4th Qtr. '79	10/1 Demonstrate blending plant at rated capacity.	

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TIMING	ACTIONS	DECISIONS/APPROVALS
1st Qtr. '80	1/1 Assume exclusive supply from European blending facility.	
2nd Qtr. '80		

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PCB-ARCH0021374

TIMING	ACTIONS	DECISIONS/APPROVALS
3rd Qtr. '80		
4th Qtr. '80		

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PCB-ARCH0021375

III. TRANSFORMER ACTION PLAN

PCB-ARCH0021376

III. Transformer Action Plan

A. Tactical Approach

1. The actions on the following pages are necessarily less detailed than those related to capacitors, since we are not certain that we have a viable product. We do have a candidate in a blend of MCS 1839, a highly alkylated biphenyl, with trichlorobenzene. The actions described are intended to bring us to go/no-go decisions at various steps toward commercialization; if the product survives them, it will be necessary to re-examine the plan and detail the further steps involved in justifying dedicated facilities.

2. One step in the plan is firm -- U.S. production of the present PCB-based transformer blends will cease essentially concurrently with PCBs for capacitors, whether a replacement has been qualified or not.

B. Trichlorobenzene Issue

1. The most serious obstacle to success of 1839 is that it has only exhibited the needed low-temperature viscosity when blended with trichlorobenzene (TCB). TCB has been used for the same purpose in blends with PCB for many years and also is widely used as an intermediate and a solvent. While TCB has not yet acquired any environmental notoriety, there is a good probability that it will do so in future years -- being a chlorinated aromatic, it may well exhibit biomagnification, persistence or other unfavorable characteristics.

2. The only U.S. source of electrical grade TCB is Hooker, who make it as a by-product of Lindane. They may not be ready to spend the effort and money needed to assess and defend its environmental acceptability.

3. We conclude that the current program should continue for the time being on the basis of blends with TCB, but before significant investment is made, a full resolution of the TCB issue is mandatory -- preferably by finding a non-chlorinated diluent.

C. Europe

No separate European Events Chart has been prepared. For now, the only appropriate plan is for periodic communication as to status, with more detailed plans firmed up when we conclude that we do have a viable product. Final shutdown of Newport askarel production will be determined by 8/1/77.

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III. D. Transformer Action Plan (Events Chart - Worldwide)

TIMING	ACTIONS	DECISIONS/APPROVALS
1st Qtr '76	2/76 Solicit customer information on materials compatibility 2/76 Obtain GE/Westinghouse agreement to model testing program 3/76 Identify site and rough economics of interim manufacture 3/76 Define fire test program	
2nd Qtr '76	4/76 Analyze research program for finding a replacement for TCB as a diluent 5/76 Conclusion on patentability 6/76 Begin 90 day feeding studies	4/76 Management decision to accept TCB or alternate diluent program or drop

002212

PCB-ARCH0021378

III. D. Transformer Action Plan (Events Chart - Worldwide)

TIMING		ACTIONS		DECISIONS/APPROVALS
3rd Qtr '76	7/76	AR grade estimate prepared for interim manufacture.		
	7/76	Obtain GE/Westinghouse results on transformer model test program.		
	9/76	Check 1839 blends against emergent fire safety standard.	9/76	Interim approval of EC 202 including resolution of TCB issue.
	9/76	Results for 90-day feeding studies.	9/76	Customer commitment to interim manufacture.
	9/76	AR grade forecast to R.E. Beal	9/76	Decide GO/NO GO on transformer program.
	9/76	Complete MCS 1866 Review Report.		
4th Qtr '76	10/76	AR for interim manufacture in existing facilities.		
	10/76	Begin 2-year feeding studies.	10/76	AR approval for interim manufacture.
	10/76	Initiate European planning process.		
	12/76	Alternate diluent found or search abandoned.		

III-3

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PCB-ARCH0021379

III-D Transformer Action Plan (Events Chart - Worldwide)

TIMING	ACTIONS	DECISIONS/APPROVALS
1st Qtr '77	1/77 Complete site study for economic evaluation for long-term manufacture	1/77 Site selected
2nd Qtr '77		
3rd Qtr '77		
4th Qtr '77	10/77 Begin interim manufacture 11/77 1-year results of 2-year feeding studies 12/77 PIR submission for permanent facilities	
1st Qtr '78		
2nd Qtr '78	AR submission for permanent facility	

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PCB-ARCH0021380

[illegible]

FROM J. J. Zeman - B2SK

DATE January 22, 1976

SUBJECT III. C. Transformer Action Plan
Retrofit Opportunity

TO R. G. Potter

As part of the PCB Task Force planning exercise, we considered the possible opportunity of undertaking a program to retrofit askarel containing transformers. This was a natural item to consider as part of our planning. After due consideration, the Task Force has decided and will recommend that Monsanto not enter into such a program.

The reasons for this are that such a program would greatly increase Monsanto's liability and exposure to PCB contamination in the environment. Also, part of the transformer retrofit would be the re-rating of the transformer and the issuing of a new warranty. This obviously has to be the responsibility of the transformer manufacturer.

The only area we have decided Monsanto should enter would be to supply the fluids used for retrofitting. We also have decided and recommended that we not be involved in the incineration of askarel fluids. This was decided because it would require large quantities of PCB containing materials being handled within a Monsanto site, which would make it difficult for Monsanto to meet any forthcoming PCB discharge standards.

Obviously this does not preclude some other technology for destruction of PCB's, only that technology that we now possess for incineration. Also, in the case of incineration it may require building a unit much larger than the one we now have at Krummrich and on the surface this does not look like a business Monsanto should be involved in.

In the area of developing fluids for transformer retrofitting, we should be very careful not to dilute our R&D manpower and detract from our replacement programs or our own internal decontamination requirements. Such a development effort should evolve from our own program for internal decontamination.

Unless you advise otherwise, we are proceeding with our planning accordingly. Attached for your information is a document we used for analyzing the retrofitting matter.

J. J. Zeman

/rd
Attachment

0022215

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PCB PLANNING TASK FORCE

TRANSFORMER FLUID RETROFIT OPPORTUNITY

There are some one hundred thousand askarel transformers in place in the United States containing a total of about three hundred million pounds of PCB base fluid. These transformers are valued at an estimated one billion dollars. Seventy percent of them are less than ten years old. Top up for these transformers represents about one million pounds per year of fluid. Replacement over ten years would represent a demand of thirty million pounds per year of dielectric fluid plus whatever flushing medium is needed.

If there is some broad national program to drain the PCB base fluids out of these transformers, and if Monsanto has a PCB replacement fluid program for new transformers, what should Monsanto's role be regarding the retrofit opportunity?

1. No participation;
2. Sell fluid to transformer manufacturers;
3. Sell fluid to transformer users;
4. Dispose of the PCB's if they are drained;
5. Involve in a service of retrofit?

These and other postures are possible. The following outlines the issues to be resolved to answer this question.

Product

1. Do we have a proved, environmentally qualified transformer fluid? Accepted as fire resistant by FM?

2. Is it compatible with askarel transformer (design insulation, sealants, etc.)? Some or all transformer models?

3. Is it suitable for top up in askarel transformers?

4. If not, is it suitable after a reasonable drain and flush procedure?

5. What would the flush fluid be?

6. How does our fluid compare to potential competition?

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Market Volume and Timing

1. Where are these (domestic) transformers? Type, size, user, location, age, fluid fill.

2. What is the total quantity of askarel in them?

3. What volume of fluid would be needed for top up or flush and replace? When?

4. What pressures or legislation are state and federal agencies likely to impose?

Procedure

1. Will transformer users have to dispose of their askarel because of a law or because of unavailability of a compatible top up fluid?

2. Will replacement fluids allow top up; or drain, flush and fill?

3. If top up, who supplies the fluid and instructions for retrofit to the transformer user:

   - transformer manufacturers (including Allis Chalmers and others who once made them),
   - fluid manufacturer or
   - service companies.

4. If drain, flush and replace, who performs the service?

5. What roles do the transformer manufacturers want to play?

Incineration

1. What incineration load will result? Volume, timing, storage.

2. What incineration capacity is needed in what locations? What is available (Monsanto, G.E., others)? How will capacity be increased sufficiently?

