28867674

SCRTD METRO RAIL PROJECT

Preliminary Engineering

LIFE CYCLE COST MODEL

WBS 14DAA

VOLUME I

SCRTD Life Cycle Cost Model

User's Guide

Prepared by

SRI International

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TABLE OF CONTENTS

		Page Number
I.	INTRODUCTION	1
	1. Definition of Life Cycle Costs (LCC)	1
	2. Information Required for Life Cycle Cost Analyses	3
	3. Objectives of the Metro Rail LCC Model	4
	4. Abilities of the Life Cycle Cost Model	7
II.	USING THE SCRTD LIFE CYCLE COST MODEL	11
	1. Logging On	11
	2. Cost Input	16
	3. Output Reports	20
	4. Interpreting Life Cycle Cost Model Output	20
	5. Sensitivity Analysis	24
	6. Cost Differentials	26
III.	EXAMPLE PROBLEMS	27
	1. Example 1: Trade-off Between Operating and Capital Costs	27
	2. Example 2: Differing Costs and Lives	28
APPENDICES		
	A - FINANCIAL FORMULAS	31
	B - OUTPUT FOR EXAMPLE 1 WITH 8% WAGE INFLATION	33
	C - OUTPUT FOR EXAMPLE 1 WITH 12% WAGE INFLATION	47
	D - OUTPUT FOR EXAMPLE 1 USING COST DIFFERENTIALS	61
	E - COMPUTER PROGRAM	69

I. INTRODUCTION

I. INTRODUCTION

This introduction to the Metro Rail Life Cycle Cost Model covers the following four subjects:

- Definition of life cycle costs (LCC)
- Information required for LCC analysis
- Objectives of the SCRTD LCC Model
- Abilities of the SCRTD LCC Model.

1. Definition of Life Cycle Costs

Life cycle costing is a method of estimating the total lifetime cost of acquiring, operating, and maintaining a product. The product may be a piece of equipment, a facility, or an entire transportation system. The life cycle cost of a product is defined as its capital, initial, or acquisition cost plus the present value of a lifetime of operating and maintenance costs.

$$\text{LIFE CYCLE COST} = \text{CAPITAL COST} + \overset{\text{PRESENT}}{\underset{\text{VALUE}}{}} (\text{OPERATING} + \text{MAINTENANCE COSTS})$$

When investment alternatives are evaluated only on the basis of the capital cost or initial purchase price, potentially significant differences between a lifetime of operating and maintenance costs are ignored. Comparing alternatives by considering their entire lifetime (or life cycle) cost is a better method of selecting the least-cost alternative.

Life cycle cost analysis is useful when a trade-off exists between operating and maintenance costs and the capital cost of a product. For example, as shown in Figure 1, a relationship might exist between the dependability of a product and its capital cost. Product 1 has the lowest capital cost but also the lowest dependability. Product 3 has a high capital cost, but it is highly dependable. On the basis of capital cost alone, Product 1 would be the least expensive alternative. As shown in Figure 2, the inverse relationship might exist between the dependability

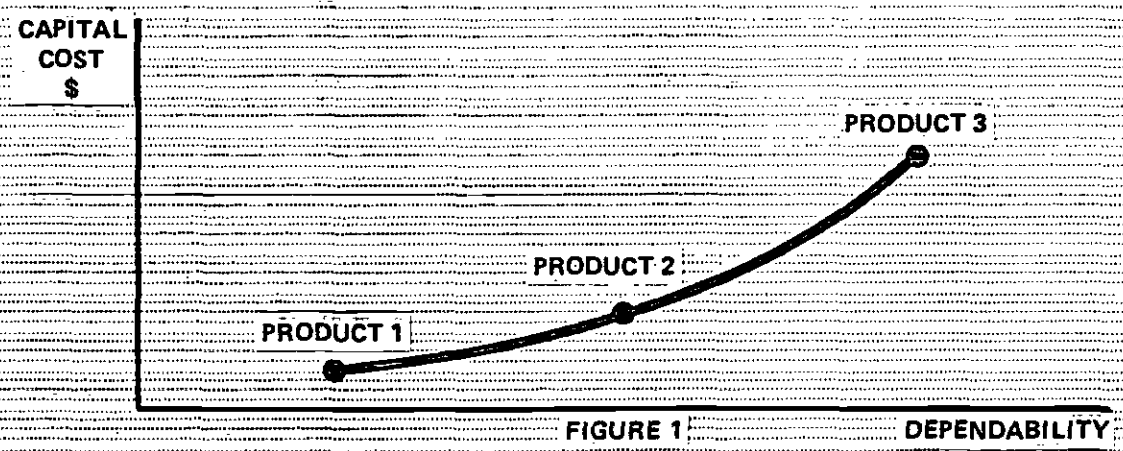

FIGURE 1

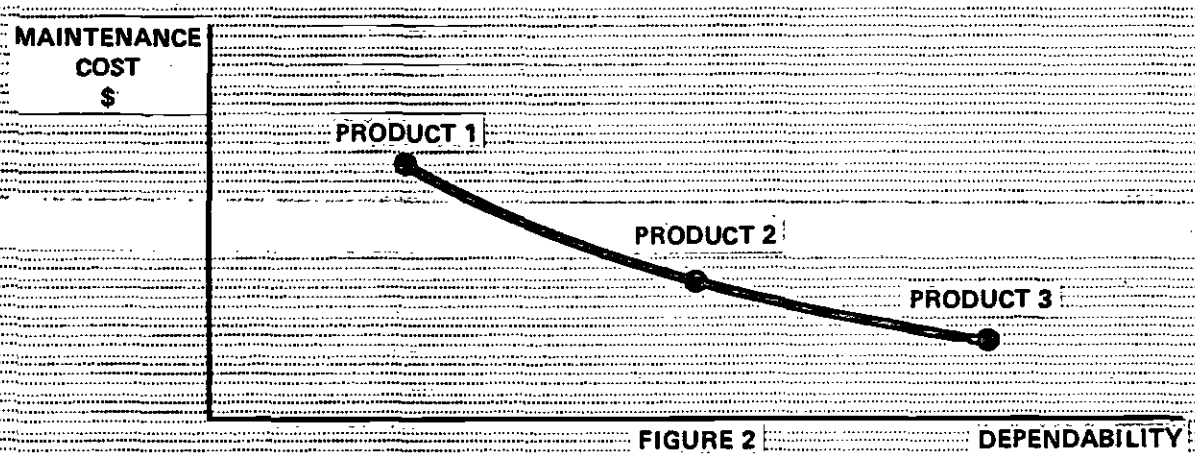

FIGURE 2

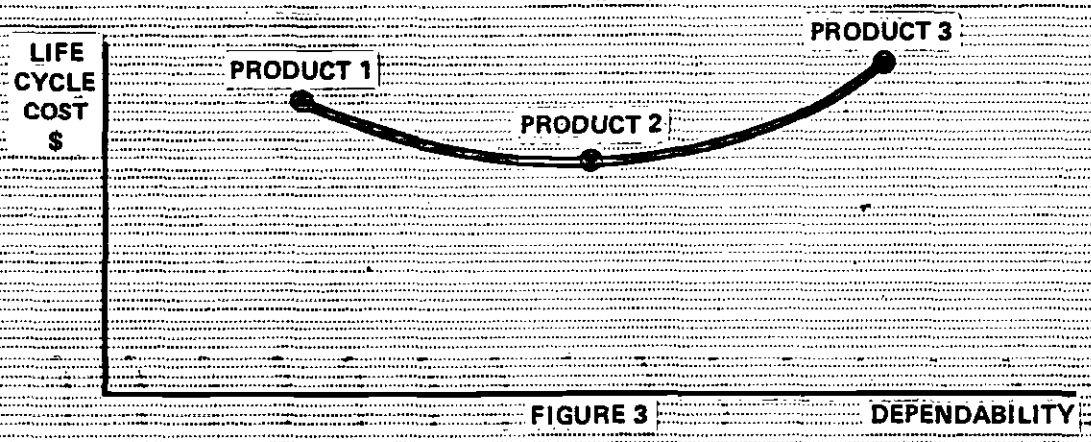

FIGURE 3

of the same product and its maintenance costs. Product 1 has the highest maintenance cost because it continually breaks down and is difficult to repair. Product 3, however, has a low maintenance cost because it rarely fails and is easy to fix.

The objective of life cycle cost analysis is to select the alternative that minimizes the sum of the capital and the operating/maintenance costs. As shown in Figure 3, adding the capital cost to the maintenance cost will indicate the product with the lowest life cycle cost. In this case, Product 2 would be preferred.

2. Information Required for Life Cycle Cost Analyses

For calculation of the life cycle cost of a product, the following parameters must either be known or estimated:

- Capital, or initial, cost
- Operating and maintenance costs
- Economic life
- Salvage value
- Time value of money.

These parameters are described in detail below.

Capital, or Initial, Costs--Capital, or initial, costs encompass the purchase price, freight and delivery charges, sales taxes, installation and testing costs, fees and licenses, and land, design, engineering, and construction expenses.

Operating and Maintenance Costs--Operating and maintenance costs comprise direct, indirect, salaried and management labor, fringe benefits, energy and utilities, parts, materials, and freight and delivery charges needed to operate, maintain, and manage the system. These costs may increase over time because of inflation and obsolescence, or they may decrease because of gains in efficiency and new technology. Operating costs do not include depreciation. Interest costs on money borrowed to pay for the capital expenditure must be excluded from operating costs. Otherwise, double counting would result, the capital expenditure being included once as a capital cost and again as the loan was repaid.

Economic Life--The economic life is the time over which a product or system can be used for the purpose for which it was intended. The physical life of a product may be longer than its economic life. When different parts of a system have different economic lives, the life cycle cost must include the anticipated replacement or major overhaul costs of the shorter-lived part or parts.

Salvage Value--The salvage value is the net dollar amount realized from the sale or disposal of used equipment or facilities. Salvage values can be positive or negative. In most of the life cycle cost analyses for the Metro Rail project, the salvage value can be assumed to be zero. This is because at high interest rates, the value of a "salvage dollar" received many years from now is negligible today. For example, if a railcar costing $1 million today could be sold 30 years from now for $50,000, and the interest rate is 15%, the salvage value of the railcar is worth

$$\frac{\$\ 50{,}000}{(1.15)^{30}} = \$755 \text{ today} \quad .$$

In this example, a 1% error in estimating the capital cost is more significant than a 1,000% error in estimating the salvage value.

Time Value of Money--The time value of money is also known as the interest or discount rate. It is a measure of the value we place on being able to use our money today as opposed to waiting until next year to use it. The interest rate used in life cycle cost analyses should represent the opportunity cost of capital--the return we could earn on the money if we were not going to invest it in the proposed project. If a project is financed by government borrowing, the appropriate interest rate is the cost of the debt to the government entity that is borrowing it. If a project is financed by taxes, the appropriate interest rate is the one that the taxpayers could earn if they could keep their money and invest it. For the purposes of simplicity and consistency in analysis, the interest rate used in Metro Rail LCC analyses should be the present yield on long-term U.S. Treasury bonds or California tax-exempt revenue bonds. The information on Treasury yields is available in the financial section of most newspapers, as illustrated in Exhibit 1. (Be sure to choose the yield and not the nominal or face rate of the bond.) On the date of publication of the newspaper clipping shown in Exhibit 1, the longest term U.S. Treasury bond had a yield of 14.06%. On April 30, 1982, the interest rate for local and state borrowings averaged 11.20% to 12.78% (depending on the bond rating), as shown in Exhibit 2.

3. Objectives of the Metro Rail LCC Model

The objective of life cycle cost analysis is to search for significant cost factors that can be influenced by planning and design decisions. Life cycle costing provides quantitative dollar comparisons between alternative methods of achieving an operational goal or requirement. The Metro Rail Life Cycle Cost Model will enable project managers

Exhibit 1

U.S. TREASURY BOND YIELDS

Treasury Issues

* * *

Bonds, Notes & Bills

Thursday, June 17, 1982

Mid-afternoon Over-the-Counter quotations; sources on request.

Decimals in bid-and-asked and bid changes represent 32nds; 101.1 means 101 1/32. a-Plus 1/64. b-Yield to call date. d-Minus 1/64. n-Treasury note.

U.S. TREASURY BONDS

Rate	Mat.	Date	Bid	Asked	Chg.	Bid Yld.
8¼s,	1982	Jun n	99.26	99.30+	.2	10.36
8⅝s,	1982	Jun n	99.26	99.30		10.70
8⅞s,	1982	Jul n	99.13	99.17+	.2	12.74
8¼s,	1982	Aug n	99.4	99.8 +	.1	12.79
9s,	1982	Aug n	99.8	99.12		12.79
11¼s,	1982	Aug n	99.16	99.20		12.67
8⅝s,	1982	Sep n	98.17	98.21 –	.1	13.17
11⅞s,	1982	Sep n	99.14	99.18 –	.3	13.16
12⅛s,	1982	Oct n	99.12	99.14 –	.3	13.54
7½s,	1982	Nov n	97.13	97.17 –	.4	13.54
7½s,	1982	Nov n	97.16	97.20 –	.9	14.04
13⅞s,	1982	Nov n	99.26	99.30 –	.4	13.91
9⅛s,	1982	Dec n	97.20	97.24 –	.3	13.96
15⅛s,	1982	Dec n	100.11	100.15 –	.4	14.16
13⅝s,	1983	Jan n	99.17	99.21 –	.4	14.22
8s,	1983	Feb n	96.4	96.8 –	.4	14.19
13⅞s,	1983	Feb n	99.20	99.24 –	.4	14.26
9¼s,	1983	Mar n	96.10	96.14 –	.5	14.23
12⅝s,	1983	Mar n	98.20	98.24 –	.6	14.27
14⅛s,	1983	Apr n	100.2	100.6 –	.8	14.26
7⅞s,	1983	May n	94.30	95.2 –	.7	13.89
11¾s,	1983	May n	97.30	98.2 –	.6	13.98
15⅝s,	1983	May n	101	101.2 –	.7	14.38
3½s,	1978-83	Jun	91.23	92.7 –	.3	11.86
8¼s,	1983	Jun n	95.1	95.5 –	.5	14.11
14⅝s,	1983	Jun n	100.4	100.8 –	.7	14.35
15⅞s,	1983	Jul n	101.8	101.10 –	.12	14.55
9¼s,	1983	Aug n	94.19	94.23 –	.9	14.37
11⅞s,	1983	Aug n	97.9	97.13 –	.9	14.39
16⅛s,	1983	Aug n	101.24	101.26 –	.10	14.54
9¾s,	1983	Sep n	94.20	94.24 –	.10	14.39
16s,	1983	Sep n	101.16	101.24 –	.10	14.46
15½s,	1983	Oct n	100.30	101.6 –	.10	14.50
7s,	1983	Nov n	91.21	91.29 –	.13	13.52
9⅞s,	1983	Nov n	94.4	94.12 –	.14	14.44
12¼s,	1983	Nov n	96.29	97.1 –	.13	14.48
10½s,	1983	Dec n	94.17	94.25 –	.10	14.43
13s,	1983	Dec n	97.26	98.2 –	.13	14.45
15s,	1984	Jan n	100.8	100.16 –	.14	14.44
7¼s,	1984	Feb n	90.5	90.13 –	.11	13.84
15½s,	1984	Feb n	100.13	100.24 –	.14	14.47
14½s,	1984	Mar n	98.30	99.2 –	.17	14.74
14¼s,	1984	Mar n	99.24	100 8	.16	14.25
13⅞s,	1984	Apr n	98.17	98.25 –	.14	14.44
9¼s,	1984	May n	91.10	91.18 –	.18	14.48
13¼s,	1984	May n	97.30	98.6 –	.10	14.37
13¾s,	1984	May n	98.14	98.22 –	.11	14.54
15⅝s,	1984	May n	101.20	101.24 –	.15	14.46
8⅞s,	1984	Jun n	90.10	90.18 –	.11	14.41
6¾s,	1984	Aug	86.26	87.26 –	.4	13.05
7¼s,	1984	Aug n	87.28	88.4 –	.11	13.81
13¼s,	1984	Aug n	97.12	97.21 –	.17	14.56
12⅛s,	1984	Sep n	95.10	95.18 –	.17	14.48
14¾s,	1984	Nov n	99.10	99.14 –	.17	14.65
16s,	1984	Nov n	102.16	102.29 –	.16	14.67
14s,	1984	Dec n	98.30	99.6 –	.13	14.39
8s,	1985	Feb n	87.6	87.14 –	.21	13.81
14⅜s,	1985	Feb n	99.18	99.26 –	.19	14.78
13⅜s,	1985	Mar n	97.7	97.11 –	.18	14.57
3½s,	1985	May	82.10	83.10 –	.6	10.02
4½s,	1975-85	May	82.18	83.18 –	.6	11.02
10⅜s,	1985	May n	90.5	90.13 –	.20	14.54
14⅛s,	1985	May n	98.20	98.24 –	.20	14.47
14⅜s,	1985	May n	99.19	100.3 –	.17	14.20
14s,	1985	Jun n	98.17	98.25 –	.20	14.51
8¼s,	1985	Aug n	84.29	85.5 –	.21	14.25
9⅜s,	1985	Aug n	87.24	88 –	.22	14.50
15⅞s,	1985	Sep n	102.22	102.30 –	.20	14.72
11¼s,	1985	Nov n	92.17	92.25 –	.23	14.51
14⅛s,	1985	Dec n	98.16	98.24 –	.18	14.59
13⅛s,	1986	Feb n	96.25	97.1 –	.29	14.57
14s,	1986	Mar n	98	98.8 –	.24	14.62
7⅞s,	1986	May n	81.1	81.9 –	.17	14.30
13¾s,	1986	May n	97.20	97.24 –	.19	14.52
8s,	1986	Aug n	80.22	80.30 –	.18	14.23
6¼s,	1986	Nov	78.12	79.12 –	1.4	11.99
13⅞s,	1986	Nov n	97.22	97.30 –	.22	14.53
16⅛s,	1986	Nov n	103.27	103.31 –	.27	14.86
9s,	1987	Feb n	82.7	82.15 –	.25	14.28
12⅞s,	1987	Feb n	93.23	94.9 –	1	14.48
12s,	1987	May n	92.6	92.14 –	.22	14.19
14s,	1987	May n	97.27	98.3 –	.25	14.56
13⅜s,	1987	Aug n	96.27	97.31 –	.25	14.57
7¾s,	1987	Nov n	75.28	76.12 –	.24	14.00
12⅝s,	1988	Jan n	92.9	92.17 –	.23	14.37
13¼s,	1988	Apr n	95.5	95.13 –	.30	14.44
8¼s,	1988	May n	77.3	77.9 –	.28	13.94
14s,	1988	Jul n	97.25	97.29 –	.29	14.53
15⅜s,	1988	Oct n	102.18	102.22 –	.31	14.70
8¼s,	1988	Nov n	77.14	77.30 –	1	14.09
14⅝s,	1989	Jan n	99.28	100 –	.27	14.62
14⅜s,	1989	Apr n	99	99.8 –	.28	14.56
9¼s,	1989	May n	79.4	79.20 –	.30	13.94
10¾s,	1989	Nov n	84.10	84.18 –	.32	14.19
3½s,	1990	Feb	81.30	82.30 –	.16	6.25
8¼s,	1990	May	73.16	74.16 –	.26	13.62
10⅜s,	1990	Aug n	83.6	83.14 –	1.4	14.25
13s,	1990	Nov n	93.16	93.24 –	1.7	14.31
14½s,	1991	May n	99.20	99.28 –	1.5	14.52
14⅞s,	1991	Aug n	101.16	101.24 –	1.2	14.52
14¼s,	1991	Nov n	98.16	98.24 –	1.4	14.49
14⅜s,	1992	Feb n	100.18	100.26 –	1	14.46
13⅞s,	1992	May n	96.11	96.15 –	1.2	14.43
4¼s,	1987-92	Aug	81.28	82.12 –	.18	6.67
7¼s,	1992	Aug	65.4	65.20 –	1.4	13.58
4s,	1988-93	Feb	82.6	82.22 –	.15	6.25
6¾s,	1993	Feb	61.1	61.17 –	.21	13.72
7¼s,	1993	Feb	66.10	66.26 –	.21	13.94
7½s,	1988-93	Aug	64.28	65.12 –	.22	13.65
8¾s,	1993	Aug	69.17	69.25 –	1.1	14.07
8¾s,	1993	Nov	69.6	69.14 –	1.4	14.09
9s,	1994	Feb	71.6	71.14 –	1.1	14.05
4¼s,	1989-94	May	82.6	82.22 –	.15	6.20
8¼s,	1994	Aug	69.8	69.16 –	1.4	14.06
10½s,	1994	Nov	76.24	77 –	1.7	14.09
3s,	1995	Feb	82.12	82.28 –	.16	4.82
10½s,	1995	Feb	78.24	79 –	1.6	14.09
10¾s,	1995	May	78	78.8 –	1	14.07
12⅝s,	1995	May	91.4	91.12 –	1.1	14.10
11½s,	1995	Nov	84.2	84.10 –	1.6	14.14
7s,	1993-98	May	57.2	57.18 –	1.9	12.57
8½s,	1998	Nov	82.3	82.19 +	.3	5.07
8½s,	1994-99	May	65.6	65.22 –	1.3	13.79
7⅞s,	1995-00	Feb	59.28	60.4 –	1.7	14.03
8⅜s,	1995-00	Aug	62.10	62.18 –	1.20	14.15
11¾s,	2001	Feb	83.20	84.6 –	1.6	14.17
13⅛s,	2001	May	92.14	92.22 –	1.2	14.25
8s,	1996-01	Aug	60.28	61.4 –	1.4	13.83
13⅜s,	2001	Aug	93.31	94.3 –	1.10	14.29
15¼s,	2001	Nov	107.21	107.29 –	1.5	14.32
14¼s,	2002	Feb	99.11	99.19 –	1.5	14.31
8¼s,	2000-05	May	61.26	62.2 –	.30	13.72
7¼s,	2002-07	Feb	58.22	58.30 –	1.4	13.34
7⅞s,	2002-07	Nov	60.2	60.10 –	1.4	13.34
8⅜s,	2003-08	Aug	61.6	61.14 –	1.10	13.90
8¾s,	2003-08	Nov	63.28	64.4 –	1.6	13.87
9⅛s,	2004-09	May	66.8	66.16 –	1.8	13.92
10¼s,	2004-09	Nov	74.20	74.28 –	1.8	13.98
11¾s,	2005-10	Feb	83.21	83.29 –	1.5	14.07
10s,	2005-10	May	71.30	72.6 –	1.4	13.98
12¾s,	2005-10	Nov	90.16	90.24 –	1.10	14.08
13⅞s,	2006-11	May	98.8	98.16 –	1.7	14.09
14s,	2006-11	Nov	99.12	99.20 –	1.6	14.06

