

MONSANTO SALES OF CHLORINATED BIPHENYL
DIELECTRIC FLUIDS ARE \$18 MILLION PER YEAR
WORLDWIDE.

EQUIVALENT TO 40-45 MILLION LBS. PER YEAR.

DSW 223362

STLCOPCB4053446

MONSANTO ARE SOLE SUPPLIER TO THE U.S.A.
CAPACITOR/TRANSFORMER INDUSTRY.

THE DOMESTIC MARKET (25M TO 35M LBS)

REPRESENTS 61%
OF OUR DOLLAR SALES

EXPORT SALES

U.S. EXPORTS = 17%

EX-U.S.A. = 22%

(NEWPORT, ENGLAND)

100%

DSW 223363

MAJOR COMPETITION OUTSIDE U.S.A.

(MARKET APPROX. 60 MILLION LBS.)

		%
BAYER - GERMANY	13 M LBS.	22
PRODELEC (RHONE PROGIL)	21 M LBS.	35
FRANCE		
(MONSANTO U.S.A./U.K.)	15 M LBS.	25
	49	82

DSW 223364

STLCOPCB4053448

KEY MARKETING ISSUE

1. PROBABLE THAT WITHIN TWO YEARS USE OF AROCLOR
(CHLORINATED BIPHENYL - PCB) WILL BE UNACCEPTABLE
IN U.S.A.
2. CAPACITORS - \$6.5 M
TRANSFORMERS - \$4.5 M
3. RESULTING IN SUBSEQUENT MOVE FROM CHLORINATED
BIPHENYL OUTSIDE U.S.A.

DSW 223365

CAPACITOR RESULT

1. REPLACE AROCLOR WITH MCS 1238
(ALKYL BIPHENYL BASED)
2. AGAINST 3 MAJOR CAPACITOR INDUSTRY ALTERNATES
 - A) ALKYL CHLORINATED, BIPHENYL OXIDE - DOW
 - B) PHTHALATE ESTERS
 - C) REDESIGN TO EXCLUDE LIQUID COMPLETELY
3. MAJOR ACCOUNTS - 11
G.E. HAVE 50% OF MARKET

DSW 223366

TRANSFORMER RESULT

1. REPLACE AROCLOR BY
 - A) ALKYL BIPHENYL BASED FLUID
 - OR
 - B) CHLORINATED BIPHENYL METHANE
2. AGAINST MAJOR TRANSFORMER INDUSTRY ALTERNATES
 - A) SILICONE DOW-CORNING
 - B) AIR-COOLED DESIGNS
 - C) MINERAL OIL + FIRE PROTECTION INSTALLATION
 - D) HIGH FLASH POINT OIL DISTILLATES
3. MAJOR ACCOUNTS - 2
 - G. E. > 37%
 - WESTINGHOUSE > 37%

DSW 223367

CAPACITOR MARKET**U.S.A.** (Total ~\$140 Million)

<u>Type</u>	<u>Application</u>	<u>Approx. Annual Aroclor H Lbs.</u>
1. Power	Utilities (90%)	4-5
(Indicator - Total Installed New Generation Capacity)		
2. Medium Voltage	Air Conditioner/ Appliances	7-8
(Indicator - A/C Sales Forecast. Consumer Spending)		
3. Lighting	Fluorescent/Street	4-5
(Indicator - Commercial Building Starts 7 Months Lag)		

Ex-U.S.A.**60-70% Power**

DSW 223368

STLCOPCB4053452

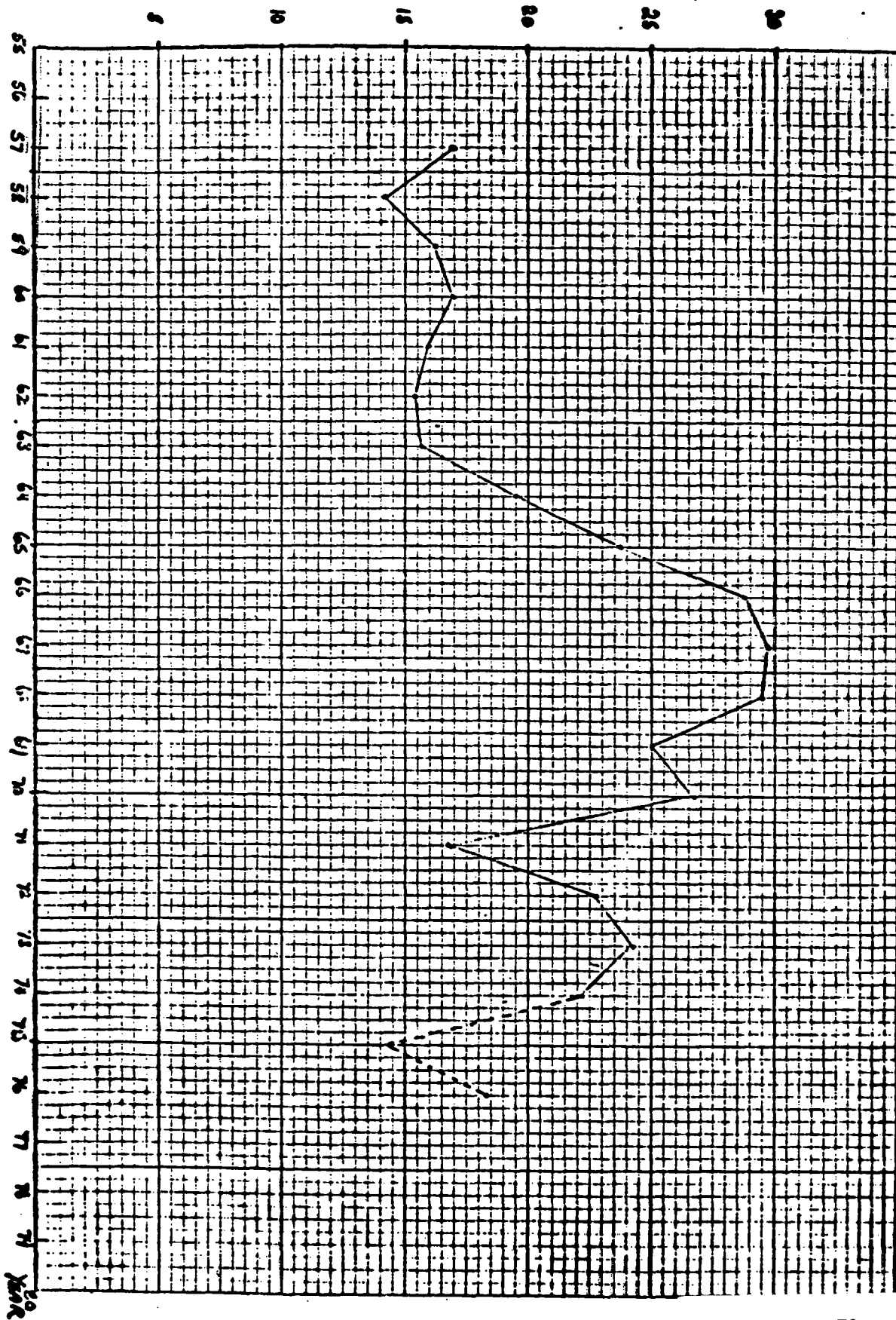
CAPACITORSU.S.A. - KEY CUSTOMERS (BASED FULL 1974 SALES)