Manufacturing

1. How will we manufacture/purchase the needed volumes of flushing and replacement fluids?

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Law

1. Who is responsible for performance of each transformer retrofitted?

2. Who will be responsible for PCB entering the ecology during draining, flushing, transportation, storage and incineration of askarels?

Public Relations

1. What would be the risks to Monsanto's image if we were to handle and transport PCB's and concentrate volumes at incineration sites?

Economics

1. Sales of fluids for retrofit programs?

   Profit opportunity.

   New capital required.

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PCB-ARCH0021384

IV. IMPACT ON
RELATED BUSINESS

IV. Impact on Related Business

A.1 Economic Dependence - U.S.

While various other products have been developed using polyphenyls, Aroclor remains the dominant outlet in both pounds and dollars -- 50% of budgeted Anniston polyphenyl production for 1976 is biphenyl for Aroclor. Because we have dropped non-electrical uses of Aroclors, including all solid Aroclors (chlorinated terphenyl) in recent years, we already have twice the capacity needed. Total loss of dielectrics would reduce requirements to less than 25% of capacity. A "domino effect" would then begin, because the next largest volume, Santosol 340 (hydrogenated terphenyl), would no longer be cost competitive, and the remaining products including the now-profitable Therminol 66 could not support the investment.

Since MIPB is a biphenyl derivative and is functionally at least as good as other candidate hydrocarbons, it was chosen for the MCS 1238 blend. MCS 1238 relates only to the capacitor business, and our transformer candidate uses relatively little biphenyl, so the other derivatives will suffer somewhat even if the replacement program is completely successful.

Table I shows the impact of dielectrics on the flow sheet (based on volumes in the 10/31 Production Plan).

Use of biphenyl in dielectrics is not the only way to maintain a viable flow sheet, of course. Any profitable large volume use of either biphenyl or quaterphenyl would have the same therapeutic effect. Terphenyl volume would be less advantageous, due to flow sheet balance considerations. A quaterphenyl outlet must be profitable on a fully-costed basis, rather than the by-product accounting currently practiced.

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TABLE I

	Present Business	No Dielectrics	No Aroclor, 8M lbs., MCS 1238	No Aroclor 20M# MCS 1238
Aroclor/Pyranol Sales, M Lbs.	33,800	-0-	-0-	-0-
Santosol 340/Therminol 66, etc., Sales M Lbs.	14,450	14,450	14,450	14,450
MCS 1238 Sales, M Lbs.	200	-0-	8,000	20,000
Misc. Derivatives & Sales per se, M Lbs.	5,300	5,300	5,300	5,300
Total Polyphenyl Requirements, M Lbs.	37,200	18,600	23,200	30,300
Unit Cost, ¢/Lb.				
Biphenyl	19.2	27.3	24.0	20.8
Santosol 340, Therminol 66	23.6	33.1	29.5	25.7

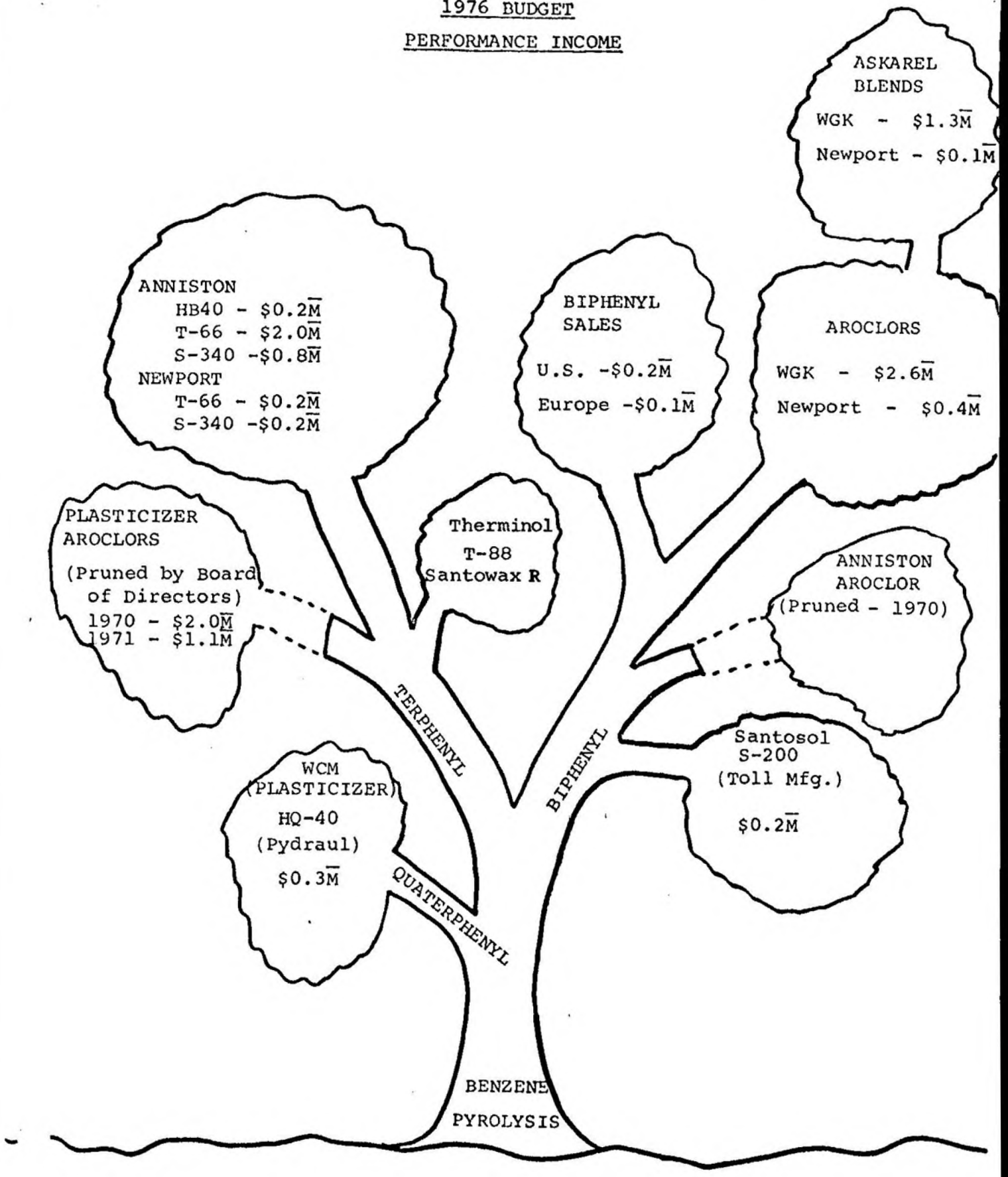
IV-2

1222200

PCB-ARCH0021387

1976 BUDGET

PERFORMANCE INCOME



P O L Y P H E N Y L T R E E

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PCB-ARCH0021388

IV. Impact on Related Business

A.2 Economic Dependence - Europe

PCB's represent only 26% of our European polyphenyl output, but 54% of sales revenue. Immediate loss of PCB's would put the complex at a negative performance income, but there are more options available to correct the problem than in the U.S. In addition to the therapeutic effect of a successful MCS 1238 program, the following actions can be taken:

1. Increase merchant biphenyl volume.

2. Increase capacity for hydrogenation of terphenyl for Santosol 340 and/or Santotherm 66, either by debottlenecking from 1500 to 2000 tons/year or by a major expansion to 5000 tons/year, depending on the degree of customer commitment to the products. While these actions would have a negative effect on U.S. economics (by replacing U.S. exports) the worldwide effect would be positive because of the more favorable flowsheet balance in Europe, and reductions of freight and tariff.

3. Europe can also follow any U.S. lead on new polyphenyl derivatives.

Impact of MCS 1238 on our European business is illustrated in Table II (using a 2000 ton/year volume of hydrogenated terphenyl in 1978 as an example).

Except for the "1976 Budget" column, these figures are very rough and are only intended to indicate direction. More detailed analysis is to be completed during 1977. This study must answer the question of interdependence of the MCS 1238 program and a major HB-40 expansion.