Source: Wall Street Journal, June 17, 1982.

Exhibit 2

STATE AND LOCAL BOND YIELDS

1.35 INTEREST RATES Money and Capital Markets

Averages, percent per annum; weekly and monthly figures are averages of business day data unless otherwise noted.

	Instrument	1979	1980	1981	1982				1982, week ending				
					Jan.	Feb.	Mar.	Apr.	Apr. 2	Apr. 9	Apr. 16	Apr. 23	Apr. 30
	MONEY MARKET RATES												
1	Federal funds[1,2]	11.19	13.36	16.38	13.22	14.78	14.68	14.94	14.99	15.15	14.68	15.01	14.72
	Commercial paper[3,4]												
2	1-month	10.86	12.76	15.69	12.90	14.62	13.99	14.38	14.64	14.47	14.65	14.24	14.04
3	3-month	10.97	12.66	15.32	13.09	14.53	13.80	14.06	14.29	14.19	14.24	13.94	13.79
4	6-month	10.91	12.29	14.76	13.35	14.27	13.47	13.64	13.86	13.74	13.78	13.53	13.46
	Finance paper, directly placed[3,4]												
5	1-month	10.78	12.44	15.30	12.67	14.41	13.73	14.17	14.44	14.35	14.45	13.91	13.85
6	3-month	10.47	11.49	14.08	12.56	13.59	12.91	13.21	13.20	13.34	13.33	13.10	13.03
7	6-month	10.25	11.28	13.73	12.56	13.58	12.89	13.09	13.16	13.24	13.19	12.96	12.90
	Bankers acceptances[4,5]												
8	3-month	11.04	12.78	15.32	13.06	14.47	13.73	13.95	14.18	14.13	14.08	13.85	13.73
9	6-month	n.a.	n.a.	14.66	13.31	14.09	13.33	13.49	13.69	13.59	13.61	13.41	13.33
	Certificates of deposit, secondary market[6]												
10	1-month	11.03	12.91	15.91	13.03	14.78	14.12	14.44	14.68	14.54	14.61	14.36	14.17
11	3-month	11.22	13.07	15.91	13.51	15.00	14.21	14.44	14.70	14.56	14.60	14.34	14.21
12	6-month	11.44	12.99	15.77	14.25	15.12	14.25	14.42	14.69	14.54	14.57	14.31	14.25
13	Eurodollar deposits, 3-month[3]	11.96	14.00	16.79	14.29	15.75	14.90	15.18	15.31	15.28	15.43	15.25	14.85
	U.S. Treasury bills[4]												
	Secondary market[7]												
14	3-month	10.07	11.43	14.03	12.28	13.48	12.68	12.70	13.32	13.10	12.77	12.39	12.42
15	6-month	10.06	11.37	13.80	12.83	13.61	12.77	12.80	13.17	13.06	12.92	12.61	12.57
16	1-year	9.75	10.89	13.14	12.77	13.11	12.47	12.50	12.76	12.69	12.59	12.38	12.30
	Auction average[8]												
17	3-month	10.041	11.506	14.077	12.412	13.780	12.493	12.821	13.399	12.893	12.849	12.497	12.469
18	6-month	10.017	11.374	13.811	12.930	13.709	12.621	12.861	13.243	12.802	12.899	12.719	12.640
19	1-year	9.817	10.748	13.159	13.143	13.180	12.509	12.731	.....	.....	.....	12.731	.....
	CAPITAL MARKET RATES												
	U.S. Treasury notes and bonds[9]												
	Constant maturities[10]												
20	1-year	10.67	12.05	14.78	14.32	14.73	13.95	13.98	14.32	14.20	14.07	13.86	13.75
21	2-year	10.12	11.77	14.56	14.57	14.82	14.19	14.20	14.51	14.40	14.27	14.09	13.99
22	2-½-year[11]	.....	.....	.....	.....	.....	.....	.....	.....	14.35	.....	14.10	.....
23	3-year	9.71	11.55	14.44	14.64	14.73	14.13	14.18	14.47	14.36	14.21	14.09	14.02
24	5-year	9.52	11.48	14.24	14.65	14.54	13.98	14.00	14.34	14.25	14.00	13.85	13.87
25	7-year	9.48	11.43	14.06	14.67	14.46	13.93	13.94	14.30	14.21	13.90	13.76	13.82
26	10-year	9.44	11.46	13.91	14.59	14.43	13.86	13.87	14.15	14.13	13.85	13.69	13.78
27	20-year	9.33	11.39	13.72	14.57	14.48	13.75	13.57	13.92	13.88	13.51	13.39	13.47
28	30-year	9.29	11.30	13.44	14.22	14.22	13.53	13.37	13.70	13.66	13.31	13.19	13.28
	Composite[12]												
29	Over 10 years (long-term)	8.74	10.81	12.87	13.73	13.63	12.98	12.84	13.17	13.10	12.79	12.69	12.73
	State and local notes and bonds												
	Moody's series[13]												
30	Aaa	5.92	7.85	10.43	12.30	12.20	11.95	11.66	11.90	12.30	11.70	11.20	11.20
31	Baa	6.73	9.01	11.76	13.95	13.83	13.70	13.29	13.70	13.70	13.30	13.00	12.78
32	*Bond Buyer* series[14]	6.52	8.59	11.33	13.28	12.97	12.82	12.59	13.13	12.99	12.54	12.29	11.97
	Corporate bonds												
	Seasoned issues[15]												
33	All industries	10.12	12.75	15.06	16.05	16.13	15.68	15.53	15.73	15.70	15.59	15.42	15.40
34	Aaa	9.63	11.94	14.17	15.18	15.27	14.58	14.46	14.66	14.68	14.53	14.31	14.31
35	Aa	9.94	12.30	14.75	15.75	15.72	15.21	14.90	15.18	15.10	14.91	14.81	14.75
36	A	10.20	12.89	15.29	16.19	16.35	16.12	15.95	16.14	16.09	15.96	15.85	15.82
37	Baa	10.69	13.67	16.04	17.10	17.18	16.82	16.78	16.91	16.89	16.80	16.69	16.70
	Aaa utility bonds[16]												
38	New issue	10.03	12.74	15.56	15.68	15.93	15.26	15.83	15.88	16.13	15.78	15.55	.....
39	Recently offered issues	10.02	12.70	15.56	15.88	15.97	15.19	15.45	15.25	15.65	15.39	15.27	15.55
	MEMO: Dividend/price ratio[17]												
40	Preferred stocks	9.07	10.57	12.36	13.19	13.20	12.97	12.90	13.15	12.89	13.01	12.92	12.76
41	Common stocks	5.46	5.25	5.41	5.95	6.06	6.28	5.99	6.22	6.01	6.00	6.01	5.94

1. Weekly and monthly figures are averages of all calendar days, where the rate for a weekend or holiday is taken to be the rate prevailing on the preceding business day. The daily rate is the average of the rates on a given day weighted by the volume of transactions at these rates.
2. Weekly figures are statement week averages—that is, averages for the week ending Wednesday.
3. Unweighted average of offering rates quoted by at least five dealers (in the case of commercial paper), or finance companies (in the case of finance paper). Before November 1979, maturities for data shown are 30–59 days, 90–119 days, and 120–179 days for commercial paper; and 30–59 days, 90–119 days, and 150–179 days for finance paper.
4. Yields are quoted on a bank-discount basis, rather than an investment yield basis (which would give a higher figure).
5. Dealer closing offered rates for top-rated banks. Most representative rate (which may be, but need not be, the average of the rates quoted by the dealers).
6. Unweighted average of offered rates quoted by at least five dealers early in the day.
7. Unweighted average of closing bid rates quoted by at least five dealers.
8. Rates are recorded in the week in which bills are issued.
9. Yields are based on closing bid prices quoted by at least five dealers.
10. Yields adjusted to constant maturities by the U.S. Treasury. That is, yields are read from a yield curve at fixed maturities. Based on only recently issued, actively traded securities.
11. Each weekly figure is calculated on a biweekly basis and is the average of five business days ending on the Monday following the calendar week. The biweekly rate is used to determine the maximum interest rate payable in the following two-week period on small saver certificates. (See table 1.16.)
12. Unweighted averages of yields (to maturity or call) for all outstanding notes and bonds neither due nor callable in less than 10 years, including several very low yielding "flower" bonds.
13. General obligations only, based on figures for Thursday, from Moody's Investors Service.
14. General obligations only, with 20 years to maturity, issued by 20 state and local governmental units of mixed quality. Based on figures for Thursday.
15. Daily figures from Moody's Investors Service. Based on yields to maturity on selected long-term bonds.
16. Compilation of the Federal Reserve. Issues included are long-term (20 years or more). New-issue yields are based on quotations on date of offering; those on recently offered issues (included only for first 4 weeks after termination of underwriter price restrictions), on Friday close-of-business quotations.
17. Standard and Poor's corporate series. Preferred stock ratio based on a sample of ten issues: four public utilities, four industrials, one financial, and one transportation. Common stock ratios on the 500 stocks in the price index.

Source: Federal Reserve Bulletin, May 1982.

to evaluate the cost implications of alternative designs. The model does not permit evaluation of the risks of using new technologies, and, as with any model, the output is no more accurate than the inputs.

Because the LCC Model is computerized and allows for the simultaneous comparison of three alternatives, it is especially useful for sensitivity ("what if") analyses. If small changes in one variable, such as the inflation rate for electricity costs, can affect the choice between alternatives, management attention must be focused on additional studies and refinement of cost estimates in those areas. Conversely, if changing the value of the variable(s) within reasonable limits does not alter the outcome, further life cycle cost analysis is of little value.

4. Abilities of the Life Cycle Cost Model

Present Value and Annual Equivalent Costs

The Metro Rail LCC Model is a financial model that calculates the life cycle cost of a product or system from two perspectives:

- Present value
- Annual equivalent cost.

The present value (PV) method discounts all the future cash flows (the operating and maintenance costs) backward to the present. Because we can invest our money and earn a return on it, having a dollar in the future is not worth as much to us as having one today. The PV method "discounts" the dollar back from the future to what it would be worth if we could have it to invest today. The factor that tells us how much less we value having a dollar next year compared with this year is called the "interest" or "discount" rate. For example, if the "interest" rate is 10%, having $1,000 5 years from now would be equivalent to having

$$\frac{\$1{,}000}{(1.10)(1.10)(1.10)(1.10)(1.10)} = \frac{\$1{,}000}{(1.10)^5} = \$620.92 \text{ today} .$$

Viewing the same example another way, if we invested $620.92 at a 10% interest rate today and let it grow for 5 years, we would end up with $1,000. In summary, the PV method tells us what our future savings/costs would be worth if we could have them today.

Another way to view life cycle costs is from the standpoint of annual equivalent cost (AEC). The AEC method amortizes the present cash flow (the initial or capital cost) forward, spreading it out in equal annual amounts over the life of the product or system. The AEC is the amount we would repay each year if we were to borrow just enough money for the capital expenditure, similar to the payments made on a home

mortgage. For example, if we were to borrow $100,000 at an interest rate of 15% and pay it back in equal annual payments over a 30-year period, the AEC would be $15,230.02.*

The AEC method is useful for comparing a capital cost to a stream of annual savings, such as might occur in a cost savings project. The AEC can be calculated easily if the capital cost, the number of years to be modeled, and the interest rates are known. If the annual equivalent cost is more than the annual savings, the project is not cost-effective. If the AEC is less than the annual savings, the project is cost-effective. The difference between the AEC and the savings represents the net annual benefit (or loss) due to implementation of the project.

The AEC method is most useful, however, in comparing alternatives with different economic lives. Because the method calculates the annual equivalent of the capital cost, it is not necessary to consider the cost of replacing a capital expenditure. The two alternatives are directly comparable on the basis of their equivalent costs.

Both the AEC method and the PV method result in an identical ranking of alternatives. The mathematical formulas for AEC and PV as a function of the interest rate and the number of years to be modeled are contained in Appendix A.

Life Cycle Cost Model Inputs

All inputs to the LCC Model must be in dollars, years, and percentages. The model does not convert the number of mechanics, kilowatt-hours, or yards of concrete into dollars. Those calculations must be performed manually or generated as the output from simulation models.

The LCC Model accepts inputs for 20 categories of capital costs and 20 categories of operating and maintenance costs.** For each capital cost, the user must specify the base-year cost, the economic life of the item, and the salvage value. For the operating and maintenance costs, the user must input the base-year annual cost and inflation rate for each cost.

In addition, the user must input the number of years of operations to be modeled (up to 50), the interest rate, the timing of the capital costs relative to the operating and maintenance costs, and an inflation rate for replacement costs on capital expenditures.

---

*The present value of 30 years of costs/savings of $15,230.02 per year at a discount rate of 15% will equal $100,000.

**The computer program can be modified to provide as many cost categories as required.

The LCC Model has been designed for flexibility. If the user is interested in calculating the lifetime or the annual cost of the entire system, inputs can be made for all costs associated with building and operating a subway. Such an analysis might prove useful in determining the required break-even fare or anticipated operating deficit. More likely, the user will wish only to compare two or more alternatives that affect only one or two cost areas (e.g., electricity savings against dipped profile costs). In that case, the model only calculates the life cycle cost of the system or subsystem under analysis.

Inputting all the absolute costs associated with an alternative is not necessary, especially when most of the costs are unaffected by the choice of alternatives. Two alternatives can be evaluated by comparing their incremental costs with their incremental savings. Being careful to keep the arithmetic signs (+/-) correct, the user can identify the preferable alternative by using the difference in capital costs as the capital cost input and the difference in operating and maintenance costs as the operating and maintenance cost input. If the present value of the savings less the capital costs is positive, the project is cost-effective. If the present value of the savings less the capital costs is negative, the project is not cost-effective. A more detailed description of this approach is included in Chapter III, "Example Problems."

II. USING THE METRO RAIL LIFE CYCLE COST MODEL

This chapter describes the procedures for running the Life Cycle Cost (LCC) Model on SCRTD terminals. It covers five subject areas:

- Logging on (and off)
- Cost input
- Output reports
- Interpreting the LCC model output
- Sensitivity analysis
- Cost differentials.

