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1.0 Introduction

OPTEL Corporation is being formed to develop, manufacture, and sell electronic and opto-electronic devices and systems to be used in various areas of communications and data-processing.

The company is based on a group of technical personnel with international reputations in the field of optical electronics. They bring with them the leading expertise in three new fields of technology: cathodochromic, photochromic, and liquid crystal materials and devices.

The company proposes to exploit these technologies to develop and manufacture storage and display devices, projection displays, data transmission systems, laser addressed optical data storage and retrieval systems, and other opto-electronic devices. These devices perform functions that cannot be done by conventional electronic techniques. In other areas, the devices offer substantially improved performance at lower cost.

Immediate markets include: low cost computer addressed display and print out devices, a low cost projection display device with storage, and an optical replacement of the magnetic disc. Longer range potentials include a low cost facsimile transmission system with pick up and print out capability for the home and very large capacity (greater than 10^{10} bits) optically addressed read and write computer memory.

The total market potential of the above systems is very large,

several billion dollars. Therefore, in the beginning we have to select a sector of this market, where our novel technologies offer the greatest competitive advantages. In the first two years, OPTEL Corporation is planning to concentrate on the development, manufacture, and marketing of a cathodochromic display tube and system to be used in radar displays and pictorial displays transmitted through radio channels or telephone lines. We also propose to develop and market alpha-numeric indicators and projection display systems using liquid crystals and multichannel signal integrators, and processors using photochromic materials.

The market for display systems with storage in communications and data processing is very large today, and it is one of the most rapidly expanding sectors of the electronics industry. The timely introduction of the cathodochromic storage tube into this market, with the many advantages of reflective displays, will insure rapid growth for our corporation and large gains for our investors.

2.0 Products and Markets

The proposed products of our company are based on three new technologies: cathodochromic, photochromic, and liquid crystal materials and devices. In this section the three product areas will be described in detail; the size of the markets are estimated for each group of products, and the existing and anticipated competing techniques and systems will be outlined.

2.1.0 Cathodochromic materials and devices: Cathodochromic materials were proposed and discovered [1] [2] by Dr. Z.J. Kiss, the president of OPTEL Corporation. Cathodochromic materials are colored by electron beam and can be erased either by light or by heat. The effect was first observed in 1967 and in the following two years different materials leading to different colors and varying erase characteristics were developed. The first device [2] utilizing these materials, a cathodochromic storage and display tube, was built and demonstrated.

2.1.1. The cathodochromic display and storage device: In a conventional Cathode Ray Tube, the phosphor is replaced by the cathodochromic material, using the same manufacturing techniques and facilities as used for ordinary television tubes. An image is formed on the cathodochromic tube (CCT) by coloring the powder with the electron beam and viewing the image in reflected ambient light, in a fashion similar to a pencil writing on white paper and reading in reflected light. This image

2.2.1 Liquid crystals: A new electronically controlled reflective display concept has recently been discovered based on an effect in certain classes of nematic liquid crystals [6, 7]. This concept offers for the first time reflective operation, flat construction, and low power and voltage operation which suggests the use of integrated cirucits in the addressing function. The effect has been called "dynamic scattering" because scattering centers are introduced in the liquid crystal by the disruptive effects of ions in transit through the ordered fluid. Since the active layer of liquid is only of the order of one mil thick and held between two pieces of glass by capillary action, none of the conventional problems in handling liquids are experienced. Several crude prototypes of devices using the new effect have been fabricated. These include a numeric indicator, an all-electronic clock with no moving parts, and an electronically controlled window.

Two of the inventors of the liquid crystal technology, Dr. J.E. Goldmacher, the developer of the materials, and L.A. Zanoni, the inventor of the devices, are joining OPTEL Corporation. (See Appendix III and IV.)

2.2.2 Liquid crystal products and markets: The liquid crystal technology provides a low cost electronic light shutter which can be used in a great variety of applications, such as alphanumeric indicators, electronically controlled windows, and high contrast reflective displays.