TABLE II

	1976 Budget with PCBs	1976 Without Dielectrics	1978 Without Dielectrics	1978 with 2600T MCS 1238
Sales Revenue $M	$ 5920	2705	4320	8740
Gross Profit $M	1510	459	1070	2557
%	25%	17%	25%	29%
Performance Income	916	(97)	519	1563
% on Gross Inv.	18%	(3%)	15%	29%

IV-5

022224

PCB-ARCH0021390

V. APPENDIX

PCB-ARCH0021391

V. Appendix

A. Potential Problem Analysis - Capacitors

The Task Force applied the Kepner-Tregoe type of analysis to our capacitor program to identify potential problems and determine preventive and contingency actions for those problems with a significant probability. The more significant of the preventive actions have been inserted in the Events Chart. The following is a Summary of the exercise.

Potential Problem:

Adverse medical information is received:

1. Legitimate adverse data from our own or outside studies.

2. Ill-founded accusations from environmentalists or competitors.

3. Inconclusive data after 2-year program.

Preventive Actions:

1. Publish our testing procedures and interim results (with appropriate disclaimer). Review progress with government agencies periodically.

2. Ensure that our own program is complete and timely; be ready with facts to refute accusations.

Contingency Actions:

1. PCB equipment should not be dismantled prematurely.

2. If competent adverse data is received:

   a. Recycle through EC 202 procedure and withdraw 1238 if "no go".

   b. Re-assess the dielectrics business.

   c. Consider extended timing if no viable competitor has emerged.

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PCB-ARCH0021392

Potential Problem:

Viable competition emerges to reduce our market share to an unacceptable level.

1. Dow fluid succeeds in power capacitors, perhaps with a sulfone boost.

2. Small capacitors switch to phthalates and/or "dry" technology.

Preventive Actions:

1. Consider further patent activities to block use of sulfones by others.

2. Tout the absence of halogen in 1238, look for weaknesses in competitive fluids.

3. Meet competitive prices on a cost/performance basis.

4. Begin aggressive promotion of 1238 as the PCB replacement during 2nd Quarter 1976 to preempt emergence of other competitors after 9/1/76 issuance of testing protocol.

5. Seek contractual commitments from major customers.

Contingency Actions:

1. If market share is clearly lost and competition has no serious weakness, re-assess continuing in the dielectrics business.

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PCB-ARCH0021393

Potential Problem:

Loss of G.E. support.

1. Due to pricing or timing of our capital commitment.

2. Due to more attractive alternatives.

3. Due to failure of 1238 in performance or environmental acceptability.

Preventive Actions:

1. Price 1238 at its proper level considering performance vs. potential competition.

2. Maintain Management contact with G.E. at all relevant levels.

3. Continue the Monsanto/G.E. Research Agreement.

4. Find an approach that would permit G.E. to continue to enjoy Magvar license revenue.

5. Move aggressively to permit G.E. to exploit their inherent technical leadership.

Contingency Actions:

1. Remain flexible on market needs for pricing and timing.

2. Possibly consider G.E. share in 1238 investment.

Potential Problem:

Continuing unacceptable PCB contamination from WGK interim blending.

Preventive Actions:

1. Seek acceptance of a definition of "acceptable" that is not zero.

2. Seek acceptance of expected contamination level of first batches.

3. Consider sites other than WGK.

4. Do the best possible cleanout job.

   a. Test procedure beforehand.

Contingency Actions:

1. Suspend production and re-assess situation.

2. Consider crash project at another site.

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PCB-ARCH0021395

Potential Problem:

Toll manufacture proves unreliable.

1. Meeting volume requirements on time.
2. Quality control.
3. Yield/cost control.
4. Force majeure event.
5. Security - confidential information, sales to competitors.

Preventive Actions:

1. Execute well-drawn secrecy agreements and contracts.
2. Inspect facilities re safety, OSHA and environmental control, and overall competence before signing contracts. Provide continuing technical support and surveillance.
3. Consider earlier manufacture "inside".
4. Carry engineering forward on "inside" manufacture to be ready for a potential crash project.

Contingency Actions:

1. Purchase MIPB from e.g. Tanatex.
2. Accelerate program for self-manufacture.

POTENTIAL PROBLEM ANALYSIS WORK SHEETS TRANSCRIPT

*Indicates most significant problems

(1) (Irreversible)

Choice of 1238

* - Adverse Med. Data (outside/inside)

- MIPB
- TXS

} Degrees

- Appearance of Superior (sooner) Comp.

* - Too many sources (M/I Problem)

} Someone avoids patent

- R.M. Supply Deficiency
- R.M. Quality Deficiency
+ Best anyone knows of.
+ No Chlorine
- Dry capacitors prove more cost/eff.
- Timing -- we let it slide ⟶ 1016 accepted

* - Loss of G.E. support (for 1238)

- Pricing
- Alternatives
- Function
- Timing

- Demand for fire resistance

(?) Research Supply -- until interim S/U

- Violating Rule -- get dictate
- Demand > Supply
  - Possible rapid escalation
- R.M. Quality/Availability - MIPB
  TXS

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(3) Interim Blending/Toll MIPB & TXS

* - Unacceptable PCB Contamination

* - Dependence on toll manufacture

- limited support resources } Force majeure items
- accident - strike
- loss of tech/security

- create MIPB capacity Ex 'M'

- Soon enough
  - contract signing delayed
  - WGK Construction
  - Emergency need (ban)
- Supply to meet specs
  - D.K.
  - Moisture
  - Biphenyl
- Can't get customer commitment - support contracts

+ Better site
  - No contamination
  -Sooner/Cheaper

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(4) Pricing (Economics)

- Adverse G.E. reaction

  - other

- Ultimate economics don't support pricing (Repl. cap.)

+ Better price/perf. than competitive

- Price too high vs. competitive

  - Dichlor Biphenyl in Europe

(5) Cease PCB by 1/1/78

± Gov't safety decree

  - image/publicity

- Customer suit

- Customers not ready to change

- Transformer PGM drags

(6) Activities leading to self manufacture of TXS & MIPB timed to delay capital commitment until after 2-year medical data available. PIR 6/77; A.R. 12/77

+ Don't need (already in business).

- Mgmt rejects PIR (Risk).

- Delay in medical program

  - Inconclusive result

- Outside accusation re 1238.

  - Synergistic environmental effect

OVERALL PLAN - Dielectrics Business

- Veto by Management

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PCB-ARCH0021399

A. Adverse Medical Data - MIPB or TXS or Blend

- Inside --- clearly bad
  inconclusive 6/77
- Outside --- competent
  hysterical

- Preventive Actions
  - Publish procedures & results (with disclaimer).
    - Review with government as we progress.
  - Influence committee (R. Train/Industry Committee) protocol 9/76.
  - Be sure our program is complete.
    - Content & timing.
  - Ask NCR for MIPB data (if any) (after announcing 1238 compositions).

- Contingency Actions
  - Don't prematurely dismantle PCB equipment.
  - If competent adverse data
    - re-assess dielectrics business;
    - ask for time if no competitor has achieved credibility;
    - if one component only is implicated, consider replacing.

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B. M/I not adequate -- competitor(s) prove viable.

- Dow fluid gets power capacitors (with TXS?).
- Small ones go to DOP/DINP or Dry-type.

Preventive Actions

- Further patent action (?).
- Tout "non-halogenated" property of 1238.
- Looking for weakness in Dow fluid.
- Price consistent with performance.
- Begin aggressive promotion of 1238 as a PCB replacement during 2nd Quarter 1976.
- Alliance with G.E. (see item C).
- Contracts

Contingency Actions

- Re-assess dielectrics business.

C. Loss of G.E. Support

- Pricing
- Alternatives
- Functionality
- Timing of interim vs. long-term pricing

Preventive Actions

- Price consistent with performance.
- Maintain contacts at all relevant levels.
- Continue research agreements.
- Find support for continued Magvar licensing.
- Emphasize retention of lead time.

Contingency Actions

- Flexibility -- in pricing, timing, shared venture

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D. Continuing unacceptable PCB contamination of product from "interim" blending.