P = POWER	M = MEDIUM	L = LIGHTING
		<u>Percent</u>
G. E.	P-M-L	39.7
Westinghouse	P	11.0
Universal	L	8.6
Aerovox	M-L	8.6
Cornell Dubilier	M	6.8
Mallory	M	4.6
Sangamo	P	3.2
McGraw	P	3.6
Sprague	M	4.1
BUC	M	4.4
Jard	M	<u>3.0</u>
		97.6

K-E 10-3-12 TO THE 10-3-12 10-3-12 10-3-12

MILES

TOTAL AROCLOR SALES



DSW 223370

STLCOPCB4053454

U.S.A. - CAPACITOR MARKET

1. POWER CAPACITORS

- A. 4 Major Producers - G. E., Hudson Falls
 - Westinghouse, Bloomington
 - McGraw Edison
 - Sangamo
- B. 80% of market is supply to Utilities.
- C. -From 1955 to 1965 represented 25-30% of Aroclor usage.
 - Introduction of Magvar type technology has cut Aroclor usage per KVAR by 45%.
- D. -The demand for power capacitors peaked 1974.
 - Demand 1975 to 1980 will be 50-75% of 1974 demand depending on level of new system capacity.
 - Old systems have now substantially completed power factor correction programs.
- E. -Continued use of 1975 technology would demand 3-4 M lbs. of Aroclor 1016 per year.

DSW 223371

CHART 1POWER CAPACITOR HISTORY AND FORECAST

<u>YEAR</u>	<u>MILLION KVAR INSTALLED</u>	<u>KVAR/LB. AROCLOR</u>	<u>*AROCLOR EQUIV. INSTALLED KVAR M LBS.</u>	<u>TOTAL MKT. CALCULATED M LBS.</u>	<u>ACTUAL</u>
1954	4.0	2.0	2000	2500	
55	4.2	2.0	2100	2625	
56	5.4	2.0	2700	3375	
57	5.9	2.0	2950	3687	
58	5.0	2.0	2500	3125	
59	6.4	2.0	3200	4000	
1960	8.0	2.0	4000	5000	
61	7.4	2.0	3700	4625	
62	7.2	2.0	3600	4500	
63	8.8	2.0	4400	5500	
64	10.3	2.0	5150	6437	
65	11.6	2.1	5523	6904	
66	12.3	2.25	5466	6832	
67	15.1	2.50	6040	7550	
68	18.9	2.75	6870	8587	
69	16.2	2.875	5630	7037	
1970	19.1	2.875	6640	8300	8851
71	18.2	3.25	5600	7000	5113
72	18.5	3.75	4930	6162	5470
73	20.5	4.50	4555	5693	5720
74	24.5	4.50	5444	6805	6208
1975	10.5)	4.55	2307	2880	
1976	10.5)	4.55	2307	2880	
1977	10.5) Westinghouse	4.55	2307	2880	
1978	11.9) Forecast	4.55	2630	3287	
1979	14.7)	4.55	3230	4037	
1980	14.7)	4.55	3230	4037	

*Represents approx. 80% of total power market.