The electronically controlled window is perhaps the simplest device. Basically, it is a parallel plate capacitor with transparent

electrodes (tin oxide on glass). With no voltage applied the window is clear. When approximately fifty volts is applied the window becomes opalescent. It is possible that this opalescent effect could be used to provide glass door panels and windows that could be frosted at the touch of a button to insure privacy for the users. A step away from that is the possibility that liquid crystals can be used to provide electronic curtains that will automatically control the amount of sunlight admitted into our homes.

If one wishes to operate the liquid crystal panel as a reflective display, a specular reflecting back electrode is needed. Edge lighting is possible for viewing under conditions of complete darkness. A seven-segment numeric indicator (capable of displaying the numerals 0 through 9 by application of excitation voltage to the proper segments of the cell) has been constructed which uses commercially available integrated circuits for the clock (TIS43), counter (TISN7490) and decoder (Fairchild L930759). Discrete transistors (2N40084) were used for the segment drivers. The panel consisted of the glass/liquid crystal/glass sandwich discussed previously with segmented electrode defined by photoresist techniques.

The circuit characteristics of liquid crystal devices are similar to that of a field-effect electroluminescent cell. Both liquid crystal cells and electroluminescent cells behave essentially as a linear capacitor in parallel with a high resistance. In addition, liquid crystal analogs to the well known photoconductor - electroluminescent image converters and light

amplifiers can be prepared by similarly coupling a photo-conductive layer in series with a liquid crystal cell. The resultant image converter and/or light amplifer will differ from its electroluminescent- photo-conductor analog mainly in that the reflection and/or scattering of light from an ambient light source while the electroluminescent device obtains its light by the luminescence of the electroluminescent material.

The liquid-crystal display, however, possesses several important advantages over electroluminescent phosphors:

a. Reflective or transmissive operation.

b. Contrast is independent of the ambient.

c. Lower voltage and power requirements.

d. The DC operation simplifies the addressing function (audio frequency used in electro-luminescent cells for best results).

e. One is not restricted to a specific color for the display.

A market presently exists only in the area of alphanumeric displays. in the other areas, liquid crystal technology fulfills a new function which cannot be performed by present-day electronic techniques. OPTEL Corporation is proposing to concentrate first on the prototype of an alphanumeric indicator and a photoconductive-liquid crystal projection display panel. Such a display panel, coupled with a CCST or another type of storage tube CRT display , can be used as a projection display with storage capability. There is a very large military market for such a projection system to display computer generated data for command and control.

3.0 Organization and Key Personnel

A block diagram of the organization of OPTEL Corporation is shown on Figure 3. The corporation will consit of four technical divisions, sales and marketing, and a business and service organization. We presently have the key personnel for the four technical divisions and for the sales and marketing. We are actively searching for a manager of business and services. In the first three quarters of our operations, we will concentrate on the development of a CCT radar display prototype and a liquid crystal alpha numeric indicator. We have sixteen technical personnel to accomplish this task. Since we expect to have prototypes by the end of the third quarter, this is also the time to form our sales force.

In the Research and Materials Department, we will develop and manufacture the cathodochromic materials to be used in the cathodochromic tubes. We propose to both supply materials for the tubes used and carry out further research on novel CC materials. The rate of expansion of this latter effort will be determined by government contract support.