Preventive Actions

- Define acceptable level > 0
- Go elsewhere than WGK (Everett)
- Do good job on cleanup
  - Testing of Procedure
- Acceptance of expected level.

Contingency Actions

- Suspend production & re-assess.

E. Toll manufacture proves unreliable

- Meeting volume requirements on time
- Quality
- Yield/cost
- Force Majeure event
- Secrecy/technology/capability

Preventive Actions

- Good contracts/secrecy agreements
- Manufacture inside
- Provide technical/supervisor support
  - Monitor operation
- Develop engineering for inhouse manufacture (be ready).

Contingency Actions

- Accelerate self-manufacture
- Buy MIPB

V.2 - Appendix

CHART 1

CAPACITOR DIELECTRIC FLUID POTENTIAL

(AS $\bar{M}$ LBS. AROCLOR)

WORLD AREA	CURRENT M/I %	'74	'75	'76	'77	'78	'79	'80
U.S.A.	100	22	13	16	17	18	19	20
West Europe	25	15	12	15	15	15	15	15
East Europe	40-50	6	5	5	5	6	6	6
ROW	50	7	7	7	7	8	9	9
TOTAL	58	50	37	43	46	47	49	50

Note 1: Japan uses approx. 8-10 $\bar{M}$ lbs. per year of non-PCB capacitor dielectrics having banned PCB in 1972.

Note 2: Monsanto non-PCB candidate MCS-1238 will have usage of .75 lbs. for each 1 lb. of Aroclor replaced because of difference in specific gravity.

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PCB-ARCH0021403

V.3 - Appendix

CHART 2

MONSANTO CAPACITOR FLUIDS SALES FORECAST

a) MCS-1238 Sales From U.S.A. ($\overline{M}$ Lbs.)

	Domestic	U.S. Export (excl. Europe)	Europe	Total
1976	1.3	-	-	1.3
1977	9.3	1.5	0.2	11.0
1978	13.5	2.0	1.0	16.5
1979	14.0	2.5	3.0	19.5
1980	14.5	3.0	-	17.5
1985	16.0	3.5	-	19.5

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b) MCS-1238 Sales From U.K.

1976	-	-	-	-
1977	-	-	-	-
1978	-	-	-	-
1979	-	-	-	-
1980	-	-	3.0	3.0
1985	-	-	4.0	4.0

c) Aroclor Sales

	Domestic	U.S. Export	U.K. Produced	Total
1976	14.6	2.8	5.9	23.2
1977	5.2	1.0	6.0	12.2
1978	-	-	4.0	4.0
1979	-	-	-	-
1980	-	-	-	-
1985	-	-	-	-

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PCB-ARCH0021404

V.4 - Appendix

CHART 3

TRANSFORMER FLUID MARKET ($\bar{M}$ LBS. EXPRESSED AS AROCLOR/TCB BLEND)

WORLD AREA	M/I %	'74	'75	'76	'77	'78	'79	'80	'85
U.S.A.	100	14	14.5	10	5	12	14	15	18
West Europe	7-10	30	31.5	33	35	37	38	40	51
Canada	100	3	3	3	3	3	3	3	3
Miscellaneous	25	4	4	4	4	4	4	4	4
TOTAL	42	51	53	50	47	56	59	62	76

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V.5[1] Appendix

CAPACITOR FLUID SALES (U.S. Produced)

CHART 4a

	DOMESTIC				EXPORT				TOTAL D & E		
	SALES		GROSS		SALES		GROSS		SALES		GROSS
	M Lbs	$M	Profit	%	M Lbs	$M	Profit	%	M Lbs	$M	Profit
1970	27583	3872	1725	44	4717	699	255	36	32300	4571	1980
1971	17369	2748	978	35	3288	485	118	24	20657	3233	1096
1972	22654	4271	2108	49	3069	517	139	27	25723	4788	2247
1973	37742	7756	2259	29	4333	837	276	33	42075	8593	2535
1974	22098	6731	2753	40	2483	720	264	37	24581	7451	3017
1975	13468	5092	1957	38	2270	968	332	34	15738	6060	2289

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CAPACITOR FLUID SALES (U.K. Produced)

CHART 4b

Year	Sales M Lbs.	Sales $M	G.P. $M	G.P. %
1972	7142	1172	336	29
1973	7288	1437	403	28
1974	7861	2440	546	22
1975	5471	2168	362	17
1976E	5861	2383	636	27

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V.6[1] - Appendix

TRANSFORMER FLUID SALES (U.S. PRODUCED) CHART 5a

	DOMESTIC				EXPORT				TOTAL D & E		
	SALES		GROSS		SALES		GROSS		SALES		GROSS
	M Lbs	$M	PROFIT	%	M Lbs	$M	PROFIT	%	M Lbs	$M	PROFIT
1970	15902	2494	956	38	5454	853	259	30	21356	3347	1215
1971	14007	2571	879	34	5383	926	262	28	19390	3497	1141
1972	11384	2378	825	34	3673	686	172	25	15057	3064	997
1973	13415	2751	864	31	4014	802	202	25	17429	3553	1066
1974	13870	4522	1516	34	4093	1290	333	26	17963	5812	1849
1975	14202	5884	2326	40	4454	1791	532	30	18656	7675	2858

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V.6[2] - Appendix

TRANSFORMER FLUID SALES (U.K. Produced)

CHART 5b

Year	Sales M Lbs.	Sales $M	G.P. $M	G.P. %
1972	3193	643	166	26
1973	2518	546	139	25
1974	3422	1007	204	20
1975	2646	986	171	17
1976B	2205	832	215	26

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V. 7. Appendix - Toxicological Program

Study	Project #	Material (MCS #)	Projected Completion Date	Estimated Cost 1/76 Initiation	Estimated Cost 1/77 Initiation
Chick edema factor bioassay	BTL-76-4	1238	2/76	1000	
8-day LC 50 Bobwhite quail	TF-76-1	1045	3/76	750	
" " " " "	TF-76-2	1302	3/76	750	
" " " " "	TF-76-3	1238	3/76	750	
8-day LC 50 Mallard ducks	TF-76-1	1045	3/76	750	
" " " " "	TF-76-2	1302	3/76	750	
" " " " "	TF-76-3	1238	3/76	750	
Microbial mutagentic plate assay	BIO-76-5	1045	3/76	300	
" " " " " "	BIO-76-6	1302	3/76	250	
" " " " " "	BIO-76-7	1238	3/76	250	
Mouse Lymphoma mutagenicity	BIO-76-8	1238	3/76	2200	
Rat teratogenicity*	BTL-76-9	1238	3/76	4000	
Human skin patch test	SH-75-21	1045	3/76	900	
" " " "	SH-75-22	1302	3/76	900	
4-wk. Inhalation study	BTL-75-54	1045	4/76	5100 (pd.)	
" " " "	BTL-75-52	1302	4/76	5100 (pd.)	
^{14}C Metabolism Rat		1045	6/76*	7500	
" " " "		1302	6/76*	7500	
90-day Rat feeding		1045	Completed		
" " " "	BTL-76-10	1302	7/76	7500	
" " " "		1238	7/76	Part of 2-yr study	
^{14}C Fish Residue		1045	7/76*	10000	
" " "		1302	7/76*	10000	
Human skin patch test		1238	3/77		1000
6-month inhalation		1045	1/78		70000
" " "		1302	1/78		70000
2-yr. rat feeding	BTL-75-87	1045	4/78	24000 (12,000 pd.)	
" " "	BTL-75-85	1302	4/78	24000 (12,000 pd.)	
" " "		1238	7/78	75000	
96-hr. LC 50 Trout & Bluegill	BN-76-11	1045		680	
" " " " "	BN-76-12	1302		680	
" " " " "	BN-75-13	1238		680	

*Requires ^{14}C-labeled materials available 3/1/76.
Approximate cost $200,000 for MCS 1238 only.