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CHART 2

SALES OF AROCLOR TO PF COMPANIES

M LBS

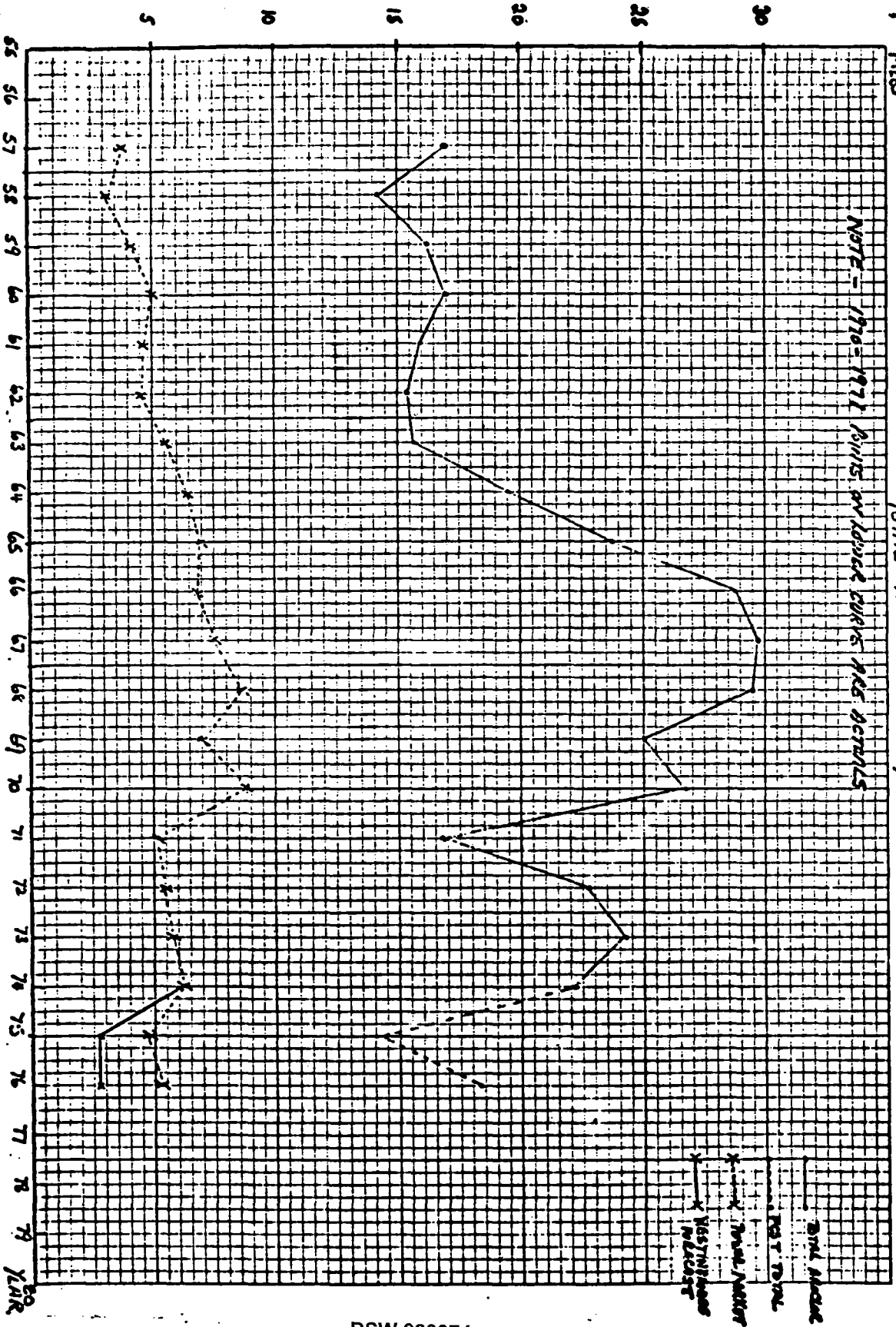
<u>YEAR</u>	<u>G. E., HUDSON FALLS</u>	<u>WESTINGHOUSE, BLOOMINGTON</u>	<u>M. E.</u>	<u>SANGAMO</u>	<u>TOTAL</u>
1968					
1969					
1970	4000	2462	1179	1210	8851
71	2500	935	733	945	5113
72	2091	1717	933	729	5470
73	2471	2143	467	639	5720
74	2280	2420	791	717	6208

DSW 223373

Miles

TOTAL AROCLOR SALES / POWER GENERATOR USAGE.

NOTE - 1970-1971 AROCLOR SALES AND ACTUALS



DSW 223374

U.S.A. CAPACITOR MARKET

2. BALLAST CAPACITORS

- A. 3 Major Suppliers - Universal (In house)
G. E. (In house & minor
supply outside)
Aerovox (Jefferson, Advance)

- B. Market approximately 5 M lbs. per year
Aroclor.

Universal	35-40%
Aerovox	10-15%
G. E.	45-55%

- C. Market relates to square feet commercial
premises and lags start by 9 months to
1 year.