The CCT product division will be the main area of business for the first two years. In the first three quarters, the effort will be concentrated on the development of the CCT prototypes. In the fourth quarter, assembly of the CCT radar display system and the setting up of CCT production

Figure 5

President 2

Year	Quarter	Total Personnel	Business & Service	Research & Materials	CCT Products	Liquid Crystals	Photochromic Devices	Sales & Marketing
1	1	9	-	2	3	1	1	-
	2	12	1	2	4	1	2	-
	3	16	1	2	5	2	3	1
	4	25	1	3	8	6	4	1
2	1	52	2	4	25	12	5	2
	2	62	2	6	30	15	5	2
	3	76	3	8	40	15	5	3
	4	102	3	8	60	15	10	4
3		400	20	60	180	60	60	40
4		1000	60	80	540	120	120	80
5		2500	100	100	1000	250	800	250

facilities will commence. We are actively looking for key production personnel for this task. After production commences, the initial group of people who developed the prototypes will remain the nucleus of an advanced development group for the CCT products division.

The liquid crystal division will build a prototype of alpha numeric indicators in the first nine months. After that time, it will set up production facilities to manufacture the indicators, at the same time that it further develops prototypes of the projection display panels. The photochromic devices activity for the first two years will primarily be handled by an advanced development group supported by government contracts.

The sales and marketing operation will commence in the third quarter. Since our approach in the first two years concentrates on the radar display subsystems, the sales effort will be primarily aimed at relatively few customers: radar manufacturers, governmental agencies, and manufacturers of aircrafts and boats, etc. Our sales manager is technically well-versed in display systems and has extensive experience in the sales of remote computer displays. In addition to selling the products, Sales and Marketing will have the equally important function of market research, to feed back the customers needs into the product design with the greatest rapidity. Initially the president and the key technical personnel will also be involved in these functions.

The Business and Service Organization will provide the services

of accounting, budget and salary records, overhead control, purchasing and non-technical negotiations with other organizations. It will provide assistance and advice to the President and technical divisions in business matters, and carry out much of the routine running of the corporation.

The projected rate of expansion of personnel reflects the projected rate of growth of the business as described in the next section. In the first year of operation, the personnel will be technically oriented in order to develop the prototype. In the second year, most of the new personnel will be engaged in production. The sales force is projected to expand rapidly only in the third year, when the sales emphasis will shift to selling to end users. As a longer range goal, five per cent. of the corporation will be involved in research activity. In addition, each of the other divisions will have their advanced development groups.

Key Personnel

Dr. Zoltan J. Kiss, President: The President of the corporation will be Dr. Zoltan J. Kiss. Dr. Kiss received his BASc in Engineering Physics in 1956, his Master's in 1957, and Ph. D. in Physics in 1959. He spent the following year at the Clarendon Laboratories, Oxford University, as a NRC post-doctoral fellow. Dr. Kiss joined RCA laboratories in 1960, where he worked on solid laser materials. In 1965, he became the head of Quantum Electronics Research at RCA, directing the research and development effort of over forty scientists and engineers. Dr. Kiss

is credited with the invention of three of the known seven solid state lasers. He is responsible for the development of impurity doped, inorganic, photochromic materials, and the invention and development of the cathodochromic storage tube.

Dr. Kiss has published over fifty technical papers in the areas of solid state physics, laser materials, photochromic materials, cathodochromic materials, and quantum electronic devices. He has lectured widely at major universities and has been the invited speaker at several international meetings in solid state physics and quantum electronics. Six patents are issued and fourteen are pending under his name assigned to RCA. This past year, Dr. Kiss received an IR - 100 award for the cathodochromic storage tube, and the David Sarnoff individual gold medal for science. Dr. Kiss is thirty-seven years old.

Dr. D.R. Bosomworth, Manager of CCT Products: Dr. Bosomworth received his BASc in Engineering Physics in 1959, his Master's in 1960, and Ph.D. in Physics in 1963. He joined RCA laboratories where he completed the design and development of a Michaelson interferometer spectrometer and the associated Fourier transfer signal processor. Using this instrument, he studied the Far I.R properties of insulators and semiconductors. He discovered and developed a new far infrared, photoconductive detector, using shallow donors in GaAs. For the past two years, he has worked on the development and manufacturing process of the CCST. He built and delivered to NASA a memory and display (MAD) system using the cathodochromic tube

with the phosphor photodiode readout. Dr. Bosomworth has published over fifteen technical papers and has four patent applications pending. Dr. Bosomworth is thirty-two years old.