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PCB-ARCH0021410

HEALTH & ENVIRONMENTAL ASSESSMENT MCS 1238

- Available data on
  Isopropyl Biphenyl
  Tolyl Xylyl Sulfone
  MCS 1238
- Outline of the test underway
- Bioaccumulation data
- Metabolism data
- Biodegradation data

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PCB-ARCH0021411

RAT ACUTE ORAL TOXICITY

Signal Word	LD_{50} g/kg	Category	IPB	TXS	MCS 1238
Danger	< .05	Highly Toxic	—	—	—
Warning	.05-.5	Moderately Toxic	—	—	—
Caution	.5-5	Slightly Toxic	5.0	—	3.8
—	>5	Practically Non-Toxic	—	7.6	—

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PCB-ARCH0021412

RABBIT ACUTE DERMAL TOXICITY

Signal Word	LD_{50} mg/kg	Category	IPB	TXS	MCS 1238
Danger	<.2	Highly Toxic	—	—	—
Warning	.2-1	Moderately Toxic	—	—	—
Caution	1-5	Slightly Toxic	—	—	—
—	>5	Practically Non-Toxic	>10.2	>7.9	>5.0

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PCB-ARCH0021413

SUBACUTE MAMMALIAN TOXICITY
90-DAY RAT FEEDING STUDIES

IPB

Dietary
Concentrations: 0, 100, 300 and 1000 ppm
Parameters Evaluated:

- Behavioral activity
- Food consumption
- Body weight
- Hematology
- Clinical chemistry
- Organ weights
- Gross pathology
- Histopathology

No Adverse Effect Level: 1000 ppm

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PCB-ARCH0021414

SUBACUTE MAMMALIAN TOXICITY
90-DAY RAT FEEDING STUDIES

TXS

Dietary
Concentrations: 0, 1000, 3000 and 10,000 ppm
Completion 7/76

MCS 1238

Dietary
Concentrations: 0, 100, 300 and 1000 ppm
Completion 7/76

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PCB-ARCH0021415

MCS 1238
ACUTE MAMMALIAN TOXICITY

Acute Oral LD_{50} Rats	3.8 g/kg Slightly toxic
Acute Dermal LD_{50} Rabbits	>5.0 g/kg Practically non-toxic
Skin Irritation Rabbits	3.6/8.0 Moderate irritant
Eye Irritation Rabbits	12/110 Slight irritant

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PCB-ARCH0021416

SKIN SENSITIZATION

Human Skin Patch Test, Repeated Application

Number	IPB	TXS
• Of Subjects	50	50
• With Irritation	0	0
• With Skin Fatigue	0	0
• Sensitized		

Completion 3/76

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PCB-ARCH0021417

SUBACUTE MAMMALIAN TOXICITY
4-WEEK INHALATION STUDIES

Vapor Concentration
6 hours/day—5 days/week
(mg/cubic meter)

IPB. . . . . 0, 10 and 100
TXS. . . . . 0, 10 and 100

Parameters Evaluated

- Behavioral activity
- Respiratory response
- Gross pathology
- Histopathology

Completion 4/76

V-27

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PCB-ARCH0021418

CHRONIC MAMMALIAN TOXICITY
TWO-YEAR RAT FEEDING STUDIES

Dietary Concentrations (PPM)

IPB..... **0, 500 and 1000**
TXS..... **0, 1000 and 3000**
MCS 1238..... **0, 100, 300 and 1000**

Parameters Evaluated:

- **Chronic Toxicology**
- **Oncology**

Completion 7/78

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PCB-ARCH0021419

ACUTE AVIAN TOXICITY
8-day LC_{50} PPM

	IPB	TXS	MCS 1238
Bobwhite Quail..	>10,000	>10,000	>10,000
Mallard Ducks...	>10,000	>10,000	>10,000

Practically Non-Toxic = >5000 ppm
Slightly Toxic = 500 to 5000 ppm

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PCB-ARCH0021420

ACUTE FISH TOXICITY
96-Hour LC_{50} PPM

	IPB	TXS	MCS 1238
Bluegills.....	5	8	11
Rainbow Trout.....	10-100	8	8

Slightly Toxic = 10 to 100 ppm
Moderately Toxic = 1 to 10 ppm
Highly Toxic = < 1 ppm

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PCB-ARCH0021421

BIOACCUMULATION IN MAMMALS (RATS)

- 25 PPM DIELECTRIC FLUID IN DIET
- 30 DAY EXPOSURE, 75 DAY RECOVERY
- FAT SAMPLES COMPOSITED PERIODICALLY
- EXTRACTED, ISOLATED AND ANALYZED

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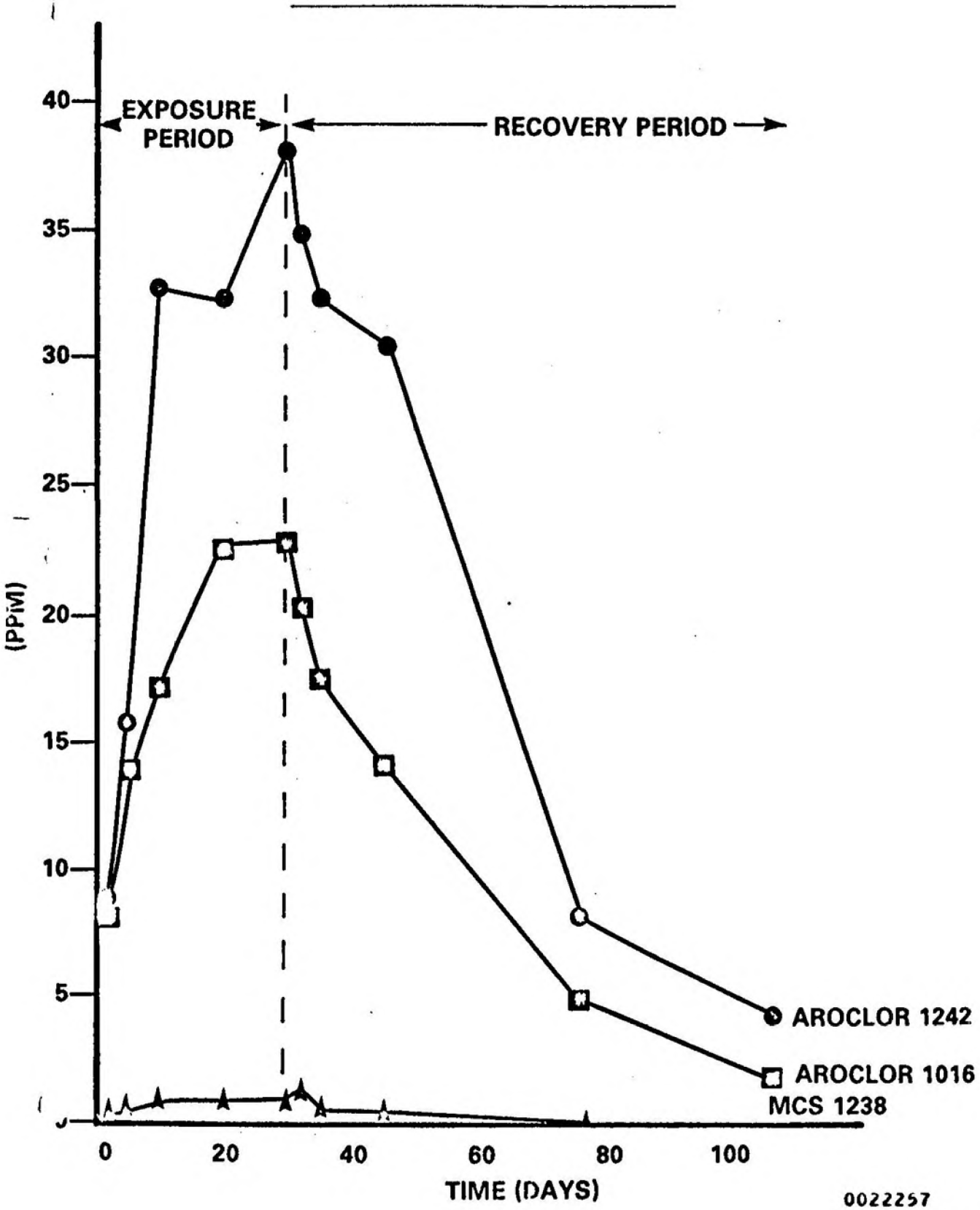
FAT TISSUE RESIDUE LEVEL VS. TIME