Example problems are described in Chapter III and are used to demonstrate how the model functions. The computer procedures used to generate input and output files for those examples are described in this chapter.

1. Logging On

Access to the Model

The SCRTD LCC Model is on the SRI VAX computer system and can be accessed by using TYMNET. The SCRTD terminal to be used is ADM42. This terminal has a 132-line carriage and a high-speed print capability. Output results therefore are printed on-line rather than sent to a separate printer. The TYMNET telephone number is:

213-623-8500.

The logging in procedure begins with the computer request for the log in entry code.

The code is: SRI 3559005

The computer will request the password.

Enter the password:

SRIINTL

Enter *52

The computer will respond with:

SERVICE 52 START

The computer will request the user name.

After entering username, the user types SCRTD and hits the return carriage. Then the computer prompts for the password, and the user enters it.

After this log on, the message of the day appears. Exhibit 3 is an example of the log on procedure.

Creating, Editing, and Deleting Input Files

The user will create, edit, and delete input files to make changes to alternatives being run. The user can create and store several files and access and edit them as required.

After the log on procedure has been completed, the VAX asks for a user command by printing a "$." The user responds by entering

EDT FILENAME.DAT

where FILENAME.DAT is the name of the file to be edited. If FILENAME.DAT is a new file, the computer will indicate that this is an empty file and that the user may start entering data. We suggest using one of the existing input files that contains instructions for entering data. STATSIZE.DAT or STATSIZEZ.DAT are two files available for user modification. Exhibit 4 is an input file for Example 1 (discussed in Chapter III).

Once the user is in the edit mode, the file can be edited using the instructions presented in Exhibit 5.

After changes to the input file have been completed, the user enters

EXIT or
EXIT FILENAME.DAT

If no name is given on EXIT, the name specified with the EDT command above will be used. If FILENAME.DAT is the original name of the file, a new copy of the old file with the editing changes will be made. If it is a new name, a new data file will be created and the original file retained. To delete a file, the user types

DEL FILENAME.DAT;*

and all versions of FILENAME.DAT will be deleted.

Running the LCC Model

To run the LCC Model, the user types in LCC. The following message appears:

ENTER LCC MODEL INPUT FILENAME:

Exhibit 3

LOG ON PROCEDURE AND ACCESSING EDITOR

```
XPXXXX@XXXPXXX@XXP@XX X@XXX@XXPXX
-2354-037
Please Log In;  SRI3559005


P 07
SRI  Is Online

*
Service 52 Start

Username:  SCRTD
Password:

        WELCOME TO VAX/VMS VERSION V2.5 ON NODE _CRVAX::

              YOU HAVE NEW MAIL.

O NEW DOWNTIME SCHEDULE - TYPE DOWNTIME TO GET MOST CURRENT LIST. 4-JUL-82

O THE IMSL LIBRARY HAS BEEN UPDATED TO VERSION 8.1.

O ANY PROBLEMS, QUESTIONS OR GRIPES SHOULD BE MAILED TO ACTION OR PHONE
  OPERATIONS X3550.


$ EDT STATSIZE.DAT
```

II. USING THE METRO RAIL LIFE CYCLE COST MODEL

INPUT FILE FOR EXAMPLE 1

```
set screen 133
*t w
    1           #                  SCRTD Life Cycle Cost Model (LCC) Input
    2           #
    3           # The character "#" as the first non-blank character on a line flags that line
    4           # as a comment in the input file. Lines starting with "#" are also
    5           # required to delimit records of one type from another, e. g.
    6           # to separate the capital equipment cost records from the operations and
    7           # maintenance cost records.  Other than serving as delimiters, "#" records
    8           # are otherwise ignored in the input stream.
    9           #
   10           # On line below, input the run title (up to 80 characters)
   11           EIGHT CAR VS TEN CAR TRAINS
   12           # On line below, enter:
   13           # (1) Base year for run, e.g. 1985
   14           # (2) First year of operations, e.g. 1987
   15           # (3) Number of years to be modelled, from 1 to 50
   16           1982 1988 40
   17           #
   18           # Remainder of file is repeated for each alternative (up to 3)
   19           #
   20           # On line below, enter Alternative's title (up to 80 characters):
   21           Eight Car Stations
   22           #
   23           # On line below, enter:
   24           # (1) Alternative's interest or discount rate in %
   25           # (2) Alternative's capital equipment inflation rate in %
   26           10 5.0
   27           #
   28           # Capital equipment cost records (<= 20)
   29           # One record must be entered for each capital equipment cost for the alter-
   30           # native.  No "#" lines may be present between these records for a single
   31           # Alternative.  Below enter on each record:
   32           # (1) Capital equipment name (<= 20 characters) followed by a ":"
   33           #     to separate from rest of data on line
   34           # (2) Number of years the equipment has for economically useful life
   35           # (3) First year of capital outlay
   36           # (4) Last year of capital outlay
   37           # (5) Amount of outlay in base period in thousands of dollars
   38           # (6) Salvage value in thousands of base year dollars
   39           # (7) "R" (for repeat) if capital outlay is repeated as a lump sum in last year
   40           #     of equipment's life, leave blank if not.
   41           STRUCTURE:40 1984 1987 200000 0
   42           FINISH:25 1987 1987 20000  0 R
   43           # This ends capital cost records for this alternative.
   44           #
   45           # Operations and maintenance (O & M) cost records (<= 20)
   46           # One record must be entered for each O & M cost for the
   47           # alternative.  No "#" lines may be present between these lines for a singla
   48           # alternative.  Below enter on each record:
   49           # (1) O & M cost name (<= 20 characters followed by a ":" to separate from
   50           # rest of data on line
   51           # (2) Annual outlay in base year dollars (thousands)
   52           # (3) Inflation rate for O & M item in %
   53           TRAIN OPERATORS: 4000 12
   54           SUPERVISORS: 800 12
   55           ELECTRICITY: 1000 9
   56           JANITORS: 750 7
   57           MAINT SUPPLIES: 400 6
   58           # This ends operations and maintenance cost records for this alternative
   59           #
   60           # Additional alternatives will be indicated simply by the presence of more data
   61           # records following at this point.
   62           Ten Car Stations
   63           #
   64           10 5.0
   65           #
   66           STRUCTURE: 40 1984 1987 225000 0
   67           FINISH: 25 1987 1987 23000 0 R
   68           #
   69           TRAIN OPERATORS:3200 12
   70           SUPERVISORS:600 12
   71           ELECTRICITY: 1100 9
   72           JANITORS: 800 7
   73           MAINT SUPPLIES: 420 6
   74           #
[EOB]
*exit statsize2.dat;1
_DRB1:[SCRTD]STATSIZE2.DAT;1 74 lines
$ LCC
ENTER LCC MODEL INPUT FILE NAME: statsize2.dat
FORTRAN STOP
LCC MODEL OUTPUT IS ON FILE COSTOUT.LIS
```

Exhibit 5

VAX EDITING PROCEDURES

Notes:
- Underlined letters are the minimum typing required to get the given command or qualifier to execute.
- R, R1, and R2 will now refer to ANY of the range types previously discussed unless noted.
- Default range will be current line unless noted.

COPY R1 to [R2][/QUERY][DUPLICATE:n]

Notes:
- R1 copied BEFORE R2. R2 is single line range.
- QUERY allows user verification before a line is copied.
- DUPLICATE means make n copies of R1.

DELETE [R][/QUERY]

EXIT [file]

Notes:
- Leaves EDT and saves file.
- Default file is current file, next highest version.

FIND R

Note: Moves current line to R. R must be single line range.

INCLUDE file [R]

Notes:
- Copies a file before R.
- If R is a buffer name with no line range specification, buffer is created if nonexistent , otherwise R is copied before first line in buffer.

INSERT[R]

Note: Inserts lines before R. Use CTRL/Z to stop inserting.

MOVE [R1] to [R2] [/QUERY]

PRINT file [R]

Note: Copies text from R to file in page printable format.

QUIT

Note: Leaves editor, omits all changes in this session.

REPLACE [R]

Note: Deletes R then enters Insert mode.

RESEQUENCE [R][/SEQUENCE[:init:incr]]

Notes:
- Default R is whole buffer.
- init is initial line to RESEQUENCE.
- incr is increment for RESEQUENCEing.
- Default initial line is first line in buffer.
- Default increment is 1.

SHOW BUFF

Note: Shows current status of all user-created buffers in the current editing session.

SUBSTITUTE /string1/string2[/R][/QUERY][/NOTYPE]

Notes:
- NOTYPE means do not type SUBSTITUTEd lines.
- Any nonalphanumeric character can be a string delimiter as long as that character is not in string1 or string 2.

TYPE[R][/STAY]

Note: /STAY makes the new current line the last one typed.

WRITE file [R][/SEQUENCE[:init:incr]]

Notes:
- Creates new file from R.
- See RESEQUENCE for /SEQUENCE qualifier info.

The user enters the appropriate name and hits the carriage return. When the model has completed running,

```
FORTRAN STOP
LCC MODEL OUTPUT IS ON FILE COSTOUT.LIS
```

appears. Exhibit 6 shows the above commands.

To have the output printed on his or her terminal, the user enters the command

```
OUT COSTOUT.LIS
```

after the job run is completed. The first line of the file is printed out in response to the command. When the user enters the following command

```
PALL
```

the output file will be printed out at the terminal. (This command stands for print all.) Exhibit 7 shows the procedure and the first table of the sample output.

When the user is finished with the output file,

```
PURGE COSTOUT.LIS
```

is entered and the file is purged.

If the user wants only the summary table for each alternative, the following command should be entered after OUT COSTOUT.LIS:

```
PALT
```

This command (for print alternative) will automatically print the input summary tables without any additional input from the user.

2. Cost Input

The input data required to run the LCC model are contained in separate files that are accessed by the program. A file can be created, edited, and/or deleted by using the VAX editing procedures described above in the section on "Logging On."

Exhibit 4 (p. 13) is a sample input file. Instructions specifying the lines on which data items are to be entered are included in the file.

There are two basic sets of input data. The first set provides information that is used by each of the up to three alternatives contained in the model run. The second set contains data specific to each of the alternatives.

Exhibit 6

RUNNING LIFE CYCLE COST MODEL

```
$ LCC
ENTER LCC MODEL INPUT FILE NAME:  statsize2.dat
FORTRAN STOP
LCC MODEL OUTPUT IS ON FILE COSTOUT.LIS
```

Exhibit 7

PRINTING OUTPUT AT THE USER'S TERMINAL

```
$ out costout.lis
    1           1                                    SOUTHERN CALIFORNI
A RAPID TRANIST DISTRICT
*PALL
1                                        SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
                                              METRO RAIL LIFE CYCLE COST MODEL
                                                (IN THOUSANDS OF DOLLARS)

                                         RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

BASE YEAR                                1982
FIRST YEAR OF OPERATIONS                 1988
PROJECT LIFE (YEARS)                       40

ALTERNATIVE'S ASSUMPTIONS:

INTEREST RATE (PERCENT)                  10.0
CAPITAL COST INFLATION RATE (PERCENT)     5.0

CAPITAL COST OUTLAYS IN 1982 DOLLARS:

        NAME          LIFE     FIRST YR.    LAST YR.     AMOUNT     SALVAGE    REPEATED
                    (YEARS)    OF CAP.      OF CAP.        K$          K$
                               OUTLAY       OUTLAY

STRUCTURE             40         1984         1987     200000.00      0.00        NO
FINISH                25         1987         1987      20000.00      0.00        YES

OPERATING & MAINTENANCE COST OUTLAYS IN 1982 DOLLARS:

        NAME          ANNUAL     INFLATION
                      OUTLAY       RATE
                        K$           %

TRAIN OPERATORS       4000.00      12.00
SUPERVISORS            800.00      12.00
ELECTRICITY           1000.00       9.00
JANITORS               750.00       7.00
MAINT SUPPLIES         400.00       6.00


NET PRESENT VALUE OF ENTIRE PROJECT          554856
```

Data and information in the first set of inputs are:

- Run title--Up to 80 alphanumeric characters.
- Base year for the run (e.g., 1982)--Present values will be calculated to the base year, and the value of outlays will be specified in base-year dollars.
- First year of operations (e.g., 1990)--This is the year when the system will begin operations.
- Number of years to be modeled, from 1 to 50--This is the life of the project(s) to be analyzed.

Alternative-specific data are:

- Alternative name or title--Up to 80 alphanumeric characters.
- Interest rate for the alternative (in percent)--The interest rate to be used to discount money outlays and determine net present value of the project.
- Capital equipment inflation rate for the alternative (in percent)--The rate that is used to inflate capital equipment costs, given in base-year dollars, to the amount of actual outlays in future years.
- Up to 20 capital equipment items can be entered. For each item, the following data are required:
  - Capital equipment name, up to 20 characters.
  - Number of years of the economic life of the equipment. This number may be less than, equal to, or greater than the life of the project.
  - First year when funds are expended to acquire the equipment.
  - Last year of expenditures on the equipment. If the first and last years are the same, the entire expenditure is allocated to that year. If the last year is greater than the first year, the expenditure is spread out evenly throughout the period specified.
  - Amount of expenditure or outlay for the equipment, in thousands of base-year dollars. This amount will be inflated by the capital equipment inflation rate to the year(s) of actual outlay.

- Salvage value, in base-year dollars. This amount will be inflated and assigned as a negative outlay in the last year of the equipment's useful life or the last year of the number of years to be modeled.

- "R" for repeat of the capital expenditure if its useful life is less than the number of years to be modeled.

- Up to 20 operations and maintenance (O&M) cost items can be entered. For each item, the following data are required:

  - O&M cost name, up to 20 characters.

  - Amount of annual outlay for the item, in thousands of base-year dollars.

  - Inflation rate for the O&M item, in percent.

As indicated above, up to three alternatives can be evaluated in a model run. The data items listed above are repeated for each alternative. The delimiter "#" is used to indicate breaks in data inputs; one is used after each of the first four input lines and after the last line of input of capital cost items, and one is used after the last line of O&M cost items. The model automatically terminates reading the input file when it encounters the end of the file.

3. Output Reports

Up to three alternatives can be evaluated in each run of the LCC Model. For each alternative, the LCC Model generates two tables. The first table displays the input data for the alternative, and the second provides capital and operating cost data for each year in the study period as well as the life cycle cost of the project (or net present value). The second table may continue for several pages, depending on the number of years in the study period. Exhibits 8 and 9 are examples of the first pages of these tables. (Appendices B through D are examples of complete tables for three different model runs.) The data in the first output table were explained in the preceding description of the input file. The data contained in the second table are described below.

4. Interpreting the Life Cycle Cost Model Output

The first set of line items on Exhibit 9 represent the outlays for capital expenditures. For each expenditure category, the year(s) of outlay and the amount (in base-year dollars) are input variables. The model allocates the dollar amount over the number of years specified. For example, if a capital equipment item in base-year dollars costs $1,000 and expenditures are to be over a 3-year period, $333 will be allocated to each year. The $333 will be increased by the capital equipment inflation rate for the appropriate number of years. If the inflation rate is 10% and the expenditure is made 2 years after the base year, the amount recorded would be $333 x $(1.1)^2$, or $403.

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

BASE YEAR	1982
FIRST YEAR OF OPERATIONS	1988
PROJECT LIFE (YEARS)	40

ALTERNATIVE'S ASSUMPTIONS:

INTEREST RATE (PERCENT)	10.0
CAPITAL COST INFLATION RATE (PERCENT)	5.0

CAPITAL COST OUTLAYS IN 1982 DOLLARS:

NAME	LIFE (YEARS)	FIRST YR. OF CAP. OUTLAY	LAST YR. OF CAP. OUTLAY	AMOUNT K$	SALVAGE K$	REPEATED
STRUCTURE	40	1984	1987	200000.00	0.00	NO
FINISH	25	1987	1987	20000.00	0.00	YES

OPERATING & MAINTENANCE COST OUTLAYS IN 1982 DOLLARS:

NAME	ANNUAL OUTLAY K$	INFLATION RATE %
TRAIN OPERATORS	4000.00	8.00
SUPERVISORS	800.00	8.00
ELECTRICITY	1000.00	9.00
JANITORS	750.00	7.00
MAINT SUPPLIES	400.00	6.00

NET PRESENT VALUE OF ENTIRE PROJECT 367225

SAMPLE SUMMARY OUTPUT REPORT

Exhibit 8

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		1982	1983	1984	1985	1986	1987	1988	1989	1990
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	55125	57881	60775	63814	0	0	0
	-- PRESENT VALUE	0	0	45558	43487	41510	39624	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	25526	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	15849	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	55125	57881	60775	89340	0	0	0
	-- PRESENT VALUE	0	0	45558	43487	41510	55473	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		0	0	0	0	0	0	33923	33923	33923
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	6347	6855	7404
	-- PRESENT VALUE	0	0	0	0	0	0	3583	3518	3454
SUPERVISORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1269	1371	1481
	-- PRESENT VALUE	0	0	0	0	0	0	717	704	691
ELECTRICITY	-- ACTUAL DOLLARS	0	0	0	0	0	0	1677	1828	1993
	-- PRESENT VALUE	0	0	0	0	0	0	947	938	930
JANITORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1126	1204	1289
	-- PRESENT VALUE	0	0	0	0	0	0	635	618	601
MAINT SUPPLIES	-- ACTUAL DOLLARS	0	0	0	0	0	0	567	601	638
	-- PRESENT VALUE	0	0	0	0	0	0	320	309	297
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	0	0	0	0	0	0	10987	11860	12803
	-- PRESENT VALUE	0	0	0	0	0	0	6202	6086	5973
SUM OF AEC AND OPERATING COSTS		0	0	0	0	0	0	44910	45783	46726
N.P.V. OF ENTIRE PROJECT Y.T.D.		0	0	45558	89045	130555	186028	192230	198316	204289

Exhibit 9

SAMPLE DETAILED OUTPUT REPORT

The salvage value of each item of equipment is recorded as a negative outlay at the end of its useful life or at the end of the study period, whichever comes first. Salvage values are specified in base-year dollars and are increased by the capital equipment inflation rate.

