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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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 $4.4M in 1976 and $4.5M 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 $4.5M worldwide total dielectrics ($4.05M US-produced, $0.45M Europe). Position the business for future growth beyond 1979.

      2) Achieve sales volume in 1979 of 19.5M pounds worldwide.

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.

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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 $\overline{M}$ 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.

$\overline{M}$ 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).

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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.

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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

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.

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.

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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 $\overline{M}$ 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.

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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J. Financial

(To be provided)

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."

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.

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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.

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	

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	

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)	

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	

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	

TIMING	ACTIONS	DECISIONS/APPROVALS
Nov. 1976		
Dec. 1976		

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.

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.

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		

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

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".

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.

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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.

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 '76		

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		

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			

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

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

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

TIMING	ACTIONS	DECISIONS/APPROVALS
Mar '77		
Apr '77		

TIMING	ACTIONS	DECISIONS/APPROVALS
May '77		
June '77		

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

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

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

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		

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.	

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

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

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

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

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