25 PPM FEED LEVEL FOR RATS



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DIELECTRIC FLUID ACCUMULATION FACTORS

FLUID	ACCUMULATION FACTOR*
MCS 1238	0.04
AROCLOR 1016	0.9
AROCLOR 1242	1.4

*ACCUMULATION FACTOR = (TISSUE CONCENTRATION/ FEED CONCENTRATION) AFTER 30 DAYS

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PCB-ARCH0021424

BIOCONCENTRATION POTENTIAL

- EQUILIBRATE FLUID BETWEEN WATER AND 1-OCTANOL
- DETERMINE CONCENTRATION IN EACH PHASE
- CALCULATE PARTITION COEFFICIENT (C_O/C_W)
- ESTIMATE BIOCONCENTRATION FACTOR

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PCB-ARCH0021425

PARTITION COEFFICIENTS (LOGARITHMS)

PRODUCT	LITERATURE	CALCULATED	EXPERIMENTAL
BIPHENYL	4.1		4.1
DIPHENYL SULFONE	2.4		2.5
ISOPROPYL BIPHENYL		5.6	5.5
TOLYLXYLYL SULFONE		4.1	3.9
MCS 1238		4.7	4.5

PCB-ARCH0021426

BIOCONCENTRATION FACTORS (BF)

LOG (BF) = 0.54 LOG (P) + 0.12

PRODUCT	LOG P	BF
BIPHENYL	4.1	200
ISOPROPYL BIPHENYL	5.5	1200
TOLYLXYLYL SULFONE	3.9	160
MCS 1238	4.5	400
TRICHLOROBIPHENYL	6.2*	3200
TETRACHLOROBIPHENYL	6.9*	6300

*CALCULATED

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FUTURE BIOACCUMULATION STUDIES

- C^{14} METABOLISM IN RATS
- C^{14} BIOCONCENTRATION IN FISH

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BIODEGRADATION

- MICROBIAL ORGANISMS – NATURALLY OCCURRING
- ULTIMATE – CO_2,H_2O, INORGANIC SALTS
- PRIMARY – DISAPPEARANCE OF TEST MATERIAL

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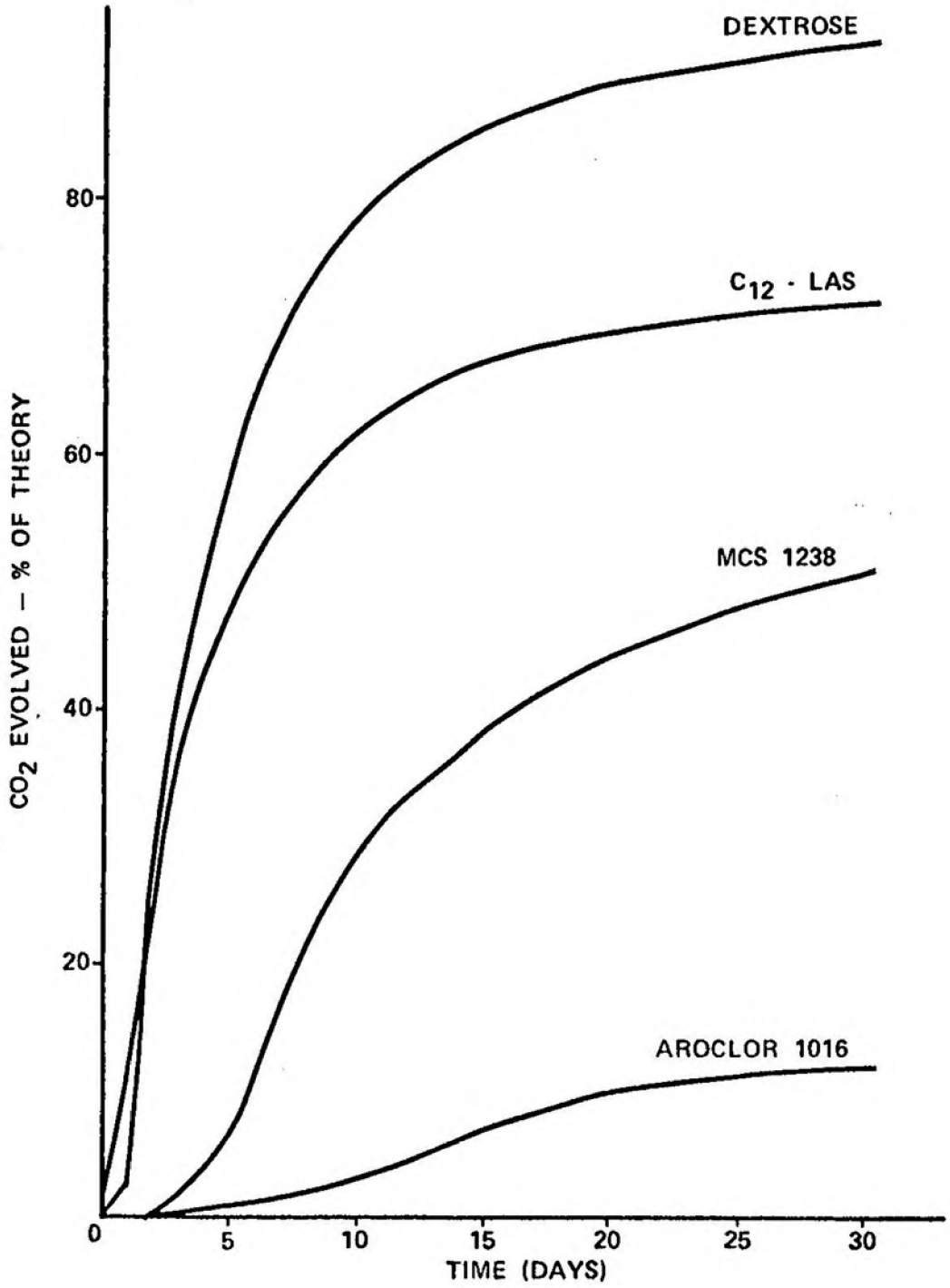
ULTIMATE BIODEGRADATION