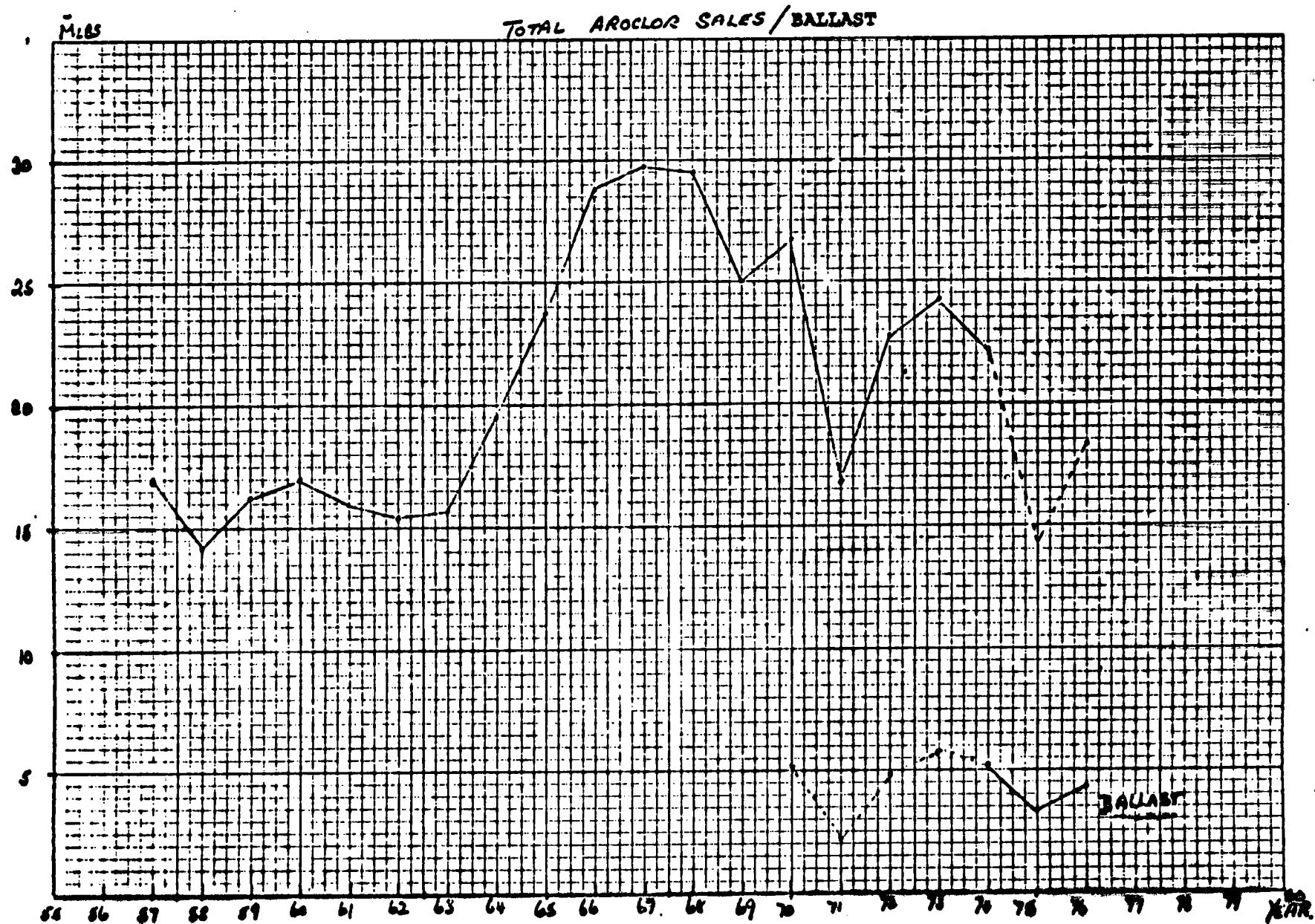
DSW 223375

CHART 4

AROCLOR CONSUMPTION - BALLAST CAPACITOR PRODUCERS

	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975</u>	<u>1976</u>
G.E. -40% Ft. Ed.	2212	1206	2292	2677	2541	1520	2200
Universal	2258	1220	1918	2366	1950	1170	1660
Aerovox 40%	<u>745</u>	<u>337</u>	<u>658</u>	<u>728</u>	<u>752</u>	<u>770</u>	<u>596</u>
	5215	2763	4868	5771	5243	3460	4455

DSW 223376



DSW 223377

STLCOPCB4053461

U.S.A. - CAPACITOR MARKET

3. PERMANENT SPLIT CAPACITOR MOTORS

A. Air Conditioners represent approx. 60% of this market.

B. Major Suppliers are:

G. E., Fort Edwards	*	50-60%
E.U.C.	*	100%
Mallory	*	100%
Jard	*	100%
Aerovox	*	60%
Sprague	*	50%
Cornell Dubilier		30%

*More than 50% of total Aroclor used in this sector.

C. The "average" air conditioner capacitor contains .6 lb. of Aroclor 1016 in 1975 (.7 in 1972, .8 in 1970, and .9 in 1965 (Schweizer, E.U.C., Sprague)).

D. Air conditioner sales figures are extracted from "Appliance" survey.

E. 20% of this market is below 370 volts.
50% below 440 volts.

DSW 223378

STLCOPCB4053462

CHART 5PSC MOTOR CAPACITOR MARKET

<u>YEAR</u>	<u>NO. OF ACs</u> <u>SHIPPED (000)</u>	<u>(60%) EQUIVALENT M LBS</u> <u>AROCLOL</u>	<u>ADJUSTED TO LBS.</u> <u>100%</u>
1965	3773	3395	5658
66	4305	3874	6456
67	5176	4658	7763
68	5261	4735	7891
69	7060	6354	10590
70	7458	5966	9943
71	7314	5851	9751
72	6942	4859	8098
73	8185	5729	9548
74	7053	4937	8228
75	5000	3000	5000