E. Kornstein, Manager of Photochromic Devices: Mr. Kornstein received the AB degree in Physics and Mathematics from New York University in 1951. He received the MS degree in Physics from Drexel Institute of Technology in 1954.

Mr. Kornstein joined the Radio Corporation of America in Camden, New Jersey, in February 1951, and for approximately eight years worked in the following areas: development of color television cameras, television projectors for theaters, optical-radar rangefinders.

Mr. Kornstein has been with the Burlington facility since 1960, where he is the manager of the Optical Physics Techniques Group. This group has developed Q-switching techniques for laser rangefinders; CW optically pumped lasers; undersea second harmonic laser generators for the Navy; 50 magawatt, 10 pps ruby rangefinders for missile trackers; high power lasers for atmospheric research; laser alignment equipment, a lightweight, compact, ruby laser rangefinder for the Huey Cobra helicopter and was recently a laser obstacle scanner for the Department of Transportation. He is a member of the Optical Society and Boston regional chairman for the SMPTE (Society of Motion Picture and Television Engineer). He is the author of several published papers.

Dr. Joel Goldmacher: Dr. Goldmacher received his Bachelors

degree in Chemistry from Brooklyn Politechnic Institute and his Master's and Ph. D. in organic chemistry from Cornell University. Dr. Goldmacher is the developer of nematic liquid crystal materials. He has published extensively in the field of organic chemistry. He is thirty-three years old.

Mr. Ted C. Grunau, Manager of Sales and Marketing: Mr. Grunau obtained his BASc in Engineering Physics at the University of Toronto. From 1956 to 1959, he was design engineer for Isotope Corporation of Canada, involved in the development of thickners measuring beta gauges. In 1960, Mr. Granau joined the Hewlott-Packard Corporation, and presently he is the manager of marketing for Canada. He has extensive experience in the promotion, marketing, and sales of electrical measuring instruments, CRT scopes, computer displays and peripherals. Mr. Grunau is thirty-six years old.

Other key technical people joining OPTEL Corporation in the first six months include:

Dr. A. Fisher; Ph. D. in inorganic chemistry. Dr. Fisher is a well known expert in the field of electroluminescent materials and inorganic materials technology. He will be responsible for the initiation of research and materials activities to produce the cathodochromic materials.

Mr. L. Zanoni: one of the inventors of liquid crystal devices. He holds a B. A. degree in Chemistry and presently is employed by RCA laboratories. Mr. Zanoni has extensive background in device technology; his main responsibility will be to construct prototypes of the liquid crystal

devices.

Mr. Peter D. Stevens: Mr. Stevens is the key man for the advanced systems development associated with the various products. He obtained his BASc in E.E. in 1956. He has held various positions since that time at Ferranti Electronics in systems design development and production. In 1959, he was project supervisor for the design, installation, maintenance, and customer acceptance of a special purpose check-sorting computer system for the Federal Reserve Bank of New York. In 1963, he was chief engineer of the computer systems department, responsible for the complete operation to build and install general purpose digital computer systems. Mr. Stevens is thirty-six years old.

4.0 Business Plan and Financial Estimates

In this section, a detailed plan of action is presented for the different product areas. The development cost is broken down for each product; estimates for the first nine months of operation are expected to be accurate. Financial projections for five years are based on several assumptions which are described below.