If the useful life of a capital expenditure item extends beyond the study period, the remaining value is recorded as a negative outlay in the last year of analysis, in addition to the salvage value of the item. This amount is calculated by subtracting the salvage value from the cost of the equipment, adjusting the value for inflation, and then multiplying by the fraction of useful life remaining. For example, assume the cost of the equipment is $1,000, its salvage value is $100, its useful life is 20 years, the study period covers the first 15 of those years, the interest rate is 10%, the last year of the analysis is 2000, and the base year is 1985. Under those assumptions, the following amount would be recorded in the year 2000 and would represent the value of the equipment at that time:

$$-(\$1{,}000-\$100) \times (1.10)^{(2000-1985)} \times (15/20) = -\$2{,}820 \quad .$$

Added to the -$2,820 is the salvage value, or

$$-\$100 \times (1.10)^{(2000-1985)} = -\$418 \quad .$$

Each of the capital outlays is shown in actual and discounted values. The actual value is the amount of money that will be spent (or received); the discounted values represent the present value of the outlay discounted to the base year.

The annual equivalent costs (AECs) for each year are shown immediately under the sum of capital outlays. These costs represent amortization of the cash flow for the sum of the capital items. Equal annual outlays over the life of the product are calculated similarly to the repayment of traditional home mortgages. For those capital items whose useful life is less than the study period and whose purchase must be repeated, the AEC for period useful life is calculated separately. For example, if an item must be replaced every 5 years, the model will calculate the purchase price of the item every 5 years, determine its AEC over its 5-year useful life, and add it to the appropriate sum of AECs for other capital items.

The interest payments made between the expenditure for the capital equipment and its actual use (when it begins to generate revenues) must be considered. The actual outlays for capital items are increased by the interest rate for the number of years between expenditure and the first year of operations before being multiplied by the factor to generate AECs. For example, suppose a $1,000 expenditure were made in 1995 and the system began operation in 1997. If the interest rate were 10%, the model would use $1,000 x $(1.1)^2$ = $1,210 as the amount that would be amortized over useful life of the equipment.

The formula for the amortization factor is:

$$\frac{r}{1 - (1+r)^{-n}} \quad \text{or} \quad \frac{r\,(1+r)^{n}}{(1+r)-1} \quad ,$$

where "r" denotes the interest rate and "n" the number of years of useful life.

Operating and maintenance costs are shown next. The user specifies the annual amount of each operating and maintenance item in base-year dollars. The model adjusts these for inflation and records the values on the table once the system begins in operation. The present value of each entry is also given.

To provide an estimate of the actual outlays for SCRTD for each year of operation, the sum of the operating costs and the annual equivalent of capital costs is listed.

The net present value of the outlays is given on the last page of the second output tables (as well as in the first output table). This figure represents the amount of base-year dollars that could be invested at the specified interest rate and just be sufficient to provide the stream of actual capital and operating costs associated with the project.

5. Sensitivity Analysis

To conduct sensitivity analyses using the LCC Model, the user adjusts the appropriate variables in the input file and reruns the program. A sensitivity analysis was performed for Example 1 (Chapter III). Appendix B gives the output listing for the first case and Appendix C gives the listing for the second.

In Example Problem 1, the first case specifies 8% inflation for train operator and supervisor wages. In this case, the 8-car station has a lower present value and therefore is preferred to the 10-car station. If wage inflation is 12% instead of 8%, the net present value of the 10-car station is lower than that for the 8-car station. Figure 4 presents these results. This illustrative sensitivity analysis shows that the alternative chosen depends on the input assumption regarding wage rates, among other variables.

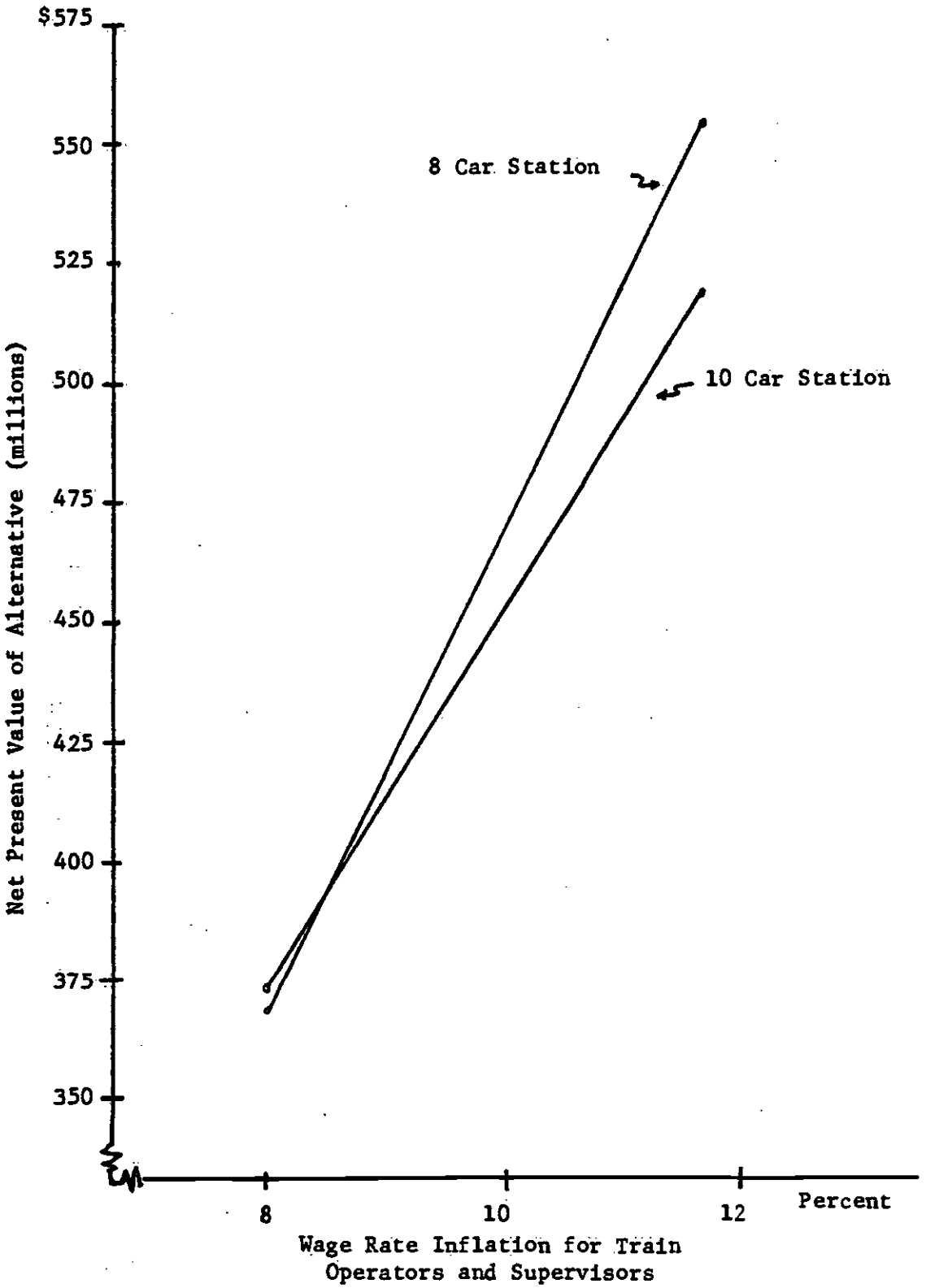

FIGURE 4: SENSITIVITY GRAPH FOR EXAMPLE 1

6. Cost Differentials

The user may prefer to work with cost differentials rather than actual amounts for each alternative. In this case, the user enters into the input file the difference in costs (either positive or negative) for each category as one alternative instead of using two alternatives, each containing the absolute cost levels for the capital and operating and maintenance cost categories. The present vaue of the cost difference method is equal to the difference between the present values for the two alternatives. Appendix D contains the results of running the differences for the 10- and 8-car alternatives in Appendix B. The positive value of the present value indicates that the 10-car station has a higher life cycle cost than the 8-car station. If the wage inflation were increased to 12%, the present value of the difference would be negative, indicating that the 10-car station alternative has a lower life cycle cost than the 8-car station alternative.

III. EXAMPLE PROBLEMS

III. EXAMPLE PROBLEMS

This chapter discusses two sample problems. Example 1 has been run on the LCC Model, and the output is presented in Appendices B through D. In the first run, absolute costs are used. The second run is a sensitivity analysis indicating the effects of a higher inflation rate for train operators' salaries. The third run uses the difference between the base and the second alternative run specified in the first run (described in Section 6 of Chapter II). By using differences, only one alternative needs to be run. If the present value is positive, the base alternative is more expensive than the second alternative. Conversely, if the present value is negative, the base alternative has the lower present value.

The second example problem is presented for the user to solve.

Example 1: Trade-off Between Operating and Capital Costs

The South Sucotash Transit District (SSTD) is trying to decide whether to build subway stations capable of holding 8- or 10-car trains. Using 10-car trains would require fewer operators but would increase the cost of the stations. A preliminary analysis indicates the following costs associated with each alternative:

		Costs (thousands of dollars)		
Annual Operating and Maintenance Costs		Eight-Car Stations	Ten-Car Stations	Difference
Train operators		$4,000	$3,200	-$800
Supervisors		800	600	- 200
Station electricity		1,000	1,100	100
Station Maintenance				
Labor		750	800	50
Supplies		400	420	20
Capital Costs	**Life**			
Station structure	40	200,000	225,000	25,000
Station finish	25	20,000	23,000	3,000

All costs have been estimated in 1982 dollars. The timing of the costs for the two capital item is as follows:

	Capital Expenditure	
	Structure	Finish
First year of construction	1984	1987
Last year of construction	1987	1987

The first year of the system's operations is 1988.

Anticipated inflation rates per year are as follows:

- Train operators and supervisors--8%
- Janitors (station maintenance)--7%
- Electricity--9%
- Maintenance supplies--6%.

The current cost of money (interest rate) is 10%. Based on life cycle cost alone, should the SSTD build stations for 8-car or 10-car trains?

Example 2: Differing Costs and Lives

An architect is trying to select an escalator for a newly refurbished building. After considering the engineering requirements, he has reduced the choice to three models. On the basis of an analysis of the reliability and maintainability of the three escalators, he has developed the following data:

	Costs (thousands of dollars)		Life
Escalator	Initial Purchase Price (1982)	Annual Maintenance Cost (1982)	Expectancy (years)
Model A	$120	$6	20
Model B	140	5	25
Model C	160	5	30

The architect also makes the following assumptions:

- The cost of new escalators will increase 2% per year over the next 50 years.
- Annual maintenance costs will increase 6% per year over the next 50 years.

- The building will last 50 years, at which time it will be torn down, and the escalator will be sold at its depreciated value.

- The cost of money is currently 10.5%.

The owner of the building has requested that the architect choose the escalator with the lowest life cycle cost. Based on the information above, which escalator should the architect select?

Appendix A

FINANCIAL FORMULAS

Appendix A

FINANCIAL FORMULAS

Present Value of a Future Cash Flow

$$PV = \frac{AMT}{(1 + r)^n}$$

where

PV = present value
AMT = amount, in future year's dollars
r = interest rate
n = number of years.

Annual Equivalent Cost

$$AEC = \text{Capital Cost} * \frac{r}{1-(1 + r)^{-n}}$$

$$= \text{Capital Cost} * \frac{r(1 + r)^n}{(1 + r)^n - 1}$$

Replacement Cost

$$RC = \text{Capital Cost} * (1 + i_c)^n$$

where

i_c = capital cost inflation rate.

Appendix B

OUTPUT FOR EXAMPLE 1 WITH 8% WAGE INFLATION

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

BASE YEAR	1982
FIRST YEAR OF OPERATIONS	1988
PROJECT LIFE (YEARS)	40

ALTERNATIVE'S ASSUMPTIONS:

INTEREST RATE (PERCENT)	10.0
CAPITAL COST INFLATION RATE (PERCENT)	5.0

CAPITAL COST OUTLAYS IN 1982 DOLLARS:

NAME	LIFE (YEARS)	FIRST YR. OF CAP. OUTLAY	LAST YR. OF CAP. OUTLAY	AMOUNT K$	SALVAGE K$	REPEATED
STRUCTURE	40	1984	1987	200000.00	0.00	NO
FINISH	25	1987	1987	20000.00	0.00	YES

OPERATING & MAINTENANCE COST OUTLAYS IN 1982 DOLLARS:

NAME	ANNUAL OUTLAY K$	INFLATION RATE %
TRAIN OPERATORS	4000.00	8.00
SUPERVISORS	800.00	8.00
ELECTRICITY	1000.00	9.00
JANITORS	750.00	7.00
MAINT SUPPLIES	400.00	6.00

NET PRESENT VALUE OF ENTIRE PROJECT 367225

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		1982	1983	1984	1985	1986	1987	1988	1989	1990
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	55125	57881	60775	63814	0	0	0
	-- PRESENT VALUE	0	0	45558	43487	41510	39624	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	25526	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	15849	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	55125	57881	60775	89340	0	0	0
	-- PRESENT VALUE	0	0	45558	43487	41510	55473	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		0	0	0	0	0	0	33923	33923	33923
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	6347	6855	7404
	-- PRESENT VALUE	0	0	0	0	0	0	3583	3518	3454
SUPERVISORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1269	1371	1481
	-- PRESENT VALUE	0	0	0	0	0	0	717	704	691
ELECTRICITY	-- ACTUAL DOLLARS	0	0	0	0	0	0	1677	1828	1993
	-- PRESENT VALUE	0	0	0	0	0	0	947	938	930
JANITORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1126	1204	1289
	-- PRESENT VALUE	0	0	0	0	0	0	635	618	601
MAINT SUPPLIES	-- ACTUAL DOLLARS	0	0	0	0	0	0	567	601	638
	-- PRESENT VALUE	0	0	0	0	0	0	320	309	297
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	0	0	0	0	0	0	10987	11860	12803
	-- PRESENT VALUE	0	0	0	0	0	0	6202	6086	5973
SUM OF AEC AND OPERATING COSTS		0	0	0	0	0	0	44910	45783	46726

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		1991	1992	1993	1994	1996	1996	1997	1998	1999
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		33923	33923	33923	33923	33923	33923	33923	33923	33923
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	7996	8636	9327	10073	10878	11749	12689	13704	14800
	-- PRESENT VALUE	3391	3329	3269	3209	3151	3094	3038	2982	2928
SUPERVISORS	-- ACTUAL DOLLARS	1599	1727	1865	2015	2176	2350	2538	2741	2960
	-- PRESENT VALUE	678	666	654	642	630	619	608	596	586
ELECTRICITY	-- ACTUAL DOLLARS	2172	2367	2580	2813	3066	3342	3642	3970	4328
	-- PRESENT VALUE	921	913	904	896	888	880	872	864	856
JANITORS	-- ACTUAL DOLLARS	1379	1475	1579	1689	1807	1934	2069	2214	2369
	-- PRESENT VALUE	585	569	553	538	524	509	495	482	469
MAINT SUPPLIES	-- ACTUAL DOLLARS	676	716	759	805	853	904	959	1016	1077
	-- PRESENT VALUE	287	276	266	256	247	238	229	221	213
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	13822	14922	16110	17394	18781	20279	21897	23645	25534
	-- PRESENT VALUE	5862	5753	5647	5542	5440	5340	5242	5146	5052
SUM OF AEC AND OPERATING COSTS		47744	48845	50033	51317	52703	54201	55820	57568	59457
N.P.V. OF ENTIRE PROJECT Y.T.D.		210151	215904	221550	227093	232533	237873	243115	248260	253312

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		2000	2001	2002	2003	2004	2005	2006	2007	2008
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		33923	33923	33923	33923	33923	33923	33923	33923	33923
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	15984	17263	18644	20135	21746	23486	25365	27394	29585
	-- PRESENT VALUE	2875	2823	2771	2721	2671	2623	2575	2528	2482
SUPERVISORS	-- ACTUAL DOLLARS	3197	3453	3729	4027	4349	4697	5073	6479	5917
	-- PRESENT VALUE	575	565	554	544	534	525	515	506	496
ELECTRICITY	-- ACTUAL DOLLARS	4717	5142	5604	6109	6659	7258	7911	8623	9399
	-- PRESENT VALUE	848	841	833	825	818	811	803	796	789
JANITORS	-- ACTUAL DOLLARS	2535	2712	2902	3105	3323	3555	3804	4071	4356
	-- PRESENT VALUE	456	443	431	420	408	397	386	376	365
MAINT SUPPLIES	-- ACTUAL DOLLARS	1142	1210	1283	1360	1441	1628	1620	1717	1820
	-- PRESENT VALUE	205	198	191	184	177	171	164	158	153
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	27575	29780	32162	34736	37518	40524	43773	47283	51077
	-- PRESENT VALUE	4960	4869	4781	4694	4609	4526	4444	4364	4286
SUM OF AEC AND OPERATING COSTS		61497	63702	66085	68659	71441	74447	77695	81206	85000
N.P.V. OF ENTIRE PROJECT Y.T.D.		258272	263141	267922	272616	277225	281750	286194	290558	294844

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		2009	2010	2011	2012	2013	2014	2015	2016	2017
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	86439	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	4954	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	86439	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	4954	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		33923	33923	33923	33923	40842	40842	40842	40842	40842
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	31952	34508	37269	40251	43471	46948	50704	54761	59141
	-- PRESENT VALUE	2437	2393	2349	2307	2265	2224	2183	2143	2104
SUPERVISORS	-- ACTUAL DOLLARS	6390	6902	7454	8050	8694	9390	10141	10952	11828
	-- PRESENT VALUE	487	479	470	461	453	445	437	429	421
ELECTRICITY	-- ACTUAL DOLLARS	10245	11167	12172	13268	14462	15763	17182	18728	20414
	-- PRESENT VALUE	781	774	767	760	753	747	740	733	726
JANITORS	-- ACTUAL DOLLARS	4660	4987	5336	5709	6109	6536	6994	7484	8007
	-- PRESENT VALUE	355	346	336	327	318	310	301	293	285
MAINT SUPPLIES	-- ACTUAL DOLLARS	1929	2045	2167	2297	2435	2581	2736	2900	3074
	-- PRESENT VALUE	147	142	137	132	127	122	118	114	109
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	55177	59609	64398	69575	75171	81219	87757	94825	102466
	-- PRESENT VALUE	4209	4133	4060	3987	3916	3847	3779	3712	3646
SUM OF AEC AND OPERATING COSTS		89100	93531	98321	103498	116012	122061	128599	135667	143307
N.P.V. OF ENTIRE PROJECT Y.T.D.		299053	303186	307246	316187	320103	323950	327728	331440	335086