DSW 223379

STLCOPCB4053463

CHART 6AROCLOR USAGE BY MAJOR MOTOR CAP. PRODUCERS-000 LBS

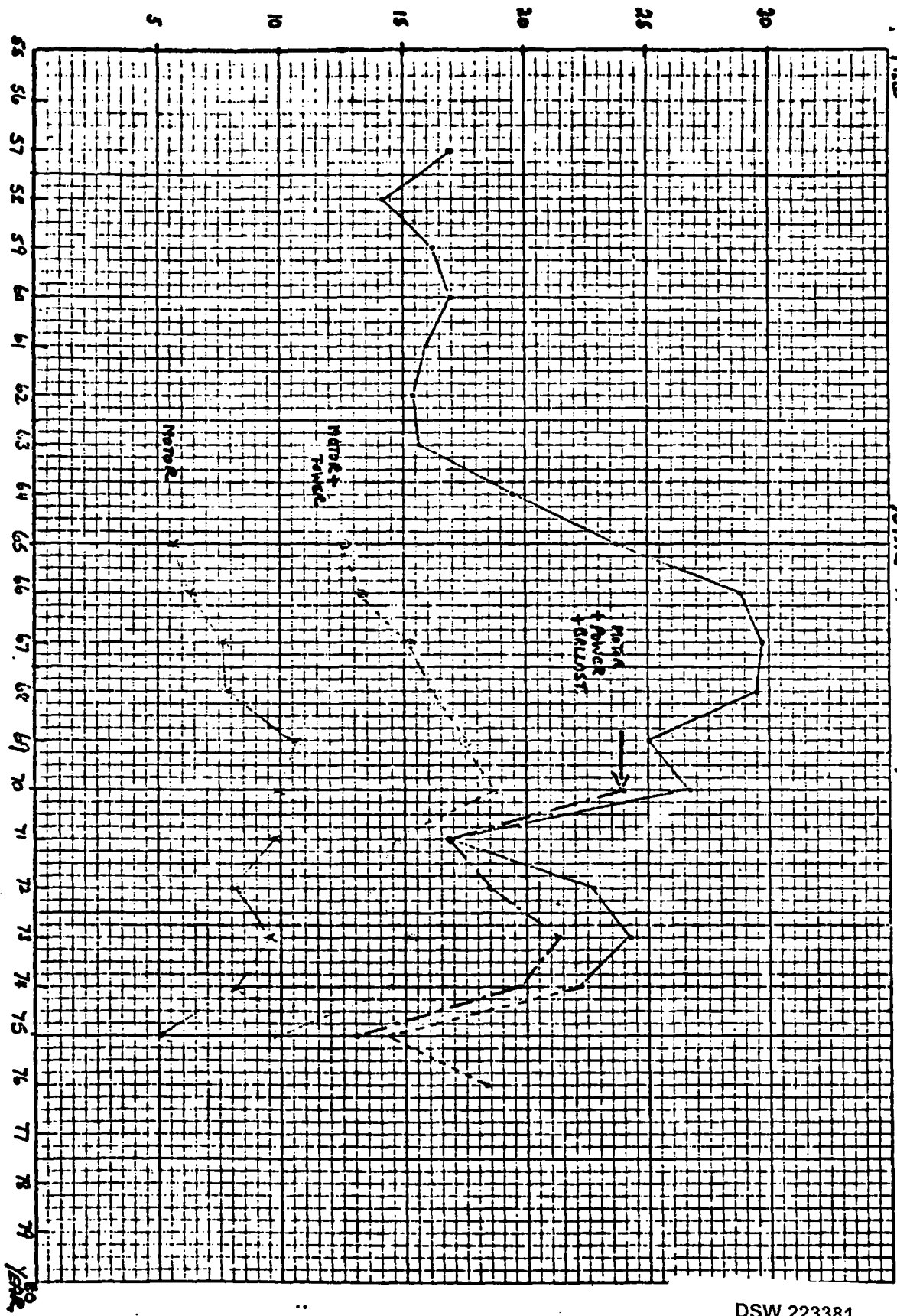
<u>CUSTOMER</u>	<u>1970</u>	<u>1971</u>	<u>1972</u>	<u>1973</u>	<u>1974</u>	<u>1975F</u>	<u>1976E</u>
G. E., Fort Edwards 60%	3352	1828	3474	4057	3850	2280	3300
E.U.C.	1414	789	600	1250	966	450	800
Mallory	2206	799	1398	1548	1003	600	800
Jard	268	474	632	963	677	370	550
Aerovox 60%	1118	511	998	1104	1140	330	894
Sprague 50%	516	569	546	637	450	315	360
C-D 30%	<u>743</u>	<u>364</u>	<u>483</u>	<u>427</u>	<u>461</u>	<u>300</u>	<u>363</u>
	9617	5334	8131	9986	8547	4645	7067

1976 Budget corresponds to AC shipment of approx. 7M units.

DSW 223380

Miles

TOTAL ACROBOL SALES / MARKET SEGMENTS



DSW 223381

TECHNOLOGY

POWER CAPACITORS (1)

1. Polypropylene has widely replaced PART of the solid dielectric system
 - Low loss
 - Better stress properties
2. 1975 - paper is required to ensure complete impregnation
 - Voids are weakness point
 - Technology can not produce today imperfection-free film
3. If paper is required, a fluid with dielectric constant similar to paper is valuable; i.e. 1016/1588, etc.
4. Today's cost of avoiding paper use gives
 - More expensive construction
 - Less reliable unit
5. When these two technologies improve
 - A fluid will be required
 - DK will not be important
 - Stress carrying capability will be important

DSW 223382

TECHNOLOGY

POWER CAPACITORS (2)

Position of Major Producers

- GE: 40% - DOP will NOT work in Power Capacitors.
- 1588 is better than 1238 (stress) but not as good as Aroclor 1016.
 - Fire resistance is significant in 10-20% of market (NEMA Standards).
 - If all plastic used, Sulfone technology is not important - base stock may do job.
 - If Aroclor not available short term 1588 favoured.

DSW 223383

TECHNOLOGY

POWER CAPACITORS (3)

Position of Major Producers

Westinghouse: 25%

- Have not thought thru possibility of sudden Aroclor demise.
- Have specific toxicity concerns which are inhibiting 1588/1238 work.
- DOP/esters will not work.
- Have made more advances with non-Monsanto non-PCB alternates (not clear if these are low DK synthetics; e.g. DDB or Dow products).
- Do not favour separate developments, will tend to follow GE.

DSW 223384

TECHNOLOGYPOWER CAPACITORS (4)Position of Major ProducersMcGraw Edison: 20%

- Have commercialized all film unit at 15% premium.
- After GE good name for technological advance.
- No major program on Monsanto non-PCB fluids.
- Review July 23/24, 1975.

Sangamo: 15%

- Will follow market.