4.1 The CCST devices: Our main effort in the first nine months will be concentrated on the construction of the prototype of the CCST radar display. In order to achieve this goal, we must immediately set up chemical facilities to prepare the cathodochromic materials, and make arrangements with tube manufacturing firms to build tubes for us using our materials. At the same time, all the electronics to drive the tubes must be assembled, and the test equipment to evaluate and test the materials and tubes will have to be acquired. We will strive to develop expertise and set up in house production facilities for the tubes at the earliest possible time. A proposed schedule of the operations in shown on Table 6. Projected sales are shown on Table 7. The price of the different CCT products reflects primarily the cost of the competing device. Even though the cost of manufacture of the CCT devices is less than its competion, this pricing is reasonable in light of the many advantages of the CCS tubes. At the projected rate of sales increase, our market penetration at the end of the fifth year is estimated to be about 5% of the radar display market, 4% of the facsimile transmission market, 4% of terminal displays,

Table 6

Year	Quarter	Plans
1	1	Set up chemical facilities, furnices, vacuum systems, materials. Order electronic test equipment and components for driving the CCS tubes. Set up spectroscopic facilities and demonstable electron beam apparatus to evaluate the materials.
	2	Prepare cathodochromic materials for sample tubes. Arrange with outside tube suppliers to prepare CCST tubes. Assemble and complete circutry needed for CCST radar display and direct view storage tube.
	3	Complete and demonstrate prototype of CCST radar display and direct view CCST. Start sales and marketing effort. Begin development of memory and display tube (MAD) needed in the facsimile transmission system.
	4	Begin assembly of CCST radar display systems with tubes manufactured outside. Start to build up "in house" production capability of CCST tubes. Expand chemical facilities for the preparation of volume quantity cathodochromic materials.
2	1	Delivery of first CCST display systems. Production of first "in house" CCST's. Complete prototype of MAD tube and assemble slow scan electronics needed in facsimile transmission. Do market research on facsimile transmission.
	2	Expand CCST tube production facility to 100 tubes per month. Initiate sales effort of facsimile systems. Initiate production of MAD tubes and high resolution tubes usable in computer terminal displays.

Table 6, continued

Year	Quarter	Plans
	3	Demonstrate prototype of terminal display. Initiate sales effort of terminal displays.
	4	Design and assemble electronics for terminal displays and its interface with users system.
3		Expand production facilities to 400 tubes per month. Organize regional marketing and sales.
4		Expand production facilities to 2000 tubes per month.
5		Expand production facilities to 6000 tubes per month.

and 5% of the straight display storage tube business.

The cost of the first years operation is shown on Table 8. Table 9 gives the forecast for the second year's cost. This includes setting up production facilities for the manufacture of the CCS tubes. The five year estimates are shown on Table 10. Table 11 shows the estimated profits and the return on capital. The favorable profit picture stems from the low manufacturing cost of the CCST devices compared to their competitors in the state of the art. The cumulated net cash flow is shown on Figure 2.

4.2 Liquid crystal devices: The liquid crystal business will be concentrated initially on alpha numeric displays, and later on the projection panel. We plan to construct a prototype of the alpha numeric indicators in the first six months, and a prototype of the projection panel in the fifth quarter of operations. In the fourth quarter, limited production of alpha numeric indicators will begin; in the fifth quarter, assembly of the projection display system will commence. Our liquid crystal business will depend primarily on this projection system. For the first two years of operation, the sales, marketing, business, and service functions will be performed by the CCST personnel. The production facility needed for the liquid crystal panels is relatively simple. Moreover, the tube manufacturing facility of the CCST devices will also be capable of producing the CCST or phosphor CRT tubes needed for the liquid crystal projection display system. Thus, by the third year of operation, the complete system can be manufactured and assembled "in house".

4.3 Photochromic devices: The first prototype in the P.C. area to be developed is the P.C. signal integrator. This can be accomplished by the end of the second quarter. We will attempt to sell this subsystem to an instrument manufacturer. In the second year of operation, our tube manufacturing facility can also produce the line-scan tubes used in the integrators. By the third quarter of the first year, we propose to start the development of the P.C. input device for the coherent processor. Government contract funds are anticipated at this time. In one year, three prototypes of this device will be completed for delivery. Production on a custom bases can commence by the end of the second year.