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		40842	40842	40842	40842	40842	40842	40842	40842	40842
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	63873	68983	74501	80461	86898	93850	101358	109467	118224
	-- PRESENT VALUE	2066	2029	1992	1956	1920	1885	1851	1817	1784
SUPERVISORS	-- ACTUAL DOLLARS	12775	13797	14900	16092	17380	18770	20272	21893	23645
	-- PRESENT VALUE	413	406	398	391	384	377	370	363	357
ELECTRICITY	-- ACTUAL DOLLARS	22251	24254	26437	28816	31409	34236	37318	40676	44337
	-- PRESENT VALUE	720	713	707	700	694	688	681	675	669
JANITORS	-- ACTUAL DOLLARS	8568	9168	9809	10496	11231	12017	12858	13758	14721
	-- PRESENT VALUE	277	270	262	255	248	241	235	228	222
MAINT SUPPLIES	-- ACTUAL DOLLARS	3259	3454	3662	3881	4114	4361	4623	4900	5194
	-- PRESENT VALUE	105	102	98	94	91	88	84	81	78
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	110725	119656	129309	139747	151032	163235	176428	190695	206121
	-- PRESENT VALUE	3582	3519	3457	3396	3337	3279	3222	3166	3111
SUM OF AEC AND OPERATING COSTS		151567	160497	170151	180589	191874	204076	217270	231536	246963
N.P.V. OF ENTIRE PROJECT Y.T.D.		338668	342187	345644	349040	352377	355656	358878	362043	365154

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

2027

CAPITAL EXPENDITURES

STRUCTURE	-- ACTUAL DOLLARS	0
	-- PRESENT VALUE	0
FINISH	-- ACTUAL DOLLARS	-71880
	-- PRESENT VALUE	-986
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	-71880
	-- PRESENT VALUE	-986
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		40842

OPERATING COSTS

TRAIN OPERATORS	-- ACTUAL DOLLARS	127682
	-- PRESENT VALUE	1752
SUPERVISORS	-- ACTUAL DOLLARS	25536
	-- PRESENT VALUE	350
ELECTRICITY	-- ACTUAL DOLLARS	48327
	-- PRESENT VALUE	663
JANITORS	-- ACTUAL DOLLARS	15752
	-- PRESENT VALUE	216
MAINT SUPPLIES	-- ACTUAL DOLLARS	5506
	-- PRESENT VALUE	76
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	222803
	-- PRESENT VALUE	3057
SUM OF AEC AND OPERATING COSTS		263645

N.P.V. OF ENTIRE PROJECT Y.T.D. 367225

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

BASE YEAR	1982
FIRST YEAR OF OPERATIONS	1988
PROJECT LIFE (YEARS)	40

ALTERNATIVE'S ASSUMPTIONS:

INTEREST RATE (PERCENT)	10.0
CAPITAL COST INFLATION RATE (PERCENT)	5.0

CAPITAL COST OUTLAYS IN 1982 DOLLARS:

NAME	LIFE (YEARS)	FIRST YR. OF CAP. OUTLAY	LAST YR. OF CAP. OUTLAY	AMOUNT K$	SALVAGE K$	REPEATED
STRUCTURE	40	1984	1987	225000.00	0.00	NO
FINISH	25	1987	1987	23000.00	0.00	YES

OPERATING & MAINTENANCE COST OUTLAYS IN 1982 DOLLARS:

NAME	ANNUAL OUTLAY K$	INFLATION RATE %
TRAIN OPERATORS	3200.00	8.00
SUPERVISORS	600.00	8.00
ELECTRICITY	1100.00	9.00
JANITORS	800.00	7.00
MAINT SUPPLIES	420.00	6.00

NET PRESENT VALUE OF ENTIRE PROJECT 370417

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		1982	1983	1984	1985	1986	1987	1988	1989	1990
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	62016	65116	68372	71791	0	0	0
	-- PRESENT VALUE	0	0	51253	48923	46699	44576	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	29354	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	18227	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	62016	65116	68372	101145	0	0	0
	-- PRESENT VALUE	0	0	51253	48923	46699	62803	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		0	0	0	0	0	0	38240	38240	38240
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	5078	5484	5923
	-- PRESENT VALUE	0	0	0	0	0	0	2866	2814	2763
SUPERVISORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	952	1028	1111
	-- PRESENT VALUE	0	0	0	0	0	0	537	528	518
ELECTRICITY	-- ACTUAL DOLLARS	0	0	0	0	0	0	1845	2011	2192
	-- PRESENT VALUE	0	0	0	0	0	0	1041	1032	1022
JANITORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1201	1285	1375
	-- PRESENT VALUE	0	0	0	0	0	0	678	659	641
MAINT SUPPLIES	-- ACTUAL DOLLARS	0	0	0	0	0	0	596	632	669
	-- PRESENT VALUE	0	0	0	0	0	0	336	324	312
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	0	0	0	0	0	0	9671	10440	11269
	-- PRESENT VALUE	0	0	0	0	0	0	5489	5357	5257
SUM OF AEC AND OPERATING COSTS		0	0	0	0	0	0	47912	48680	49510
N.P.V. OF ENTIRE PROJECT Y.T.D.		0	0	51253	100175	146875	209678	215137	220494	225751

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		1991	1992	1993	1994	1995	1996	1997	1998	1999
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		38240	38240	38240	38240	38240	38240	38240	38240	38240
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	6397	6989	7461	8058	8703	9399	10151	10963	11840
	-- PRESENT VALUE	2713	2664	2615	2568	2521	2475	2430	2386	2342
SUPERVISORS	-- ACTUAL DOLLARS	1199	1295	1399	1511	1632	1762	1903	2056	2220
	-- PRESENT VALUE	509	499	490	481	473	464	456	447	439
ELECTRICITY	-- ACTUAL DOLLARS	2389	2604	2838	3094	3372	3676	4007	4367	4760
	-- PRESENT VALUE	1013	1004	995	986	977	968	959	950	942
JANITORS	-- ACTUAL DOLLARS	1471	1574	1684	1802	1928	2063	2207	2362	2527
	-- PRESENT VALUE	624	607	590	574	558	543	528	514	500
MAINT SUPPLIES	-- ACTUAL DOLLARS	710	752	797	845	896	950	1007	1067	1131
	-- PRESENT VALUE	301	290	279	269	259	250	241	232	224
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	12166	13134	14180	15310	16531	17850	19275	20815	22478
	-- PRESENT VALUE	5159	5064	4970	4878	4788	4700	4614	4530	4447
SUM OF AEC AND OPERATING COSTS		50406	51374	52420	53550	54771	56090	57515	59055	60719
N.P.V. OF ENTIRE PROJECT Y.T.D.		230911	235975	240944	245823	250611	255311	259926	264455	268903

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations		2000	2001	2002	2003	2004	2005	2006	2007	2008
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		38240	38240	38240	38240	38240	38240	38240	38240	38240
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	12787	13810	14915	16100	17397	18789	20292	21915	23668
	-- PRESENT VALUE	2300	2258	2217	2177	2137	2098	2060	2023	1986
SUPERVISORS	-- ACTUAL DOLLARS	2398	2589	2797	3020	3262	3523	3805	4109	4438
	-- PRESENT VALUE	431	423	416	408	401	393	386	379	372
ELECTRICITY	-- ACTUAL DOLLARS	5189	5656	6165	6720	7324	7984	8702	9485	10339
	-- PRESENT VALUE	933	925	916	908	900	892	883	875	868
JANITORS	-- ACTUAL DOLLARS	2704	2893	3096	3312	3544	3792	4058	4342	4646
	-- PRESENT VALUE	486	473	460	448	436	424	412	401	390
MAINT SUPPLIES	-- ACTUAL DOLLARS	1199	1271	1347	1428	1513	1604	1701	1803	1911
	-- PRESENT VALUE	216	208	200	193	186	179	173	166	160
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	24276	26219	28319	30589	33041	35692	38557	41654	45002
	-- PRESENT VALUE	4366	4287	4209	4133	4059	3986	3915	3845	3776
SUM OF AEC AND OPERATING COSTS		62517	64460	66560	68829	71282	73932	76798	79895	83242
N.P.V. OF ENTIRE PROJECT Y.T.D.		273269	277556	281766	285899	289958	293944	297859	301703	305479

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		2009	2010	2011	2012	2013	2014	2015	2016	2017
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	99405	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	5697	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	99405	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	5697	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		38240	38240	38240	38240	46197	46197	46197	46197	46197
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	25562	27607	29815	32201	34777	37559	40563	43808	47313
	-- PRESENT VALUE	1950	1914	1880	1845	1812	1779	1747	1715	1684
SUPERVISORS	-- ACTUAL DOLLARS	4793	5176	5590	6038	6521	7042	7606	8214	8871
	-- PRESENT VALUE	366	359	352	346	340	334	327	322	316
ELECTRICITY	-- ACTUAL DOLLARS	11270	12284	13389	14594	15908	17340	18900	20601	22455
	-- PRESENT VALUE	860	852	844	836	829	821	814	806	799
JANITORS	-- ACTUAL DOLLARS	4971	5319	5691	6090	6516	6972	7460	7983	8541
	-- PRESENT VALUE	379	369	359	349	339	330	321	312	304
MAINT SUPPLIES	-- ACTUAL DOLLARS	2025	2147	2276	2412	2557	2710	2873	3045	3228
	-- PRESENT VALUE	154	149	143	138	133	128	124	119	115
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	48621	52533	56762	61335	66278	71623	77403	83652	90409
	-- PRESENT VALUE	3709	3643	3578	3516	3453	3392	3333	3274	3217
SUM OF AEC AND OPERATING COSTS		86861	90773	95003	99575	112475	117820	123600	129849	136606
N.P.V. OF ENTIRE PROJECT Y.T.D.		309188	312830	316409	325620	329073	332466	335798	339073	342290

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR V5 TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		46197	46197	46197	46197	46197	46197	46197	46197	46197
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	51098	55186	69601	64369	69519	75080	81086	87573	94579
	-- PRESENT VALUE	1653	1623	1593	1564	1536	1508	1481	1454	1427
SUPERVISORS	-- ACTUAL DOLLARS	9581	10347	11175	12069	13036	14078	15204	16420	17734
	-- PRESENT VALUE	310	304	299	293	288	283	278	273	268
ELECTRICITY	-- ACTUAL DOLLARS	24476	26679	29080	31698	34560	37660	41049	44744	48771
	-- PRESENT VALUE	792	785	777	770	763	756	750	743	736
JANITORS	-- ACTUAL DOLLARS	9139	9779	10463	11196	11980	12818	13715	14676	15703
	-- PRESENT VALUE	296	288	280	272	265	257	250	244	237
MAINT SUPPLIES	-- ACTUAL DOLLARS	3422	3627	3845	4075	4320	4579	4854	5145	5454
	-- PRESENT VALUE	111	107	103	99	96	92	89	85	82
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	97717	105619	114166	123407	133403	144215	155909	168658	182240
	-- PRESENT VALUE	3161	3106	3052	2999	2948	2897	2847	2798	2750
SUM OF AEC AND OPERATING COSTS		143914	151816	160362	169604	179601	190412	202106	214755	228438
N.P.V. OF ENTIRE PROJECT Y.T.D.		345451	348667	351609	354609	357556	360453	363300	366098	368848

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

2027

CAPITAL EXPENDITURES

STRUCTURE	-- ACTUAL DOLLARS	0
	-- PRESENT VALUE	0
FINISH	-- ACTUAL DOLLARS	-82662
	-- PRESENT VALUE	-1134
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	-82662
	-- PRESENT VALUE	-1134
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		46197

OPERATING COSTS

TRAIN OPERATORS	-- ACTUAL DOLLARS	102146
	-- PRESENT VALUE	1401
SUPERVISORS	-- ACTUAL DOLLARS	19152
	-- PRESENT VALUE	263
ELECTRICITY	-- ACTUAL DOLLARS	53160
	-- PRESENT VALUE	729
JANITORS	-- ACTUAL DOLLARS	16802
	-- PRESENT VALUE	231
MAINT SUPPLIES	-- ACTUAL DOLLARS	5781
	-- PRESENT VALUE	79
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	197041
	-- PRESENT VALUE	2703
SUM OF AEC AND OPERATING COSTS		243238

N.P.V. OF ENTIRE PROJECT Y.T.D. 37417

Appendix C

OUTPUT FOR EXAMPLE 1 WITH 12% WAGE INFLATION

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

BASE YEAR	1982
FIRST YEAR OF OPERATIONS	1988
PROJECT LIFE (YEARS)	40

ALTERNATIVE'S ASSUMPTIONS:

INTEREST RATE (PERCENT)	10.0
CAPITAL COST INFLATION RATE (PERCENT)	6.0

CAPITAL COST OUTLAYS IN 1982 DOLLARS:

NAME	LIFE (YEARS)	FIRST YR. OF CAP. OUTLAY	LAST YR. OF CAP. OUTLAY	AMOUNT K$	SALVAGE K$	REPEATED
STRUCTURE	40	1984	1987	200000.00	0.00	NO
FINISH	25	1987	1987	20000.00	0.00	YES

OPERATING & MAINTENANCE COST OUTLAYS IN 1982 DOLLARS:

NAME	ANNUAL OUTLAY K$	INFLATION RATE %
TRAIN OPERATORS	4000.00	12.00
SUPERVISORS	600.00	12.00
ELECTRICITY	1000.00	9.00
JANITORS	750.00	7.00
MAINT SUPPLIES	400.00	6.00

NET PRESENT VALUE OF ENTIRE PROJECT 554856

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		1982	1983	1984	1985	1986	1987	1988	1989	1990
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	66125	57881	60775	63814	0	0	0
	-- PRESENT VALUE	0	0	45558	43487	41510	39624	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	26526	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	15849	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	66125	57881	60775	89340	0	0	0
	-- PRESENT VALUE	0	0	45558	43487	41510	55473	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		0	0	0	0	0	0	33923	33923	33923
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	7895	8843	9904
	-- PRESENT VALUE	0	0	0	0	0	0	4457	4838	4620
SUPERVISORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1579	1769	1981
	-- PRESENT VALUE	0	0	0	0	0	0	891	988	924
ELECTRICITY	-- ACTUAL DOLLARS	0	0	0	0	0	0	1677	1828	1993
	-- PRESENT VALUE	0	0	0	0	0	0	947	938	930
JANITORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1126	1284	1289
	-- PRESENT VALUE	0	0	0	0	0	0	636	618	601
MAINT SUPPLIES	-- ACTUAL DOLLARS	0	0	0	0	0	0	567	601	638
	-- PRESENT VALUE	0	0	0	0	0	0	320	309	297
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	0	0	0	0	0	0	12844	14245	15803
	-- PRESENT VALUE	0	0	0	0	0	0	7250	7310	7372
SUM OF AEC AND OPERATING COSTS		0	0	0	0	0	0	46767	48168	49726
N.P.V. OF ENTIRE PROJECT Y.T.D.		0	0	46558	89045	130666	186028	193278	200588	207961

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		1991	1992	1993	1994	1995	1996	1997	1998	1999
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		33923	33923	33923	33923	33923	33923	33923	33923	33923
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	11092	12423	13914	15584	17454	19548	21894	24522	27464
	-- PRESENT VALUE	4704	4790	4877	4966	5056	5148	5241	5337	5434
SUPERVISORS	-- ACTUAL DOLLARS	2218	2485	2783	3117	3491	3910	4379	4904	5493
	-- PRESENT VALUE	941	958	976	993	1011	1030	1048	1067	1087
ELECTRICITY	-- ACTUAL DOLLARS	2172	2367	2580	2813	3066	3342	3642	3970	4328
	-- PRESENT VALUE	921	913	904	896	888	880	872	864	856
JANITORS	-- ACTUAL DOLLARS	1379	1475	1579	1689	1807	1934	2069	2214	2369
	-- PRESENT VALUE	585	569	553	538	524	509	495	482	469
MAINT SUPPLIES	-- ACTUAL DOLLARS	676	716	759	805	853	904	969	1016	1077
	-- PRESENT VALUE	287	276	266	266	247	238	229	221	213
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	17537	19467	21616	24007	26671	29638	32943	36626	40731
	-- PRESENT VALUE	7438	7505	7576	7649	7726	7805	7886	7971	8058
SUM OF AEC AND OPERATING COSTS		51460	53390	55538	57930	60594	63561	66866	70549	74654
N.P.V. OF ENTIRE PROJECT Y.T.D.		215398	222904	230480	238129	245865	253660	261546	269517	277575

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		2000	2001	2002	2003	2004	2005	2006	2007	2008
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		33923	33923	33923	33923	33923	33923	33923	33923	33923
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	30760	34451	38586	43215	48401	54209	60715	68000	76160
	-- PRESENT VALUE	5532	5633	5735	5840	5946	6054	6164	6276	6390
SUPERVISORS	-- ACTUAL DOLLARS	6152	6890	7717	8643	9680	10842	12143	13600	15232
	-- PRESENT VALUE	1106	1127	1147	1168	1189	1211	1233	1255	1278
ELECTRICITY	-- ACTUAL DOLLARS	4717	5142	5604	6109	6659	7258	7911	8623	9399
	-- PRESENT VALUE	848	841	833	825	818	811	803	796	789
JANITORS	-- ACTUAL DOLLARS	2535	2712	2902	3105	3323	3555	3804	4071	4356
	-- PRESENT VALUE	456	443	431	420	408	397	386	376	365
MAINT SUPPLIES	-- ACTUAL DOLLARS	1142	1210	1283	1360	1441	1528	1620	1717	1820
	-- PRESENT VALUE	205	198	191	184	177	171	164	158	153
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	45306	50406	56092	62433	69504	77392	86192	96011	106967
	-- PRESENT VALUE	8149	8242	8338	8437	8538	8643	8751	8861	8975
SUM OF AEC AND OPERATING COSTS		79228	84328	90014	96355	103427	111315	120115	129933	140889
N.P.V. OF ENTIRE PROJECT Y.T.D.		285724	293966	302303	310740	319278	327921	336672	345533	354509