DSW 223385

TECHNOLOGYPOWER CAPACITORS (5)Costs

- A. - Sales price of 180 KVAR unit is approximately \$360.
- Cost of Aroclor content (40 lbs.) is \$15; i.e. 4%.
 - Cost of paper content (40 lbs.) is \$60; i.e. 16%.
 - Cost of film content approx. (40 lbs.) is \$100; i.e. 27%.
 - Total RM cost is probably 52%.
- B. Move to 1588/1238 would have minor impact on cost.
Would need 29 lbs. x 65¢ = \$18.76
Δ Cost \$3.76; i.e. 1.04%.

DSW 223386

CONCLUSION

POWER CAPACITORS (6)

- MCS 1588 has good chance of acceptability in this sector.
- For MCS 1238 to be preferred, we or our customers must demonstrate better corona initiation/extinction characteristics than 1588.
- Potential improvements in film technology could limit product life (TXS component) and profitability.
- Industrial power units (10-20%) of market present fire resistance problem short term.
- Sudden Monsanto announcement to drop Aroclor could lead to import of German/French product, followed only possibly by move to 1588/1238.
- Canada GE/Westinghouse will follow U.S. practice.
- Potential use of 1588/1238 - 3.5 M lbs.

DSW 223387

TECHNOLOGYBALLAST (1)

1. A radical change in capacitor design involves major retooling by the ballast producer; i.e., GE/Universal can move more easily than Aerovox.
2. One major (Universal) is planning switch to dry metallized polypropylene ballast without can for purely economic reasons.
3. Inhibiting factor is voltage limitation on dry film construction - 370-440 V.
4. European suppliers claim 440 volts plus now achievable.
5. New investments required in winding, metallizing film casting equipment to supply market.
6. MCS 1588 works in ballast unit but fire resistance is a hang-up.
7. MCS 1238 not widely tested in ballast units.
8. Universal prefer 1588 to DOP.
GE undecided between DOP/1588. This market has lower research priority.
Aerovox have better results on DOP than 1588.

DSW 223388

CONCLUSION

BALLAST (2)

- Can, terminals, fuses and labour make up a high proportion of cost compared with the dielectric raw materials.
- Elimination of can and fluid effect a substantial saving.
- Ideally the industry would like 5 years grace to run present Aroclor design before move to new technology.
- If Aroclor was suddenly unavailable
 1. Import if possible would be preferred to change.
 2. If import not available Universal would move to MCS 1588 for 3-5 years.
 3. Aerovox would probably go to DOP.
 4. GE would probably go to DOP.
- In absence of imports, potential is 1.0-1.4M lbs. of 1588 (or 1238 if Universal completes satisfactory test program). This volume would be available for 3-5 years.

DSW 223389

TECHNOLOGY

3 PAPER CAPACITORS

USA

- In 1975 90% or more of units are either

AROCOR 1016

AL FOIL

PAPER

OR

AROCOR 1016

AL FOIL

PAPER / POLYPROPYLENE.

- The USA acceptance standards are stringent - much more so than International standards.
- The demand for non PCB units (approx 5% of this sector is currently being supplied by

ECONOL (DOP); ECOL (DIMP)

PAPER / POLYPROPYLENE.

AL FOIL.

These are supplied to lower standards than Aroclor units.

- EUC are introducing EUCANOL & units based on paper / MCS 1588
- Matsuyama are introducing paper / MCS 1475.

- Size limitations are important in only a small segment of the market.

- Need for fire resistance is completely unmet.

- Foreign capacitors do not meet current US standards but any relaxation in standards could open doors to cheap European designs.

DSW 223390

TECHNOLOGY.

MOTOR CAPACITORS.

EUROPE

- Page 1
- Historically the ballast market was larger than motor mkt. Europe does not have large air-conditioner market.
 - Poor can design in Europe made liquid leakage a major problem there.
 - This coupled with the lower voltage in fluorescent circuits and unspotted ballasts made development of dry plastic film ballasts attractive.
i.e. low voltage, low temperature.
 - This created a market for metallised cast polypropylene film.

DSW 223391

- Page 2.
- The plastic designs would not work at higher voltages using ballast type designs so metallised paper designs took over the medium voltage area.
 - The economics demanded a high density paper sheet with very low imperfection levels so that metal could be sprayed directly on its paper without lacquer.
 - Tervakivi, Helsinki developed such a paper.
 - With high density paper impact of dielectric constant of liquid is less and fluids like polybutene are used as impregnants. (Siemens).

MOTOR CAPACITORS

EUROPE (2).

Stage 3.

- Gradually technology of metallized cast films was improved. (Kalle, Stancu, Almvac). and tight winding techniques eliminated more air from windings (Herry, Mettar).
- Dry constructions (with liquid end fill) extended market penetration
- However costs and performances today are not competitive with mixed dielectric, Arco, Al Foil constructions in US market because
 - a) US voltages are at top limits or above for this technology
 - b) Many units are dual wound and this cannot cheaply be produced in metallized film in a can.
 - c) US paper costs are lower than European. Approx 25%.
 - d) US air conditioner purchasers have stringent life standards for capacitors.

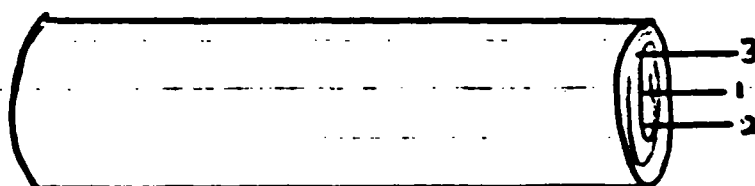
DSW 223392

MOTOR CAPACITORS - DUAL WINDING.

1) ARCUOR / FOIL.

Foil 1.  Paper. Foil 2. 