Full scale development of the optical disc will begin after the prototype of the P.C. input device is completed. In addition to government contract support, most of the revenues from the photochromic division will be reinvested for the development of the optical disc. We propose to have a prototype by the fourth year; two units can be delivered by the end of the fourth year. In the fifth year, the optical disc is anticipated to be our most profitable product.

4.4 Financial estimates: Our goal is to reach $100 million annual sales by the end of the fifth year of operations. We propose to show profits by the end of the second year. The outlines of our projections are shown on Tables 7 through 20. The three product areas are treated separately. Graphical representation of the accumulated cash flow is shown on Figure 2. As projected, OPTEL Corporation requires $500,000 investment for the first

nine months of operations. An additional $2,000,000 is required until the end of the second business year. By the third year, the company is self-sustaining.

We believe that the advantages of our technology in the most rapidly expanding sector of the electronics industry justify our projections.

Table 7

Projected CCT Devices Sales

Year	CCST (1) radar display		MAD (2) system		Terminal (3) tubes		CCST (4)		Accumulated sales $M
1	--	unit price	--	unit price	--	unit price	--	unit price	--
2	500	$5000	100	$2000	--	--	300	$1000	3.0
3	1000	5000	1000	2000	1000	$2500	1000	800	10.3
4	1500	5000	5000	1500	5000	2000	6000	600	28.6
5	2000	5000	20000	1000	20000	1250	25000	500	67.5

(1) The CCST radar display is the display end only of the total radar system.

(2) The memory and display (MAD) system includes the complete facsimile system (5" tube, 500 lines resolution).

(3) The terminal tubes are only the tubes (12" tube, 1000 lines resolution).

(4) The CCST for direct viewing includes a slow scan circuitry to display data transmitted through low bandwidth.

Table 8

Cost of Operations for the First Year
($ Thousands)

Quarters	1	2	3	4	Total
Salaries	34	51	61	79	225
Chemical facility and materials	30	40	20	50	140
Spectroscopic and test equipment	30	20	10	20	80
Plant and operation	12	10	12	14	48
Legal fees, employee benefits	15	10	15	20	60
Accounting, marketing, and selling expenses	1	1	15	30	47
Total	122	132	133	213	600
Cumulative	122	254	387	600	

Table 9

Second year CCST product costs and profits
($ Thousands)

Quarter	1	2	3	4	Total
Direct products cost	191	197	388	464	1240
Salaries (labor)	58	72	76	80	286
Production capital equipment	100	20	30	30	180
Purchased parts and subassemblies	8	75	250	320	653
Materials production	25	30	32	34	121
Development cost	92	108	119	122	441
Development and research salaries	56	64	68	68	256
Materials and contracts	12	14	15	16	57
Capital equipment	20	25	30	32	107
Leased equipment	4	5	6	6	21
Selling cost	37	42	55	65	199
Expenses	25	30	40	50	145
Salaries	12	12	15	15	54
General overhead	53	54	60	60	227
Administrative	12	12	15	15	54
Legal	15	15	16	16	62
Plant rent and upkeep	24	25	26	26	101
Miscellaneous	2	2	3	3	10
Total product expenses	373	401	622	711	2107
Depreciation	20	20	20	20	80
TOTAL COST	393	421	642	731	2187
Sales	50	250	750	1950	3000
Government contracts	25	25	25	50	125
GROSS INCOME	75	275	775	2000	3125
PROFIT	-317	-146	131	1269	938

Table 10

Projected Costs and Profits
($ Thousands)
CCST devices

Year	3	4	5
Product expenses			
Direct product cost	3,600	11,300	29,800
Development cost	1,200	2,300	4,800
Selling Cost	1,100	2,500	4,900
General OH	1,200	2,200	4,400
Total	7,100	18,300	43,900
Product costs			
Expenses	7,100	18,300	43,900
Depreciation	200	400	1,000
Total	7,300	18,700	44,900
Sales	10,300	28,600	67,500
Profit B. T.	3,000	9,900	22,600
Capital expenditures	800	1,800	3,000