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		2009	2010	2011	2012	2013	2014	2015	2016	2017
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	86439	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	4964	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	86439	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	4964	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		33923	33923	33923	33923	40842	40842	40842	40842	40842
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	85300	95535	107000	119840	134220	150327	168366	188570	211198
	-- PRESENT VALUE	6506	6625	6746	6868	6993	7120	7249	7381	7515
SUPERVISORS	-- ACTUAL DOLLARS	17060	19107	21400	23968	26844	30065	33673	37714	42240
	-- PRESENT VALUE	1301	1325	1349	1374	1399	1424	1450	1476	1503
ELECTRICITY	-- ACTUAL DOLLARS	10245	11167	12172	13268	14462	15763	17182	18728	20414
	-- PRESENT VALUE	781	774	767	760	753	747	740	733	726
JANITORS	-- ACTUAL DOLLARS	4660	4987	5336	5709	6109	6536	6994	7484	8007
	-- PRESENT VALUE	355	346	336	327	318	310	301	293	285
MAINT SUPPLIES	-- ACTUAL DOLLARS	1929	2045	2167	2297	2436	2681	2736	2900	3074
	-- PRESENT VALUE	147	142	137	132	127	122	118	114	109
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	119194	132841	148076	165082	184070	205273	228952	255397	284934
	-- PRESENT VALUE	9092	9212	9336	9461	9590	9722	9858	9997	10139
SUM OF AEC AND OPERATING COSTS		163117	166764	181998	199005	224912	246115	269793	296238	325776
N.P.V. OF ENTIRE PROJECT Y.T.D.		363600	372812	382147	396661	406151	415873	425731	435720	445867

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

		2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		40842	40842	40842	40842	40842	40842	40842	40842	40842
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	236542	264927	296719	332325	372204	416868	466893	522920	585670
	-- PRESENT VALUE	7652	7791	7933	8077	8224	8373	8526	8681	8838
SUPERVISORS	-- ACTUAL DOLLARS	47308	52985	59344	66465	74441	83374	93379	104584	117134
	-- PRESENT VALUE	1530	1558	1587	1615	1645	1675	1705	1736	1768
ELECTRICITY	-- ACTUAL DOLLARS	22251	24254	26437	28816	31409	34236	37318	40676	44337
	-- PRESENT VALUE	720	713	707	700	694	688	681	675	669
JANITORS	-- ACTUAL DOLLARS	8568	9168	9809	10496	11231	12017	12858	13758	14721
	-- PRESENT VALUE	277	270	262	255	248	241	235	228	222
MAINT SUPPLIES	-- ACTUAL DOLLARS	3259	3454	3662	3881	4114	4361	4623	4900	5194
	-- PRESENT VALUE	105	102	98	94	91	88	84	81	78
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	317929	354789	395970	441983	493399	550857	615070	686838	767057
	-- PRESENT VALUE	10285	10434	10586	10742	10902	11065	11231	11402	11576
SUM OF AEC AND OPERATING COSTS		358771	395631	436812	482825	534241	591698	655911	727680	807898
N.P.V. OF ENTIRE PROJECT Y.T.D.		456151	466585	477171	487914	498815	509880	521111	532513	544089

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight Car Stations

2027

CAPITAL EXPENDITURES

STRUCTURE	-- ACTUAL DOLLARS	0
	-- PRESENT VALUE	0
FINISH	-- ACTUAL DOLLARS	-71880
	-- PRESENT VALUE	-986
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	-71880
	-- PRESENT VALUE	-986

ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC) 40842

OPERATING COSTS

TRAIN OPERATORS	-- ACTUAL DOLLARS	655950
	-- PRESENT VALUE	8999
SUPERVISORS	-- ACTUAL DOLLARS	131190
	-- PRESENT VALUE	1800
ELECTRICITY	-- ACTUAL DOLLARS	48327
	-- PRESENT VALUE	663
JANITORS	-- ACTUAL DOLLARS	15752
	-- PRESENT VALUE	216
MAINT SUPPLIES	-- ACTUAL DOLLARS	5506
	-- PRESENT VALUE	76
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	856726
	-- PRESENT VALUE	11764

SUM OF AEC AND OPERATING COSTS 897567

N.P.V. OF ENTIRE PROJECT Y.T.D. 554856

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

BASE YEAR	1982
FIRST YEAR OF OPERATIONS	1988
PROJECT LIFE (YEARS)	40

ALTERNATIVE'S ASSUMPTIONS:

INTEREST RATE (PERCENT)	10.0
CAPITAL COST INFLATION RATE (PERCENT)	5.0

CAPITAL COST OUTLAYS IN 1982 DOLLARS:

NAME	LIFE (YEARS)	FIRST YR. OF CAP. OUTLAY	LAST YR. OF CAP. OUTLAY	AMOUNT K$	SALVAGE K$	REPEATED
STRUCTURE	40	1984	1987	225000.00	0.00	NO
FINISH	25	1987	1987	23000.00	0.00	YES

OPERATING & MAINTENANCE COST OUTLAYS IN 1982 DOLLARS:

NAME	ANNUAL OUTLAY K$	INFLATION RATE %
TRAIN OPERATORS	3200.00	12.00
SUPERVISORS	600.00	12.00
ELECTRICITY	1100.00	9.00
JANITORS	800.00	7.00
MAINT SUPPLIES	420.00	6.00

NET PRESENT VALUE OF ENTIRE PROJECT 518959

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		1982	1983	1984	1985	1986	1987	1988	1989	1990
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	62016	65116	68372	71791	0	0	0
	-- PRESENT VALUE	0	0	51253	48923	46699	44576	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	29354	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	18227	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	62016	65116	68372	101145	0	0	0
	-- PRESENT VALUE	0	0	51253	48923	46699	62803	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		0	0	0	0	0	0	38240	38240	38240
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	6316	7074	7923
	-- PRESENT VALUE	0	0	0	0	0	0	3565	3630	3696
SUPERVISORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1184	1326	1486
	-- PRESENT VALUE	0	0	0	0	0	0	669	681	693
ELECTRICITY	-- ACTUAL DOLLARS	0	0	0	0	0	0	1845	2011	2192
	-- PRESENT VALUE	0	0	0	0	0	0	1041	1032	1022
JANITORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	1201	1285	1375
	-- PRESENT VALUE	0	0	0	0	0	0	678	659	641
MAINT SUPPLIES	-- ACTUAL DOLLARS	0	0	0	0	0	0	596	632	669
	-- PRESENT VALUE	0	0	0	0	0	0	336	324	312
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	0	0	0	0	0	0	11142	12328	13644
	-- PRESENT VALUE	0	0	0	0	0	0	6289	6326	6365
SUM OF AEC AND OPERATING COSTS		0	0	0	0	0	0	49382	50568	51885
N.P.V. OF ENTIRE PROJECT Y.T.D.		0	0	51253	100175	146875	209678	215967	222293	228658

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		1991	1992	1993	1994	1995	1996	1997	1998	1999
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		38240	38240	38240	38240	38240	38240	38240	38240	38240
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	8874	9939	11131	12467	13963	15639	17515	19617	21971
	-- PRESENT VALUE	3763	3832	3901	3972	4045	4118	4193	4269	4347
SUPERVISORS	-- ACTUAL DOLLARS	1664	1864	2087	2338	2618	2932	3284	3678	4120
	-- PRESENT VALUE	706	718	732	745	758	772	786	800	815
ELECTRICITY	-- ACTUAL DOLLARS	2389	2684	2838	3094	3372	3676	4007	4367	4768
	-- PRESENT VALUE	1013	1004	995	986	977	968	959	950	942
JANITORS	-- ACTUAL DOLLARS	1471	1574	1684	1802	1928	2063	2207	2362	2527
	-- PRESENT VALUE	624	607	590	574	558	543	528	514	500
MAINT SUPPLIES	-- ACTUAL DOLLARS	710	752	797	845	896	950	1007	1067	1131
	-- PRESENT VALUE	301	290	279	269	259	250	241	232	224
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	15107	16732	18538	20546	22777	25259	28020	31092	34509
	-- PRESENT VALUE	6407	6451	6497	6546	6598	6652	6708	6766	6827
SUM OF AEC AND OPERATING COSTS		53348	54973	56778	58786	61018	63500	66260	69332	72750
N.P.V. OF ENTIRE PROJECT Y.T.D.		235065	241516	248014	254560	261158	267810	274517	281284	288111

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		2000	2001	2002	2003	2004	2005	2006	2007	2008
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		38240	38240	38240	38240	38240	38240	38240	38240	38240
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	24600	27561	30868	34572	38721	43368	48572	54400	60928
	-- PRESENT VALUE	4426	4506	4588	4672	4757	4843	4931	5021	5112
SUPERVISORS	-- ACTUAL DOLLARS	4614	5168	5788	6482	7260	8131	9107	10200	11424
	-- PRESENT VALUE	830	845	860	876	892	908	925	941	959
ELECTRICITY	-- ACTUAL DOLLARS	5189	5656	6165	6720	7324	7984	8702	9485	10339
	-- PRESENT VALUE	933	925	916	900	900	892	883	875	868
JANITORS	-- ACTUAL DOLLARS	2704	2893	3096	3312	3544	3792	4058	4342	4646
	-- PRESENT VALUE	486	473	460	448	435	424	412	401	390
MAINT SUPPLIES	-- ACTUAL DOLLARS	1199	1271	1347	1428	1513	1604	1701	1803	1911
	-- PRESENT VALUE	216	208	200	193	186	179	173	166	160
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	38313	42548	47264	52515	58363	64879	72139	80230	89248
	-- PRESENT VALUE	6891	6957	7025	7096	7170	7246	7324	7405	7488
SUM OF AEC AND OPERATING COSTS		76554	80789	85504	90755	96604	103120	110380	118471	127488
N.P.V. OF ENTIRE PROJECT Y.T.D.		295002	301959	308985	316081	323251	330496	337820	345225	352713

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		2009	2010	2011	2012	2013	2014	2015	2016	2017
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	99405	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	5697	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	99405	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	5697	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		38240	38240	38240	38240	46197	46197	46197	46197	46197
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	68240	76420	85600	95872	107376	120262	134693	150856	168959
	-- PRESENT VALUE	5205	5300	5396	5494	5594	5696	5799	5905	6012
SUPERVISORS	-- ACTUAL DOLLARS	12795	14330	16050	17976	20133	22549	25255	28286	31680
	-- PRESENT VALUE	976	994	1012	1030	1049	1068	1087	1107	1127
ELECTRICITY	-- ACTUAL DOLLARS	11270	12284	13389	14594	15908	17340	18900	20601	22455
	-- PRESENT VALUE	860	852	844	836	829	821	814	806	799
JANITORS	-- ACTUAL DOLLARS	4971	5319	5691	6090	6516	6972	7460	7983	8541
	-- PRESENT VALUE	379	369	359	349	339	330	321	312	304
MAINT SUPPLIES	-- ACTUAL DOLLARS	2025	2147	2276	2412	2557	2710	2873	3045	3228
	-- PRESENT VALUE	154	149	143	138	133	128	124	119	115
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	99301	110509	123006	136944	152490	169833	189181	210771	234863
	-- PRESENT VALUE	7674	7663	7754	7848	7945	8044	8146	8250	8357
SUM OF AEC AND OPERATING COSTS		137541	148749	161247	175185	198688	216030	235379	256968	281061
N.P.V. OF ENTIRE PROJECT Y.T.D.		360288	367951	375705	389250	397195	405238	413384	421634	429991

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

		2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		46197	46197	46197	46197	46197	46197	46197	46197	46197
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	189234	211942	237375	265860	297763	333495	373514	418336	468536
	-- PRESENT VALUE	6122	6233	6346	6462	6579	6699	6820	6944	7071
SUPERVISORS	-- ACTUAL DOLLARS	35481	39739	44508	49849	55831	62530	70034	78438	87851
	-- PRESENT VALUE	1148	1169	1190	1212	1234	1256	1279	1302	1326
ELECTRICITY	-- ACTUAL DOLLARS	24476	26679	29080	31698	34550	37660	41049	44744	48771
	-- PRESENT VALUE	792	785	777	770	763	756	750	743	736
JANITORS	-- ACTUAL DOLLARS	9139	9779	10463	11196	11980	12818	13715	14676	15703
	-- PRESENT VALUE	296	288	280	272	265	257	250	244	237
MAINT SUPPLIES	-- ACTUAL DOLLARS	3422	3627	3845	4076	4320	4579	4854	5145	5454
	-- PRESENT VALUE	111	107	103	99	95	92	89	85	82
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	261753	291766	325271	362678	404444	451082	503167	561338	626314
	-- PRESENT VALUE	8467	8580	8696	8815	8936	9061	9188	9318	9452
SUM OF AEC AND OPERATING COSTS		307950	337964	371469	408875	450641	497279	549364	607535	672511
N.P.V. OF ENTIRE PROJECT Y.T.D.		438459	447039	455735	464550	473486	482546	491734	501053	510505

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Ten Car Stations

2027

CAPITAL EXPENDITURES

STRUCTURE	-- ACTUAL DOLLARS	0
	-- PRESENT VALUE	0
FINISH	-- ACTUAL DOLLARS	-82662
	-- PRESENT VALUE	-1134
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	-82662
	-- PRESENT VALUE	-1134

ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC) 46197

OPERATING COSTS

TRAIN OPERATORS	-- ACTUAL DOLLARS	524760
	-- PRESENT VALUE	7199
SUPERVISORS	-- ACTUAL DOLLARS	98393
	-- PRESENT VALUE	1350
ELECTRICITY	-- ACTUAL DOLLARS	53160
	-- PRESENT VALUE	729
JANITORS	-- ACTUAL DOLLARS	16802
	-- PRESENT VALUE	231
MAINT SUPPLIES	-- ACTUAL DOLLARS	5781
	-- PRESENT VALUE	79
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	698896
	-- PRESENT VALUE	9588

SUM OF AEC AND OPERATING COSTS 745093

NET PRESENT VALUE OF ENTIRE PROJECT 518959

Appendix D

OUTPUT FOR EXAMPLE 1 USING COST DIFFERENTIALS

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight car (Over)/Under Ten Car Stations

BASE YEAR	1982
FIRST YEAR OF OPERATIONS	1988
PROJECT LIFE (YEARS)	40

ALTERNATIVE'S ASSUMPTIONS:

INTEREST RATE (PERCENT)	10.0
CAPITAL COST INFLATION RATE (PERCENT)	5.0

CAPITAL COST OUTLAYS IN 1982 DOLLARS:

NAME	LIFE (YEARS)	FIRST YR. OF CAP. OUTLAY	LAST YR. OF CAP. OUTLAY	AMOUNT K$	SALVAGE K$	REPEATED
STRUCTURE	40	1984	1987	250000.00	0.00	NO
FINISH	25	1987	1987	30000.00	0.00	YES

OPERATING & MAINTENANCE COST OUTLAYS IN 1982 DOLLARS:

NAME	ANNUAL OUTLAY K$	INFLATION RATE %
TRAIN OPERATORS	-8000.00	8.00
SUPERVISORS	-2000.00	8.00
ELECTRICITY	1000.00	9.00
JANITORS	50.00	7.00
MAINT SUPPLIES	20.00	6.00

NET PRESENT VALUE OF ENTIRE PROJECT 3193

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight car (Over)/Under Ten Car Stations

		1982	1983	1984	1985	1986	1987	1988	1989	1990
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	6891	7235	7597	7977	0	0	0
	-- PRESENT VALUE	0	0	5695	5436	5189	4953	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	3829	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	2377	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	6891	7235	7597	11806	0	0	0
	-- PRESENT VALUE	0	0	5695	5436	5189	7330	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		0	0	0	0	0	0	4318	4318	4318
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	-1269	-1371	-1481
	-- PRESENT VALUE	0	0	0	0	0	0	-717	-784	-691
SUPERVISORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	-317	-343	-370
	-- PRESENT VALUE	0	0	0	0	0	0	-179	-176	-173
ELECTRICITY	-- ACTUAL DOLLARS	0	0	0	0	0	0	168	183	199
	-- PRESENT VALUE	0	0	0	0	0	0	96	94	93
JANITORS	-- ACTUAL DOLLARS	0	0	0	0	0	0	75	80	86
	-- PRESENT VALUE	0	0	0	0	0	0	42	41	40
MAINT SUPPLIES	-- ACTUAL DOLLARS	0	0	0	0	0	0	28	30	32
	-- PRESENT VALUE	0	0	0	0	0	0	16	15	15
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	0	0	0	0	0	0	-1316	-1421	-1534
	-- PRESENT VALUE	0	0	0	0	0	0	-743	-729	-716
SUM OF AEC AND OPERATING COSTS		0	0	0	0	0	0	3002	2897	2784
N.P.V. OF ENTIRE PROJECT Y.T.D.		0	0	5695	11131	16319	23650	22907	22178	21462

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight car (Over)/Under Ten Car Stations

		1991	1992	1993	1994	1995	1996	1997	1998	1999
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		4318	4318	4318	4318	4318	4318	4318	4318	4318
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	-1699	-1727	-1866	-2015	-2176	-2350	-2538	-2741	-2960
	-- PRESENT VALUE	-678	-666	-654	-642	-630	-619	-608	-596	-586
SUPERVISORS	-- ACTUAL DOLLARS	-400	-432	-466	-504	-544	-587	-634	-685	-740
	-- PRESENT VALUE	-170	-166	-163	-160	-158	-155	-152	-149	-146
ELECTRICITY	-- ACTUAL DOLLARS	217	237	258	281	307	334	364	397	433
	-- PRESENT VALUE	92	91	90	90	89	88	87	86	86
JANITORS	-- ACTUAL DOLLARS	92	98	105	113	120	129	138	148	158
	-- PRESENT VALUE	39	38	37	36	35	34	33	32	31
MAINT SUPPLIES	-- ACTUAL DOLLARS	34	36	38	40	43	46	48	51	54
	-- PRESENT VALUE	14	14	13	13	12	12	11	11	11
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	-1656	-1788	-1930	-2084	-2250	-2429	-2622	-2830	-3055
	-- PRESENT VALUE	-702	-689	-677	-664	-652	-640	-628	-616	-605
SUM OF AEC AND OPERATING COSTS		2662	2630	2387	2234	2068	1889	1696	1487	1262
N.P.V. OF ENTIRE PROJECT Y.T.D.		20760	20071	19394	18730	18078	17439	16811	16195	15591

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight car (Over)/Under Ten Car Stations