3

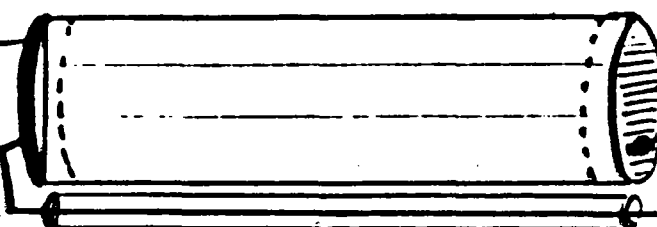


METALLISED FILM.

 AL FOIL PLASTIC AL NOT TO EDGE PLASTIC

SPRAYED AL

TERMINAL 2.



SLICE.

SPRAYED AL

TERMINAL 1

TERMINAL 2.

DSW 223393

TECHNOLOGY

MOTOR CAPACITORS SUMMARY.

1. In 1975 Aroclor 1016 still gives - lowest cost
- best performance
- fire resistance.
2. If Aroclor 1016 is available - metallised polypropylene unit may offer cost saving in 20-25% of market.
3. If Aroclor 1016 is not available nothing at present gives
 - a) fire resistance
 - b) equivalent performance.
4. There are ^{6 or 7} ~~five~~ competing compromise technologies which have differences in cost and performance, availability of raw materials, need for capital investment.
5. No one of these is today recognized as significantly superior.

a) FOIL PAPER	1588	EUC	
b) FOIL PAPER	1475	Malby	
c) FOIL PAPER	DOP	GE	DSW 223394
d) FOIL PAPER/FILM	DOP	GE	
e) FOIL SINGLE PAPER	1588	JARD	
f) FOIL Metallised Paper	1588	Schweizer	
g) Metallised polypropylene	- DOP	GE / Aeronox.	
6. The decisions of the major o/c producers will largely decide which way industry moves. (Tecnunseh will be of major significance).

MOTOR CAPACITORS

CONCLUSION.

1. This sector could develop into a battlefield if Proder goes.
2. Early support for Monsanto fluids will come from.

EUC
Mallory
Jard
C-D.

3. Early support for DOP / film will stem from

GE Fort Edwards
Aerovox
Sprague.

4. Chief support item 2 is today for MCS 1588 (1238 not widely tested) Mallory alone support 1475 today
5. ~~At~~ At 1974 levels Monsanto fluid support equals 3107 out of 8547 lbs = 36%.
GE equal 45% alone.
6. 1238 is approx. 12 months away from same acceptance as 1588.
7. Our fluids would get initial share of 2.0 - 2.5 Mlb in this sector which would over 8 years move to 5.0 M or to approx zero.

DSW 223395

NON PCB Fluids. USA.

Mlbs. MARKET PROJECTION - C AROCLOR

	76	77	78	79	80	85
Power	3.0	3.0	3.0	3.5	3.7	4.5
Ballast	1.0	1.3	1.0	.7	0	0
Motor	2.0	2.5	2.5	2.0	2.5	0 - 5.0
Misc.	1.0	1.0	1.0	1.0	1.0	1.0
<u>Total.</u>	7.0	7.8	7.5	7.2	7.2	5.5 - 10.5

PRICE.

1. Assume Aroclor 1016 price of 40¢/lb.
2. Equivalent non PCB price would be 53¢/lb.
3. GE would be more likely to use our non PCB at 55¢/lb. and you could increase volume by 2-3 Mlbs per year.
4. At 65¢/lb above forecast would hold.
5. At 75¢/lb. Motor run would go.

DSW 223396

DIELECTRICS

CAPACITORS - DEVICES FOR STORING ELECTRICAL ENERGY,

SALES PER YEAR U.S.A. \$140 M

MONSANTO SALES U.S.A. 6.5 M

FIRE RESISTANT

TRANSFORMERS - DEVICES FOR CONVERTING HIGH VOLTAGE
TO LOW VOLTAGE

SALES PER YEAR U.S.A. \$ 60 M

MONSANTO SALES U.S.A. 4.5 M

DSW 223397

**MONSANTO SALES OF CHLORINATED BIPHENYL
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DSW 223398

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DSW 223399

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DSW 223400

KEY MARKETING ISSUE

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2. CAPACITORS - \$6.5 M
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DSW 223401

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 - C) REDESIGN TO EXCLUDE LIQUID COMPLETELY
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DSW 223402

TRANSFORMER RESULT

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OR

B) CHLORINATED BIPHENYL METHANE

2. AGAINST MAJOR TRANSFORMER INDUSTRY ALTERNATES

A) SILICONE DOW-CORNING

B) AIR-COOLED DESIGNS

C) MINERAL OIL + FIRE PROTECTION INSTALLATION

D) HIGH FLASH POINT OIL DISTILLATES

3. MAJOR ACCOUNTS - 2

G. E. > 37%

WESTINGHOUSE > 37%

DSW 223403

POLYPHENYLS FAMILY TREE

STRENGTHS

- Best technology, worldwide
- Sole U. S. producer of synthetic biphenyl
- Modern plants, Anniston and Newport
- Low sulfur process, only major commercialization of terphenyl derivatives
- Fairly diversified outlets

WEAKNESSES

- Competition of by-product (HDA) biphenyl
- Under-utilization of capacity
- Anniston location not ideal
- Running unbalanced on hydrogen
- No technical continuity
- Aroclor is largest outlet (50%)

DSW 223404

POLYPHENYLS FAMILY TREE

	<u>ANNISTON</u>	<u>NEWPORT</u>
Capacity $\bar{M}$ pounds per year	90	16
1976 Budget Requirement	37	11
Capital investment (\$M)		
GROSS	3024	686
NET	390	185
Fixed + Budgeted Costs	\$2 $\bar{M}$ /year	N/A
Total Mfg. Budget	\$8 $\bar{M}$ /year	N/A