Table 11

P and L statement and return on investment
($ Thousands)
CCST devices

Year	1	2	3	4	5
Sales	---	3,125	10,000	28,600	67,500
Cost of sales	---	2,187	7,300	18,700	44,900
Operating profit	---	938	3,000	9,900	22,600
% of gross sales	---	29.9%	29.1%	34.6%	33.4%
Receivables	---	1,250	1,710	4,730	11,200
Work in process	---	464	900	2,820	7,450
Capitalization	600	725	1,600	3,200	6,300
Total investment	---	2,439	4,210	10,750	24,950
% return on investment before taxes	---	38.5%	71.5%	91.9%	90.9%

(1) Assumes two months average age of accounts receivable.

(2) Assumes three months production-delivery time.

Table 12

First year - liquid crystal products
(Dollars)

Quarter	1	2	3	4	Total
Salaries	4,000	6,000	8,500	22,500	41,000
Capital equipment	5,000	6,000	6,000	15,000	32,000
Materials	2,000	4,000	4,000	8,000	18,000
Leased equipment	1,000	1,200	1,200	1,400	4,800
Plant	200	200	400	1,200	2,000
Selling expenses	500	500	2,000	10,000	13,000
Total	12,700	17,900	22,100	58,100	110,800
		12,700	30,600	52,700	
Cumulative	12,700	30,600	52,700	110,800	

Table 14

Projected liquid crystal products sales
($ Thousands)

Year	Alpha numeric indicators	Projection displays		Total
		units	average unit price	
1	----	--	--	--
2	250	40	10,000	650
3	1,000	200	7,000	2,400
4	2,000	500	5,000	4,500
5	3,000	2,000	4,000	11,000

Table 16

Second year - liquid crystals products costs and profits
($ Thousands)

Quarter	1	2	3	4	Total
Direct products cost	67	67	60	62	256
Materials	12	15	18	20	65
Capital equipment	40	30	20	20	110
Salaries	15	22	22	22	81
Development cost	25	25	25	26	101
Materials	3	4	4	5	16
Salaries	18	18	18	18	72
Test equipment	4	3	3	3	13
Selling costs	12	15	20	25	72
Overhead	14.5	18	23	28.5	84
Plant	2.5	3	3	3.5	12
Employee benefits, legal fees	12	15	20	25	74
TOTAL COST	118.5	125	128	141.5	513
Sales	50	100	200	300	650
PROFIT	-68.5	-25	72	259.5	137

Table 18

Projected Costs nd Profits
($ Thousands)
Liquid Crystals

Year	3	4	5
Product expenses			
Direct product cost	1,100	1,900	4,200
Development cost	250	350	500
Selling cost	225	450	1,000
Overhead	300	500	900
Total	1,875	3,200	7,600
Product cost			
Expenses	1,875	3,200	7,600
Depreciation	50	120	200
Total	1,925	3,320	7,800
Sales	2,400	4,500	11,000
Profit B. T.	475	1,180	3,200
Capital expenditures	200	400	900

Table 20

P and L statement and return on investment
($ Thousands)
liquid crystals

Year	1	2	3	4	5
Sales	---	650	2,400	4,500	11,000
Cost of sales	---	513	1,925	3,320	7,800
Operating profit	---	137	475	1,180	3,200
% of gross sales	---	21.1%	19.8%	26.2%	29.1%
Receivables	---	108	400	750	1,840
Work in process	---	64	275	475	1,050
Capitalization	110	120	400	700	1,200
Total investment	110	292	1,075	1,925	4,090
% return on investment before taxes	---	47.5%	43.8%	61.4%	78.2%

(1) Assumes two months average age of accounts receivable.

(2) Assumes three months production-delivery time.

FIGURE 2

Cumulated cash outflow