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ULTIMATE BIODEGRADABILITY

CO_2 EVOLVED IN 35 DAYS

PRODUCT	PER CENT OF THEORY
MCS 1238	52
AROCLOR 1016	11
DEXTROSE	80-90
C_{12} LINEAR ALKYLBENZENE SULFONATE	60-80

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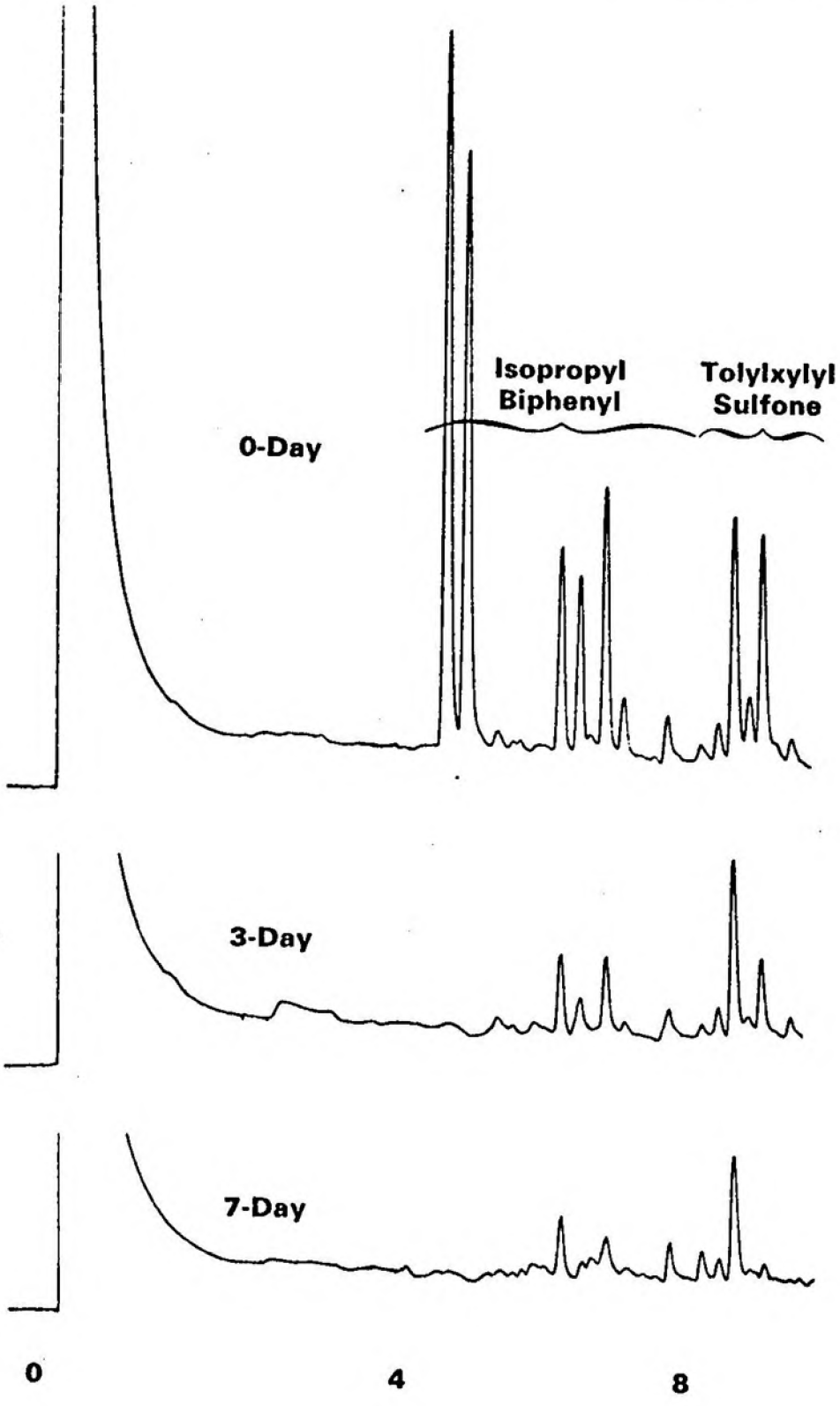
PRIMARY BIODEGRADATION OF MCS 1238



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PRIMARY BIODEGRADABILITY

	PER CENT BIODEGRADATION	
	1-DAY	7-DAY
MCS 1238	62	87
ISOPROPYL BIPHENYL	78	95
TOLYLXYLYL SULFONE	32	69

FUTURE BIODEGRADATION STUDIES

- C^{14} BIODEGRADATION IN SOIL
- C^{14} BIODEGRADATION IN RIVER WATER

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PCB-ARCH0021434

MCS 1839
HEALTH AND ENVIRONMENTAL PROGRAM

- 8-day LC_{50} Bobwhite Quail
- 8-day LC_{50} Mallard Ducks
- Microbial mutagenic plate assay
- Mouse lymphoma mutagenicity
- Rat teratogenicity
- Human skin patch test
- 4-week Inhalation study
- 6-month Inhalation study
- 90-day Rat feeding
- 2-year Rat feeding (screen)
- Chronic fish toxicity/reproduction
- Tissue residue accumulation
  - ^{14}C Metabolism—Rats
  - ^{14}C Fish residue

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PCB-ARCH0021435

MCS 1839
ACUTE MAMMALIAN TOXICITY

Acute Oral LD_{50}	>15.8 g/kg
Rats	Practically Non-toxic
Acute Dermal LD_{50}	> 7.9 g/kg
Rabbits	Practically Non-toxic
Skin Irritation	0/8
Rabbits	Non-Irritating
Eye Irritation	0/110
Rabbits	Non-Irritating

V-46

002270

PCB-ARCH0021436

Monsanto

FROM (NAME & LOCATION) J. J. Zeman -- B2SK

DATE January 22, 1976

SUBJECT V-10. Retrofit Opportunity

REFERENCE

TO : R. G. Potter

As part of the PCB Task Force planning exercise, we considered the possible opportunity of undertaking a program to retrofit askarel containing transformers. This was a natural item to consider as part of our planning. After due consideration, the Task Force has decided and will recommend that Monsanto not enter into such a program.

The reasons for this are that such a program would greatly increase Monsanto's liability and exposure to PCB contamination in the environment. Also, part of the transformer retrofit would be the re-rating of the transformer and the issuing of a new warranty. This obviously has to be the responsibility of the transformer manufacturer.

The only area we have decided Monsanto should enter would be to supply the fluids used for retrofitting. We also have decided and recommended that we not be involved in the incineration of askarel fluids. This was decided because it would require large quantities of PCB containing materials being handled within a Monsanto site, which would make it difficult for Monsanto to meet any forthcoming PCB discharge standards.

Obviously this does not preclude some other technology for destruction of PCB's, only that technology that we now possess for incineration. Also, in the case of incineration it may require building a unit much larger than the one we now have at Krummrich and on the surface this does not look like a business Monsanto should be involved in.

In the area of developing fluids for transformer retrofitting, we should be very careful not to dilute our R&D manpower and detract from our replacement programs or our own internal decontamination requirements. Such a development effort should evolve from our own program for internal decontamination.

Unless you advise otherwise, we are proceeding with our planning accordingly. Attached for your information is a document we used for analyzing the retrofitting matter.

J. J. Zeman

/rd
Attachment

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V-10. Retrofit Opportunity

PCB PLANNING TASK FORCE

TRANSFORMER FLUID RETROFIT OPPORTUNITY

There are some one hundred thousand askarel transformers in place in the United States containing a total of about three hundred million pounds of PCB base fluid. These transformers are valued at an estimated one billion dollars. Seventy percent of them are less than ten years old. Top up for these transformers represents about one million pounds per year of fluid. Replacement over ten years would represent a demand of thirty million pounds per year of dielectric fluid plus whatever flushing medium is needed.

If there is some broad national program to drain the PCB base fluids out of these transformers, and if Monsanto has a PCB replacement fluid program for new transformers, what should Monsanto's role be regarding the retrofit opportunity?

1. No participation;
2. Sell fluid to transformer manufacturers;
3. Sell fluid to transformer users;
4. Dispose of the PCB's if they are drained;
5. Involve in a service of retrofit?

These and other postures are possible. The following outlines the issues to be resolved to answer this question.

Product

1. Do we have a proved, environmentally qualified transformer fluid? Accepted as fire resistant by FM?

2. Is it compatible with askarel transformer (design insulation, sealants, etc.)? Some or all transformer models?

3. Is it suitable for top up in askarel transformers?

4. If not, is it suitable after a reasonable drain and flush procedure?

5. What would the flush fluid be?

6. How does our fluid compare to potential competition?

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Market Volume and Timing

1. Where are these (domestic) transformers? Type, size, user, location, age, fluid fill.

2. What is the total quantity of askarel in them?

3. What volume of fluid would be needed for top up or flush and replace? When?

4. What pressures or legislation are state and federal agencies likely to impose?

Procedure

1. Will transformer users have to dispose of their askarel because of a law or because of unavailability of a compatible top up fluid?

2. Will replacement fluids allow top up; or drain, flush and fill?

3. If top up, who supplies the fluid and instructions for retrofit to the transformer user:

   - transformer manufacturers (including Allis Chalmers and others who once made them),
   - fluid manufacturer or
   - service companies.

4. If drain, flush and replace, who performs the service?

5. What roles do the transformer manufacturers want to play?

Incineration

1. What incineration load will result? Volume, timing, storage.

2. What incineration capacity is needed in what locations? What is available (Monsanto, G.E., others)? How will capacity be increased sufficiently?

Manufacturing

1. How will we manufacture/purchase the needed volumes of flushing and replacement fluids?

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V-10. Retrofit Opportunity

Law

1. Who is responsible for performance of each transformer retrofitted?

2. Who will be responsible for PCB entering the ecology during draining, flushing, transportation, storage and incineration of askarels?

Public Relations

1. What would be the risks to Monsanto's image if we were to handle and transport PCB's and concentrate volumes at incineration sites?

Economics

1. Sales of fluids for retrofit programs?

   Profit opportunity.

   New capital required.