HB-40 FAMILY TREE

Capacity $\bar{M}$ pounds per year	27	3.3
1976 Budget Requirement	14	3.3
Capital Investment (\$M)		
GROSS	713	354
NET	222	314
Total Mfg. Budget	\$3 $\bar{M}$ /year	N/A

DSW 223405

POLYPHENYL FAMILY TREE

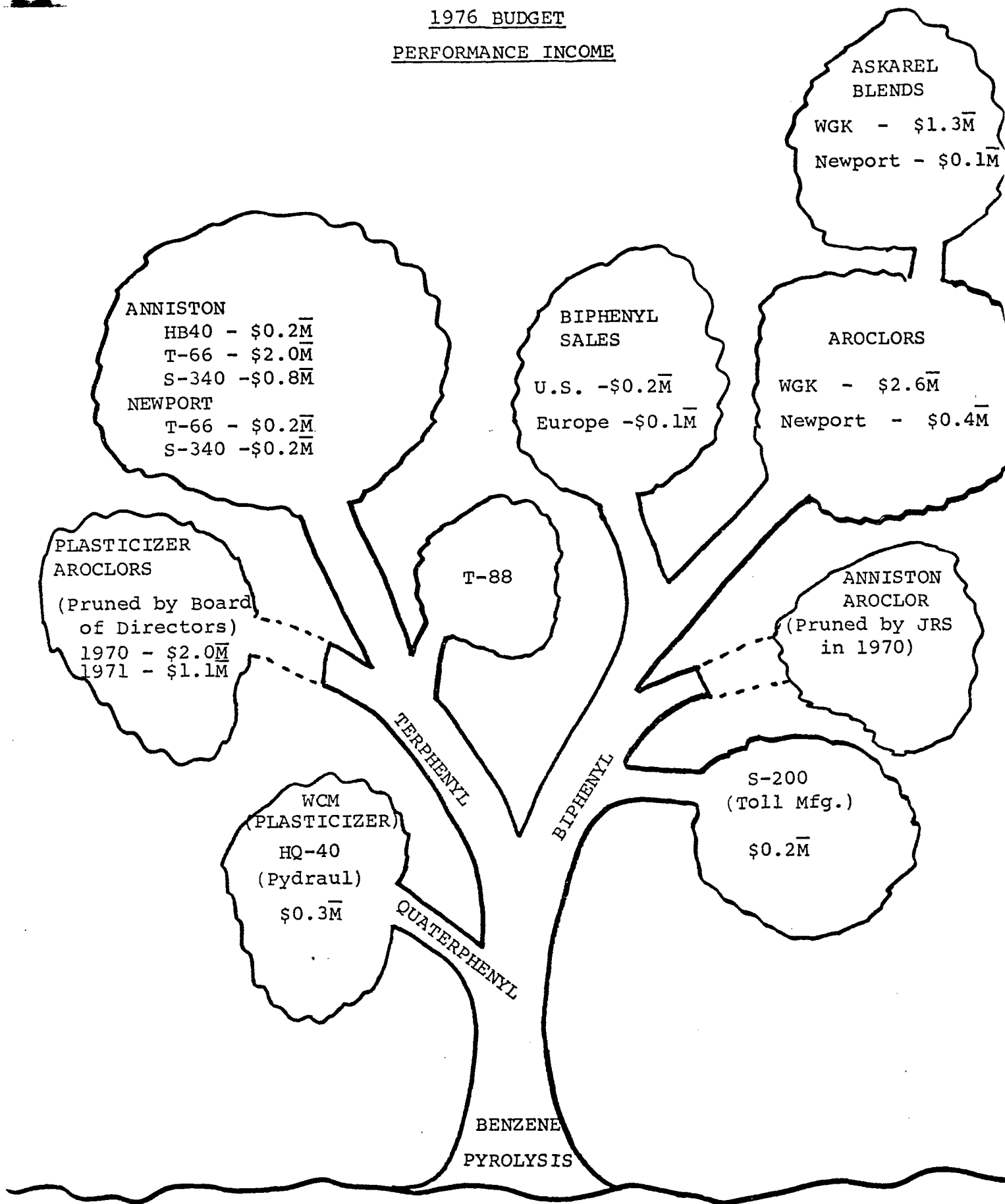
(DOMESTIC + US EXPORT)

1976 BUDGET SALES - GROSS PROFIT

	<u>M Lbs.</u>	<u>M \$</u>	<u>\$M</u>	<u>% Sales</u>
Biphenyl	1.5	0.6	0.2	37
Therminols	6.5	4.7	2.5	53
Santosols	10.7	4.5	1.5	33
Dielectrics	33.8	13.8	4.8	35
IDV-Plasticizers	<u>5.8</u>	<u>1.5</u>	<u>0.5</u>	<u>36</u>
Total	58.3	25.1	9.5	38
MAT			2.5	10
PI			7.0	28

DSW 223406

1976 BUDGET
PERFORMANCE INCOME



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

DSW 223407

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POLYPHENYL FAMILY TREE

DOMESTIC AND US EXPORT

	<u>1976</u> <u>BUDGET</u>	<u>NO AROCLOR</u> <u>8M # 1238</u>	<u>NO</u> <u>DIELECTRIC</u>	<u>NO DIELECTRIC</u> <u>NO S200</u>
BIPHENYL				
Unit Cost (\$/Cwt.)	19.20	24.04	27.27	28.02
HB-40				
Unit Cost (\$/Cwt.)	23.64	29.50	33.07	33.81
FAMILY TREE				
Performance Income (\$M)	7.0	3.6	1.9	1.7

DSW 223408