		2000	2001	2002	2003	2004	2005	2006	2007	2008
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		4318	4318	4318	4318	4318	4318	4318	4318	4318
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	-3197	-3453	-3729	-4027	-4349	-4697	-5073	-5479	-5917
	-- PRESENT VALUE	-575	-565	-554	-544	-534	-525	-515	-506	-496
SUPERVISORS	-- ACTUAL DOLLARS	-799	-863	-932	-1007	-1087	-1174	-1268	-1370	-1479
	-- PRESENT VALUE	-144	-141	-139	-136	-134	-131	-129	-126	-124
ELECTRICITY	-- ACTUAL DOLLARS	472	514	560	611	666	726	791	862	940
	-- PRESENT VALUE	85	84	83	83	82	81	80	80	79
JANITORS	-- ACTUAL DOLLARS	169	181	193	207	222	237	254	271	290
	-- PRESENT VALUE	30	30	29	28	27	26	26	25	24
MAINT SUPPLIES	-- ACTUAL DOLLARS	57	61	64	68	72	76	81	86	91
	-- PRESENT VALUE	10	10	10	9	9	9	8	8	8
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	-3298	-3560	-3843	-4148	-4477	-4832	-5215	-5629	-6075
	-- PRESENT VALUE	-593	-582	-571	-561	-550	-540	-530	-520	-510
SUM OF AEC AND OPERATING COSTS		1019	757	475	170	-159	-515	-898	-1311	-1757
N.P.V. OF ENTIRE PROJECT Y.T.D.		14997	14416	13844	13284	12734	12194	11664	11145	10635

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight car (Over)/Under Ten Car Stations

		2009	2010	2011	2012	2013	2014	2015	2016	2017
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	12966	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	743	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	12966	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	743	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		4318	4318	4318	4318	5356	5356	5356	5356	5356
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	-6390	-6902	-7454	-8050	-8694	-9390	-10141	-10952	-11828
	-- PRESENT VALUE	-487	-479	-470	-461	-453	-445	-437	-429	-421
SUPERVISORS	-- ACTUAL DOLLARS	-1598	-1725	-1863	-2013	-2174	-2347	-2535	-2738	-2957
	-- PRESENT VALUE	-122	-120	-117	-115	-113	-111	-109	-107	-105
ELECTRICITY	-- ACTUAL DOLLARS	1025	1117	1217	1327	1446	1576	1718	1873	2041
	-- PRESENT VALUE	78	77	77	76	75	75	74	73	73
JANITORS	-- ACTUAL DOLLARS	311	332	356	381	407	436	466	499	534
	-- PRESENT VALUE	24	23	22	22	21	21	20	20	19
MAINT SUPPLIES	-- ACTUAL DOLLARS	96	102	108	115	122	129	137	145	154
	-- PRESENT VALUE	7	7	7	7	6	6	6	6	5
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	-6556	-7076	-7636	-8240	-8892	-9596	-10355	-11173	-12056
	-- PRESENT VALUE	-500	-491	-481	-472	-463	-454	-446	-437	-429
SUM OF AEC AND OPERATING COSTS		-2239	-2758	-3318	-3923	-3537	-4240	-4999	-5818	-6701
N.P.V. OF ENTIRE PROJECT Y.T.D.		10135	9644	9163	9434	8970	8516	8070	7633	7204

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight car (Over)/Under Ten Car Stations

		2018	2019	2020	2021	2022	2023	2024	2025	2026
CAPITAL EXPENDITURES										
STRUCTURE	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
FINISH	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	0	0	0	0	0	0	0	0	0
	-- PRESENT VALUE	0	0	0	0	0	0	0	0	0
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		5356	5356	5356	5356	5356	5356	5356	5356	5356
OPERATING COSTS										
TRAIN OPERATORS	-- ACTUAL DOLLARS	-12775	-13797	-14900	-16092	-17380	-18770	-20272	-21893	-23645
	-- PRESENT VALUE	-413	-406	-398	-391	-384	-377	-370	-363	-357
SUPERVISORS	-- ACTUAL DOLLARS	-3194	-3449	-3725	-4023	-4345	-4693	-5068	-5473	-5911
	-- PRESENT VALUE	-103	-101	-100	-98	-96	-94	-93	-91	-89
ELECTRICITY	-- ACTUAL DOLLARS	2225	2425	2644	2882	3141	3424	3732	4068	4434
	-- PRESENT VALUE	72	71	71	70	69	69	68	68	67
JANITORS	-- ACTUAL DOLLARS	571	611	664	700	749	801	857	917	981
	-- PRESENT VALUE	18	18	17	17	17	16	16	15	15
MAINT SUPPLIES	-- ACTUAL DOLLARS	163	173	183	194	206	218	231	245	260
	-- PRESENT VALUE	6	5	5	5	5	4	4	4	4
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	-13009	-14036	-15146	-16340	-17629	-19020	-20519	-22137	-23881
	-- PRESENT VALUE	-421	-413	-406	-397	-390	-382	-375	-367	-360
SUM OF AEC AND OPERATING COSTS		-7653	-8681	-9789	-10984	-12274	-13664	-15164	-16781	-18526
N.P.V. OF ENTIRE PROJECT Y.T.D.		6783	6370	5965	5568	5179	4797	4422	4054	3694

SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT
METRO RAIL LIFE CYCLE COST MODEL
(IN THOUSANDS OF DOLLARS)

RUN TITLE -- EIGHT CAR VS TEN CAR TRAINS

TITLE OF ALTERNATIVE -- Eight car (Over)/Under Ten Car Stations

		2027
CAPITAL EXPENDITURES		
STRUCTURE	-- ACTUAL DOLLARS	0
	-- PRESENT VALUE	0
FINISH	-- ACTUAL DOLLARS	-10782
	-- PRESENT VALUE	-148
TOTAL CAPITAL EXP.	-- ACTUAL DOLLARS	-10782
	-- PRESENT VALUE	-148
ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)		6386
OPERATING COSTS		
TRAIN OPERATORS	-- ACTUAL DOLLARS	-25536
	-- PRESENT VALUE	-350
SUPERVISORS	-- ACTUAL DOLLARS	-6384
	-- PRESENT VALUE	-88
ELECTRICITY	-- ACTUAL DOLLARS	4833
	-- PRESENT VALUE	66
JANITORS	-- ACTUAL DOLLARS	1050
	-- PRESENT VALUE	14
MAINT SUPPLIES	-- ACTUAL DOLLARS	275
	-- PRESENT VALUE	4
TOTAL OPER. COSTS	-- ACTUAL DOLLARS	-25762
	-- PRESENT VALUE	-353
SUM OF AEC AND OPERATING COSTS		-20407
N.P.V. OF ENTIRE PROJECT Y.T.D.		3193

Appendix E

COMPUTER PROGRAM

```
0001            PROGRAM LCC
                C
                C       SCRTD LIFE CYCLE COST MODEL
                C
                C       WRITTEN FOR SCRTD BY SRI INTERNATIONAL, JUNE 1982
                C
                C       THIS PROGRAM IS WRITTEN IN FORTRAN-77 AND WILL NOT COMPILE
                C       ON SYSTEMS SUPPORTING ONLY FORTRAN-66 (A.K.A. FORTRAN-IV).
                C
                C       COST RELATIONSHIPS DEVELOPED BY: CLAIRE STARRY
                C       PROGRAMED BY: WILLIAM A. STOCK, JUNE 1982
                C
0002            INCLUDE 'LCCCOM.FOR'
              * C
              * C       COMMON BLOCKS --
              * C
              * C       CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003          *         COMMON/CCHAR/CNAME(3,20)
0004          *         CHARACTER*20 CNAME
              * C       NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005          *         COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
              *        $ REPEAT(3,20),CLIFE(3,20),
              *        $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
              *        $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006          *         INTEGER CYR1,CYR2,CLIFE,CNUM
0007          *         LOGICAL REPEAT
              * C       CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008          *         COMMON/OCHAR/ONAME(3,20)
0009          *         CHARACTER*20 ONAME
              * C       NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010          *         COMMON/OCOSTS/OAMT(3,20),O1NF(3,20),
              *        $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
              *        $ ONUM(3),IO,NO,MAXNO
0011          *         INTEGER ONUM
              * C       OTHER ITEMS IN COMMON:
0012          *         COMMON/CHARS/ANAME(3),RNAME
0013          *         CHARACTER*80 ANAME,RNAME
0014          *         COMMON INTRT(3),C1NF(3),TLCCV(3,60),LCCV(3),
              *        $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015          *         REAL INTRT,LCCV
0016          *         INTEGER STRTYR,BASEYR,ENDYR
              * C
              * C       VARIABLE NAMING CONVENTION:
              * C         VARIABLES WITH "..YR.." CONTAIN AN ACTUAL CALANDER YEAR,
              * C         VARIABLES WITH ONLY "..Y.." ARE RELATIVE YEARS WITH "BASEYR"
              * C           AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS.
              * C
0017            INCLUDE 'FILCOM.FOR'
              * C
              * C       FILES AND SUCH:
0018          *         COMMON/FILES/ISCRCH
              * C
                C
                C       SET MAXIMA
                C
0019            MAXNC=20
0020            MAXNO=20
```

```
0021          MAXNA=3
0022          MAXNY=60
        C     PROCESS INPUT
0023          CALL INPUT
        C     PERFORM THE CALCULATIONS
0024          CALL CALC
        C     OUTPUT RESULTS
0025          CALL OUTPUT
0026          STOP
0027          END
```

ROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	62	PIC CON REL LCL SHR EXE RD NOWRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RD WRT LONG
5	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	788	PIC OVR REL GBL SHR NOEXE RD WRT LONG
9	FILES	4	PIC OVR REL GBL SHR NOEXE RD WRT LONG

NTRY POINTS

Address	Type	Name
0-00000000		LCC

ARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
8-000002F8	I*4	BASEYR	8-00000300	I*4	ENDYR	8-00000308	I*4	IA	4-00007E9C	I*4	IC
6-0000780C	I*4	IO	9-00000000	I*4	ISCRCH	8-00000310	I*4	MAXNA	4-00007EA4	I*4	MAXNC
6-00007814	I*4	MAXNO	8-00000304	I*4	MAXNY	8-0000030C	I*4	NA	4-00007EA8	I*4	NC
6-00007810	I*4	NO	8-000002FC	I*4	NYEAR	7-000000F8	CHAR	RNAME	8-000002F4	I*4	STRTYR

RRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-00001E0	R*4	CAMT	240	(3, 20)
4-00006A0	R*4	CCOST	14400	(3, 20, 60)
8-0000000C	R*4	CINF	12	(3)
4-000004B0	I*4	CLIFE	240	(3, 20)
3-00000000	CHAR	CNAME	1200	(3, 20)
4-00007E90	I*4	CNUM	12	(3)

4-000002D0	R*4	CSAL	240	(3, 20)
4-00000000	I*4	CYRI	240	(3, 20)
4-000000F0	I*4	CYR2	240	(3, 20)
8-00000000	R*4	INTRT	12	(3)
8-000002E8	R*4	LCCV	12	(3)
6-00000000	R*4	OAMT	240	(3, 20)
6-000001E0	R*4	OCOST	14400	(3, 20, 60)
6-000000F0	R*4	OINF	240	(3, 20)
5-00000000	CHAR	ONAME	1200	(3, 20)
6-00007800	I*4	ONUM	12	(3)
4-00003DE0	R*4	PVCC	14400	(3, 20, 60)
6-00003A20	R*4	PVOC	14400	(3, 20, 60)
4-000003C0	L*4	REPEAT	240	(3, 20)
4-00007620	R*4	TCCOST	720	(3, 60)
8-00000018	R*4	TLCCV	720	(3, 60)
6-00007260	R*4	TOCOST	720	(3, 60)
4-000078F0	R*4	TPVCC	720	(3, 60)
6-00007530	R*4	TPVOC	720	(3, 60)

UNCTIONS AND SUBROUTINES REFERENCED

ALC INPUT OUTPUT

otal Space Allocated = 66742 Bytes

```
0001          SUBROUTINE INPUT
              C     ROUTINE TO MANAGE THE INPUT OF ALL DATA
              C
              C     WILLIAM A. STOCK, JUNE 1982
              C
0002          INCLUDE 'LCCCOM.FOR'
              * C
              * C     COMMON BLOCKS --
              * C
              * C     CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003          *       COMMON/CCHAR/CNAME(3,20)
0004          *       CHARACTER*20 CNAME
              * C     NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005          *       COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
              *      $ REPEAT(3,20),CLIFE(3,20),
              *      $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
              *      $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006          *       INTEGER CYR1,CYR2,CLIFE,CNUM
0007          *       LOGICAL REPEAT
              * C     CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008          *       COMMON/OCHAR/ONAME(3,20)
0009          *       CHARACTER*20 ONAME
              * C     NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010          *       COMMON/OCOSTS/OAMT(3,20),OINF(3,20),
              *      $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
              *      $ ONUM(3),IO,NO,MAXNO
0011          *       INTEGER ONUM
              * C     OTHER ITEMS IN COMMON:
0012          *       COMMON/CHARS/ANAME(3),RNAME
0013          *       CHARACTER*80 ANAME,RNAME
0014          *       COMMON INTRT(3),CINF(3),TLCCV(3,60),LCCV(3),
              *      $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015          *       REAL INTRT,LCCV
0016          *       INTEGER STRTYR,BASEYR,ENDYR
              * C
              * C     VARIABLE NAMING CONVENTION:
              * C       VARIABLES WITH "..YR.." CONTAIN AN ACTUAL CALANDER YEAR,
              * C       VARIABLES WITH ONLY "..Y.." ARE RELATIVE YEARS WITH "BASEYR"
              * C         AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS.
              * C
0017          INCLUDE 'FILCOM.FOR'
              * C
              * C     FILES AND SUCH:
0018          *       COMMON/FILES/ISCRCH
              * C
0019          LOGICAL FULL,ERROR,END,EOF,KILL
              C
              C     SCRATCH FILE FOR FREE-FIELD RE-READS
0020          ISCRCH=11
0021          OPEN(UNIT=ISCRCH,STATUS='SCRATCH')
              C     FLAG TO KILL RUN IF ERROR
0022          KILL=.FALSE.
              C
              C     READ RUN HEADER INFORMATION
              C
0023          CALL RHINPT(ERROR)
              C
```

```
      C     "IF" LOOP OVER ALTERNATIVES
      C
0024        IA=0
0025     100 IA=IA+1
0026        IF(IA .GT. MAXNA)THEN
0027          WRITE(6,6910)MAXNA
0028  6910    FORMAT(/' ERROR -- NUMBER OF ALTERNATIVES EXCEEDS LIMIT OF',I4)
0029          STOP
0030        END IF
      C
      C     READ ALTERNATIVE'S HEADER INFORMATION
      C
0031        CALL AHINPT(ERROR)
      C     SPACE OVER AS MANY DELIMITER RECORDS AS NEEDED
0032        CALL NEXGRP(EOF)
0033        IF(EOF)GO TO 900
      C
      C     READ AND PROCESS CAPITAL COSTS
      C
      C
      C     "IF" LOOP OVER CAPITAL COST RECORDS
      C
0034        IC=0
0035        FULL=.FALSE.
0036     200 IC=IC+1
0037        IF(IC .GT. MAXNC)THEN
0038          FULL=.TRUE.
0039          IC=MAXNC
0040        END IF
0041        CALL CINPUT(FULL,CNAME(IA,IC),CLIFE(IA,IC),CYR1(IA,IC),CYR2(IA,IC)
           $ ,CAMT(IA,IC),CSAL(IA,IC),REPEAT(IA,IC),ERROR,END)
0042        IF(ERROR)THEN
0043          KILL=.TRUE.
0044          IC=IC-1
0045        END IF
0046        IF(.NOT. END)GO TO 200
0047        NC=IC
0048        IF(.NOT. FULL)NC=IC-1
0049        CNUM(IA)=NC
      C     SPACE OVER AS MANY DELIMITER RECORDS AS NEEDED
0050        CALL NEXGRP(EOF)
0051        IF(EOF)GO TO 900
      C
      C     READ AND PROCESS OPERATING AND MAINTENANCE COSTS
      C
      C     "IF" LOOP OVER OPERATING AND EQUIPMENT COST RECORDS
0052        IO=0
0053        FULL=.FALSE.
0054     300 IO=IO+1
0055        IF(IO .GT. MAXNO)THEN
0056          FULL=.TRUE.
0057          IO=MAXNO
0058        END IF
0059        CALL OINPUT(FULL,ONAME(IA,IO),OAMT(IA,IO),OINF(IA,IO),
           $ ERROR,END,EOF)
0060        IF(ERROR)THEN
0061          KILL=.TRUE.
```

```
0062            IO=IO-1
0063          END IF
0064          IF(.NOT. END)GO TO 300
0065          NO=IO
0066          IF(.NOT. FULL)NO=IO-1
0067          ONUM(IA)=NO
        C     SPACE OVER DELIMITER RECORDS TO FIND E-O-F OR NEXT ALTERNATIVE
0068          IF(.NOT. EOF)CALL NEXGRP(EOF)
0069          IF(.NOT. EOF)GO TO 100
0070          NA=IA
0071          IF(KILL)THEN
0072            WRITE(6,6930)
0073   6930     FORMAT(/' NO RUN ON ACCOUNT OF INPUT ERRORS DETECTED')
0074            STOP
0076          END IF
0076          RETURN
0077    900   WRITE(6,6940)
0078   6940   FORMAT(/' ERROR -- UNEXPECTED END-OF-FILE WHILE READING ',
           $ 'DELIMITER RECORDS')
0079          STOP
0080          END
```

ROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	804	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	172	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	140	PIC CON REL LCL NOSHR NOEXE RO WRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RO WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RO WRT LONG
5	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	788	PIC OVR REL GBL SHR NOEXE RD WRT LONG
9	FILES	4	PIC OVR REL GBL SHR NOEXE RD WRT LONG

NTRY POINTS

Address	Type	Name
0-00000000		INPUT

ARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
0-000002F8	I*4	BASEYR	2-00000008	L*4	END	0-00000300	I*4	ENDYR	2-0000000C	L*4	EOF
2-00000004	L*4	ERROR	2-00000000	L*4	FULL	0-00000308	I*4	IA	4-00007E9C	I*4	IC
6-0000780C	I*4	IO	9-00000000	I*4	ISCRCH	2-00000010	L*4	KILL	0-00000310	I*4	MAXNA
4-00007EA4	I*4	MAXNC	6-00007814	I*4	MAXNO	0-00000304	I*4	MAXNY	0-00000300	I*4	NA
4-00007EA0	I*4	NC	6-00007810	I*4	NO	0-000002FC	I*4	NYEAR	7-00000FF0	CHAR	RNAME