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EX P-3514
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PCB-ARCH0021440

FROM (NAME & LOCATION) PATENT DEPARTMENT - GENERAL OFFICES E2NB

DATE November 20, 1975

SUBJECT PATENT POSITION ON PCB REPLACEMENTS

REFERENCE V.10 Appendix

TO : M. E. Gibbs - N1A

cc R. Davis - B2SF
W. C. Hammann - B3SA
R. H. Munch - T1B
C. Paton - B2SC
H. B. Roberts - E2NB
J. R. Savage - B2SL
Q. E. Thompson - T3E
D. Wood - B2SD
J. J. Zeman - B2SK

With reference to Jim Savage's memo of November 18, 1975, the current Monsanto patent position on candidate PCB replacements for electrical apparatus is as follows:

I. Hydrocarbon + Sulfone Candidates (e.g., MCS-1238, 1488, 1588)

(a) U.S.P. 3,796,934 issued 3/12/74 claims capacitors containing these fluids.

(b) Pending U.S. Application Serial No. 424,491 (a divisional application of the capacitor case in (a) above) claims the composition of these candidate fluids. Composition claims in this divisional application were allowed on 10/21/75 and Business Group's approval has been received to issue the patent. By coincidence, this application was selected for optional participation in a trial Voluntary Protest Program undertaken by the Patent Office. This experimental program is similar to opposition proceedings employed for years in Germany, Japan, etc. Because of the importance of the composition claims to the Business Group, I have recommended that the U.S. patent be allowed to issue and that Monsanto decline to participate in the trial program.

(c) Foreign counterparts of (a) and (b) were filed as a single application in:

Argentina	Holland
Australia	Italy
Belgium	Japan
Brazil	Mexico
Canada	Sweden
France	Spain
Great Britain	Switzerland
West Germany	USSR

Foreign patents have already issued in Argentina, Belgium, Great Britain, Italy and Spain.

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II. Ester + Sulfone Candidates (e.g., MCS-1475)

(a) U.S.P. 3,811,077 issued 5/14/74 claims capacitors impregnated with composition such as MCS-1475.

(b) Pending U.S. Application Serial No. 424,037 (a divisional case originating from capacitor case II(a) above) claims the composition of ester + sulfone candidates. The composition claims were allowed on 10/21/75 and were included in the trial Voluntary Protest Program referred to in Section I above. The Business Group has again approved issuance of this patent and our recommendation is to forego the experimental protest program.

(c) Foreign counterparts were filed in the following countries:

Argentina	Holland
Australia	India
Belgium	Italy
Brazil	Japan
Canada	Mexico
Finland	Sweden
France	Spain
Great Britain	Switzerland
West Germany	USSR

Only the Belgian counterpart has yet issued as a patent.

III. Chlorinated Diphenylmethanes (e.g., MCS-1558)

(a) Pending U.S. Application Serial No. 582,486 filed 5/30/75 claims electrical devices (a broad term defined as including capacitors, transformers, etc.) employing a dielectric fluid comprising at least one halogenated diphenylmethane compound wherein one of the phenyl rings is unsubstituted. These compounds were found to have good electrical and fire resistant properties coupled with excellent primary biodegradation as measured in the SCAS test procedure. No action has been received from the Patent Examiner and the foreign filing decision is yet to be reached.

(b) Claims cannot be made to the chemicals per se because they are all old compounds.

Please advise if you need further information regarding the current patent position on PCB replacements for electrical apparatus.

WHD:rk William H. Duffey

PCB-ARCH0021442

V-12. G. E. Timetable and Regulatory Situation

D. R. Bishop - B1ND

Jan. 30, 1976

Mr. W. B. Papageorge - B3NB

TO:

Dr. C. Paton - B2SK
Mr. R. G. Potter - B2SB
Mr. D. L. Sliney - B2SB
Mr. David Wood - B2SD
Mr. J. C. Weber - B2SK

F.Y.I., the attached appeared in this morning's New York Times.

The heat's off G.E. in New York...and that probably doesn't help us much with MCS 1238.

DRB

D. R. Bishop

/mks
attachment

*The Task Force feels that the reduced pressure helps us and the industry attain an orderly timetable.

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PCB-ARCH0021443

THE NEW YORK TIMES, FRIDAY, JANUARY 30, 1976

GOVERNOR BASES STAND ON PCB'S

Overrules Reid and Gives G.E. Until 1977 to Meet Federal Standard

By LINDA GREENHOUSE

Governor Carey, overruling his Commissioner of Environmental Conservation, has decided not to force the General Electric Company to stop completely its discharge of the toxic chemicals called PCB's into the Hudson River.

Instead, Mr. Carey has decided to require the company to adhere only to the Federal standard for PCB discharges, which calls for no more than 3.5 ounces a day by June 1, 1977.

The company now discharges about two pounds of the chemicals every day from two Hudson River plants compared with 30 pounds a day from 1971 to 1974.

The Environmental Commissioner, Ogden R. Reid, has asked General Electric to stop the discharges completely by next Sept. 30, and he is conducting hearings on whether the company has violated state water-quality standards.

Mr. Reid's policy has been opposed by the State Commerce Commissioner, John S. Dyson, on the ground that a standard that was stricter in New York than in other states would weaken New York's competitive position and drive out industry.

Company's Position

General Electric has said that while it could meet the Federal standard for 3.5 ounces a day, a zero discharge was not feasible and might lead to a decision to close the plants.

Governor Carey's acceptance of Mr. Dyson's argument is the first concrete sign of the policy the Governor announced this month in his State of the State speech. At that time, Mr. Carey said that he would weigh economic considerations in the formulation of environmental policy.

Mr. Reid was informed yesterday afternoon by Robert J. Morgado, Director of State Operations, of the Governor's decision. The Commissioner was not reachable for comment.

For the state to require zero discharge of PCB's, one of the Governor's top aides said yesterday, would "put us on the same old self-destruct course" of creating an unfavorable climate for industry here.

Issue Called 'Phony'

Furthermore, this aide said, "after all those years of discharging 30 pounds a day, no one can tell me there's one bit of difference between zero and 3.5 ounces."

"It's a totally phony, symbolic issue," he added.

Mr. Reid and Mr. Dyson have also clashed publicly on the implementation of a new law requiring developers to file environmental-impact statements.

PCB's — polychlorinated biphenyls — have caused liver cancer, reproductive failure and skin infections in laboratory animals. Hudson River fish tested by state and Federal researchers have shown PCB levels far in excess of the allowable limit of five parts per million set by the Food and Drug Administration.

Earlier this week the Monsanto Company, the only maker of the chemical, said it would phase out production as soon as acceptable alternates were available. PCB's are used primarily in the production of capacitors and electric generators.

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PCB-ARCH0021444

REFINING & TREAT

V-12. G. E. Timetable and Regulatory Situation

PILOT PRODUCTION

• Start Clean Up Of Pilot Refining Facility	FW 2 - Jan.
• Complete Rearrangement & Clean Up. Introduce Liquids.	FW 3 - Jan.
• Start Refining Trials	FW 4 - Jan.
• Complete Initial Refining	FW 5 - Jan.
• Conduct Treat For Power. Refine Return.	FW 6 - Feb.
• Initiate Pilot Treats	
Capability	
1 Tank x 1 Treat/Week = 2200 Units/Week (75 Gal/Wk)	FW 7 - Feb.
1 Tank x 2 Treats/Week = 4400 Units/Week (150 Gal/Wk)	FW 10 - Mar.
2 Tanks x 2 Treats/Week = 8600 Units/Week (300 Gal/Wk)	FW 14 - Apr.

PRODUCTION FACILITIES FOR FULL CONVERSION

• Determine Refining Requirements And Define Process	FW 13 - Mar.
• Specify Refining & Handling Equipment, Obtain Quotes, Prepare Layout. Prepare And Submit AR (Est. $100,000 Investment - Refining & Related Equipment)	FW 17 - Apr.
• AR Approval	FW 19 - May
• Equipment Delivery (5-6 Months)	October
• Installation Completed	December
• Start Up	January 1977
complete conversion	June 1977

RC Merrill/RC Padowicz
-1/16/76-

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