8-000002F4 I*4 STRTYR

RRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-000001E0	R*4	CAMT	240	(3, 20)
4-000005A0	R*4	CCOST	14400	(3, 20, 60)
8-0000000C	R*4	CINF	12	(3)
4-00000480	I*4	CLIFE	240	(3, 20)
3-00000000	CHAR	CNAME	1200	(3, 20)
4-00007E90	I*4	CNUM	12	(3)
4-000002D0	R*4	CSAL	240	(3, 20)
4-00000000	I*4	CYR1	240	(3, 20)
4-000000F0	I*4	CYR2	240	(3, 20)
8-00000000	R*4	INTRT	12	(3)
8-000002E8	R*4	LCCV	12	(3)
6-00000000	R*4	OAMT	240	(3, 20)
6-000001E0	R*4	OCOST	14400	(3, 20, 60)
6-000000F0	R*4	OINF	240	(3, 20)
5-00000000	CHAR	ONAME	1200	(3, 20)
6-00007B00	I*4	ONUM	12	(3)
4-00003DE0	R*4	PVCC	14400	(3, 20, 60)
6-00003A20	R*4	PVOC	14400	(3, 20, 60)
4-000003C0	L*4	REPEAT	240	(3, 20)
4-00007620	R*4	TCCOST	720	(3, 60)
8-00000018	R*4	TLCCV	720	(3, 60)
6-00007260	R*4	TOCOST	720	(3, 60)
4-00007BF0	R*4	TPVCC	720	(3, 60)
6-00007530	R*4	TPVOC	720	(3, 60)

ABELS

Address	Label	Address	Label	Address	Label	Address	Label	Address	Label	Address	Label
0-00000029	100	0-00000085	200	0-000001EF	300	0-000003B6	900	1-00000000	6910'	1-00000037	6930'
1-00000066	6940'										

UNCTIONS AND SUBROUTINES REFERENCED

IINPT CINPUT FORSOPEN NEXGRP OINPUT RHINPT

otal Space Allocated = 67796 Bytes

```
0001          SUBROUTINE RHINPT(ERROR)
      C       ROUTINE TO READ RUN HEADER INFORMATION
      C
      C       WILLIAM A. STOCK, JUNE 1982
      C
0002          INCLUDE 'LCCCOM.FOR'
     * C
     * C       COMMON BLOCKS --
     * C
     * C       CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003 *         COMMON/CCHAR/CNAME(3,20)
0004 *         CHARACTER*20 CNAME
     * C       NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005 *         COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
     *        $ REPEAT(3,20),CLIFE(3,20),
     *        $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
     *        $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006 *         INTEGER CYR1,CYR2,CLIFE,CNUM
0007 *         LOGICAL REPEAT
     * C       CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008 *         COMMON/OCHAR/ONAME(3,20)
0009 *         CHARACTER*20 ONAME
     * C       NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010 *         COMMON/OCOSTS/OAMT(3,20),OINF(3,20),
     *        $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
     *        $ ONUM(3),IO,NO,MAXNO
0011 *         INTEGER ONUM
     * C       OTHER ITEMS IN COMMON:
0012 *         COMMON/CHARS/ANAME(3),RNAME
0013 *         CHARACTER*80 ANAME,RNAME
0014 *         COMMON INTRT(3),CINF(3),TLCCV(3,60),LCCV(3),
     *        $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015 *         REAL INTRT,LCCV
0016 *         INTEGER STRTYR,BASEYR,ENDYR
     * C
     * C       VARIABLE NAMING CONVENTION:
     * C         VARIABLES WITH "..YR.." CONTAIN AN ACTUAL CALANDER YEAR,
     * C         VARIABLES WITH ONLY "..Y.." ARE RELATIVE YEARS WITH "BASEYR"
     * C           AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS.
     * C
0017          LOGICAL ERROR,EOF
0018          CHARACTER*80 LINE
0019          ERROR=.FALSE.
0020          CALL NEXGRP(EOF)
0021          IF(EOF)GO TO 910
      C       READ RUN TITLE
0022          READ(5,5000,END=910)RNAME
0023       5000 FORMAT(A80)
0024          CALL NEXGRP(EOF)
0025          IF(EOF)GO TO 910
      C       RUN NUMERIC DATA
0026          READ(5,*,ERR=900,END=910)BASEYR,STRTYR,NYEAR
0027          ENDYR=STRTYR+NYEAR-1
0028          RETURN
0029       900 BACKSPACE 5
0030          READ(5,5000)LINE
0031          L=NBLNKL(LINE)
```

```
0032           WRITE(6,6900)LINE(1:L)
0033       6900 FORMAT(/' ERROR -- RUN HEADER NUMERIC DATA INCOMPREHENSIBLE OR ',
                  $ 'MISSING'/
                  $ '            LAST RECORD READ:'/
                  $ 1X,A(L))
0034           ERROR=.TRUE.
0035           RETURN
0036        910 WRITE(6,6910)
0037       6910 FORMAT(/' ERROR -- UNEXPECTED END-OF-FILE WHILE READING RUN ',
                  $ 'HEADER INFORMATION')
0038           STOP
0039           END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	296	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	184	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	128	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RD WRT LONG
5	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	788	PIC OVR REL GBL SHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000		RHINPT

VARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
8-000002F8	I*4	BASEYR	8-00000300	I*4	ENDYR	2-00000050	L*4	EOF	AP-00000040	L*4	ERROR
8-00000308	I*4	IA	4-00007E9C	I*4	IC	6-0000780C	I*4	IO	2-00000064	I*4	L
2-00000000	CHAR	LINE	0-00000310	I*4	MAXNA	4-00007EA4	I*4	MAXNC	6-00007B14	I*4	MAXNO
8-00000304	I*4	MAXNY	8-0000030C	I*4	NA	4-00007EA0	I*4	NC	6-00007B10	I*4	NO
8-000002FC	I*4	NYEAR	7-000000F0	CHAR	RNAME	8-000002F4	I*4	STRTYR			

ARRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-000001E0	R*4	CAMT	240	(3, 20)
4-000005A0	R*4	CCOST	14400	(3, 20, 60)

8-0000000C	R*4	CINF	12	(3)
4-00000480	I*4	CLIFE	240	(3, 20)
3-00000000	CHAR	CNAME	1200	(3, 20)
4-00007E90	I*4	CNUM	12	(3)
4-00002D0	R*4	CSAL	240	(3, 20)
4-00000000	I*4	CYR1	240	(3, 20)
4-000000F0	I*4	CYR2	240	(3, 20)
8-00000000	R*4	INTRT	12	(3)
8-00002E8	R*4	LCCV	12	(3)
6-00000000	R*4	OAMT	240	(3, 20)
6-0000E1E0	R*4	OCOST	14400	(3, 20, 60)
6-000000F0	R*4	OINF	240	(3, 20)
5-00000000	CHAR	ONAME	1200	(3, 20)
6-00007800	I*4	ONUM	12	(3)
4-0003DE0	R*4	PVCC	14400	(3, 20, 60)
6-0003A20	R*4	PVOC	14400	(3, 20, 60)
4-000003C0	L*4	REPEAT	240	(3, 20)
4-00007620	R*4	TCCOST	720	(3, 60)
8-00000018	R*4	TLCCV	720	(3, 60)
6-00007260	R*4	TOCOST	720	(3, 60)
4-00078F0	R*4	TPVCC	720	(3, 60)
6-00007530	R*4	TPVOC	720	(3, 60)

ABELS

Address	Label	Address	Label	Address	Label	Address	Label	Address	Label
0-000000A1	900	0-00000100	910	1-00000000	6000'	1-00000003	6900'	1-00000060	6910'

UNCTIONS AND SUBROUTINES REFERENCED

BLNKL NEXGRP

otal Space Allocated = 67284 Bytes

```
0001          SUBROUTINE AHINPT(ERROR)
              C     ROUTINE TO READ AN ALTERNATIVE'S HEADER INFORMATION
              C
              C     WILLIAM A. STOCK, JUNE 1982
              C
0002          INCLUDE 'LCCCOM.FOR'
            * C
            * C     COMMON BLOCKS --
            * C
            * C     CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003        *       COMMON/CCHAR/CNAME(3,20)
0004        *       CHARACTER*20 CNAME
            * C     NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005        *       COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
            *      $ REPEAT(3,20),CLIFE(3,20),
            *      $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
            *      $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006        *       INTEGER CYR1,CYR2,CLIFE,CNUM
0007        *       LOGICAL REPEAT
            * C     CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008        *       COMMON/OCHAR/ONAME(3,20)
0009        *       CHARACTER*20 ONAME
            * C     NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010        *       COMMON/OCOSTS/OAMT(3,20),OINF(3,20),
            *      $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
            *      $ ONUM(3),IO,NO,MAXNO
0011        *       INTEGER ONUM
            * C     OTHER ITEMS IN COMMON:
0012        *       COMMON/CHARS/ANAME(3),RNAME
0013        *       CHARACTER*80 ANAME,RNAME
0014        *       COMMON INTRT(3),CINF(3),TLCCV(3,60),LCCV(3),
            *      $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015        *       REAL INTRT,LCCV
0016        *       INTEGER STRTYR,BASEYR,ENDYR
            * C
            * C     VARIABLE NAMING CONVENTION:
            * C       VARIABLES WITH "..YR.." CONTAIN AN ACTUAL CALANDER YEAR,
            * C       VARIABLES WITH ONLY "..Y.." ARE RELATIVE YEARS WITH "BASEYR"
            * C         AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS.
            * C
0017          LOGICAL ERROR,EOF
0018          CHARACTER*80 LINE
0019          ERROR=.FALSE.
0020          CALL NEXGRP(EOF)
0021          IF(EOF)GO TO 910
              C     ALTERNATIVE'S TITLE
0022          READ(5,5000,END=910)ANAME(IA)
0023       5000 FORMAT(A80)
0024          CALL NEXGRP(EOF)
0025          IF(EOF)GO TO 910
              C     READ ALTERNATIVE NUMERIC DATA
0026          READ(5,*,ERR=900,END=910)INTRT(IA),CINF(IA)
0027          RETURN
0028        900 BACKSPACE 5
0029          READ(5,5000)LINE
0030          L=NBLNKL(LINE)
0031          WRITE(6,6900)LINE(1:L)
```

```
0032     6900 FORMAT(/' ERROR -- ALTERNATIVE HEADER NUMERIC DATA ',
              $ 'INCOMPREHENSIBLE OR MISSING'/
              $ '           LAST RECORD READ:'/
              $ 1X,A<L>)
0033          ERROR=.TRUE.
0034          RETURN
0035      910 WRITE(6,6910)
0036     6910 FORMAT(/' ERROR -- UNEXPECTED END-OF-FILE WHILE READING ',
              $ 'ALTERNATIVE HEADER INFORMATION')
0037          STOP
0038          END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	328	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	200	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	128	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RD WRT LONG
5	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	700	PIC OVR REL GBL SHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000		AHINPT

VARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
8-000002F8	I*4	BASEYR	8-00000300	I*4	ENDYR	2-00000050	L*4	EOF	AP-00000040	L*4	ERROR
8-00000308	I*4	IA	4-00007E9C	I*4	IC	6-0000780C	I*4	IO	2-00000054	I*4	L
2-00000000	CHAR	LINE	8-00000310	I*4	MAXNA	4-00007EA4	I*4	MAXNC	6-00007814	I*4	MAXNO
8-00000304	I*4	MAXNY	8-0000030C	I*4	NA	4-00007EA0	I*4	NC	6-00007810	I*4	NO
8-000002FC	I*4	NYEAR	7-000000F0	CHAR	RNAME	8-000002F4	I*4	STRTYR			

ARRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-00001E0	R*4	CAMT	240	(3, 20)
4-000005A0	R*4	CCOST	14400	(3, 20, 60)
8-0000000C	R*4	CINF	12	(3)

```
 4-00000488   I*4   CLIFE                240   (3, 20)
 3-00000000   CHAR  CNAME               1200   (3, 20)
 4-00007E90   I*4   CNUM                  12   (3)
 4-000002D0   R*4   CSAL                 240   (3, 20)
 4-00000000   I*4   CYR1                 240   (3, 20)
 4-000000F0   I*4   CYR2                 240   (3, 20)
 8-00000000   R*4   INTRT                 12   (3)
 8-000002E8   R*4   LCCV                  12   (3)
 6-00000000   R*4   OAMT                 240   (3, 20)
 6-000001E0   R*4   OCOST              14400   (3, 20, 60)
 6-000000F0   R*4   OINF                 240   (3, 20)
 5-00000000   CHAR  ONAME                1200   (3, 20)
 6-00007800   I*4   ONUM                  12   (3)
 4-00003DE0   R*4   PVCC               14400   (3, 20, 60)
 6-00003A20   R*4   PVOC               14400   (3, 20, 60)
 4-000003C0   L*4   REPEAT               240   (3, 20)
 4-00007620   R*4   TCCOST               720   (3, 60)
 8-00000018   R*4   TLCCV                720   (3, 60)
 6-00007260   R*4   TOCOST               720   (3, 60)
 4-00007BF0   R*4   TPVCC                720   (3, 60)
 6-00007530   R*4   TPVOC                720   (3, 60)
```

ABELS

Address	Label	Address	Label	Address	Label	Address	Label	Address	Label
0-000000C1	900	0-00000120	910	1-00000000	5000'	1-00000003	6900'	1-00000075	6910'

UNCTIONS AND SUBROUTINES REFERENCED

BLNKL NEXGRP

otal Space Allocated = 67332 Bytes

```
0001          SUBROUTINE CINPUT(FULL,CNAME,ICLIFE,ICYR1,ICYR2,CAMT,CSAL,REPEAT,
                     $ ERROR,END)
              C     THIS ROUTINE PROCESSES INPUT RECORDS FOR CAPITAL EQUIPMENT COSTS
              C     ON A FREE-FIELD BASIS.
              C
              C     WILLIAM A. STOCK, JUNE 1982
              C
0002          CHARACTER*20 CNAME
0003          LOGICAL FULL,REPEAT,ERROR,END
0004          CHARACTER*80 LINE
0005          INCLUDE 'FILCOM.FOR'
            * C
            * C     FILES AND SUCH:
0006        *       COMMON/FILES/ISCRCH
            * C
0007          END=.FALSE.
0008          ERROR=.FALSE.
0009          READ(5,5000,END=920)LINE
0010       5000 FORMAT(A80)
              C     FIND START (I1) OF EQUIPMENT TITLE
0011          I1=NBLNK1(LINE)
0012          IF(I1 .EQ. 0)THEN
0013            WRITE(6,6900)
0014       6900   FORMAT(/' ERROR -- ALL BLANK RECORD IN CAPITAL COST DATA')
0015            ERROR=.TRUE.
0016            RETURN
0017          END IF
              C     CHECK FOR END OF CAPITAL EQUIPMENT COST RECORDS DELIMITER
0018          IF(LINE(I1:I1) .EQ. '#')THEN
0019            END=.TRUE.
0020            RETURN
0021          END IF
              C     FIND ACTUAL LINE LENGTH (L)
0022          L=NBLNKL(LINE)
              C     FIND END (I2) OF EQUIPMENT TITLE
0023          ICOLON=INDEX(LINE,':')
0024          IF(ICOLON .EQ. 0)THEN
0025            WRITE(6,6905)LINE(1:L)
0026       6905   FORMAT(/' ERROR -- THE FOLLOWING CAPITAL COST RECORD CONTAINS',
                     $  ' NO COLON TO DELIMIT TITLE:'/
                     $  1X,A<L>)
0027            ERROR=.TRUE.
0028            RETURN
0029          END IF
0030          I2=ICOLON-1
              C
              C     AFTER EASTBLISHING THAT CAPITAL EQUIPMENT COST ARRAYS HAVE ROOM,
              C     WE CAN START LOADING THEM
              C
0031          IF(FULL)THEN
0032            WRITE(6,6907)LINE(1:L)
0033       6907   FORMAT(/' ERROR -- CAPITAL EQUIPMENT COST ARRAY SIZES EXCEEDED',
                     $  ' AT RECORD:'/1X,A<L>)
0034            ERROR=.TRUE.
0035            RETURN
0036          END IF
              C     CAPITAL EQUIPMENT NAME
```

```
0037            IF(I2 .EQ. 11)THEN
0038              CNAME=' '
0039            ELSE
0040              CNAME=LINE(11:I2)
0041            END IF
        C       ESTABLISH WHETHER REPEAT CODE "R" EXISTS AT END OF LINE
0042            REPEAT=(LINE(L:L) .EQ. 'R' .OR. LINE(L:L) .EQ. 'r')
        C       SUBTRACT 1 FROM "L" IF LAST CHARACTER IN LINE IS "R" (REPEAT)
0043            LM=0
0044            IF(REPEAT)LM=1
        C       LINE(ICOLON+1:L-LM)SHOULD BE NUMERIC ONLY AND SHOULD HAVE
        C       SUFFICIENT CHARACTERS
0045            IF((L-LM)-(ICOLON+1)+1 .LE. 0)THEN
0046              WRITE(6,6910)LINE(1:L)
0047             6910   FORMAT(/' ERROR -- NO NUMERIC FIELD IN FOLLOWING CAPITAL COST',
                $  ' RECORD:'/1X,A<L>)
0048              ERROR=.TRUE.
0049              RETURN
0050            END IF
        C       WRITE NUMERIC PART OF INPUT RECORD TO SCRATCH FILE SO WE CAN
        C       RE-READ AS LIST DIRECTED
0051            REWIND ISCRCH
0052            WRITE(ISCRCH,1000)LINE(ICOLON+1:L-LM)
0053             1000 FORMAT(A80)
0054            REWIND ISCRCH
0055            READ(ISCRCH,*,ERR=900,END=910)CLIFE,CYR1,CYR2,CAMT,CSAL
0056            ICLIFE=CLIFE
0057            ICYR1=CYR1
0058            ICYR2=CYR2
0059            RETURN
0060             900 WRITE(6,6920)LINE(1:L)
0061             6920 FORMAT(' ERROR -- THE FOLLOWING CAPITAL COST RECORD HAS ',
                $ 'INCOMPREHENSIBLE NUMERIC DATA:'/1X,A<L>)
0062            ERROR=.TRUE.
0063            RETURN
0064             910 WRITE(6,6930)LINE(1:L)
0065             6930 FORMAT(/' ERROR -- THE FOLLOWING CAPITAL COST RECORD CONTAINS',
                $ ' INSUFFICIENT DATA:'/1X,A<L>)
0066            ERROR=.TRUE.
0067            RETURN
0068             920 WRITE(6,6940)
0069             6940 FORMAT(/' ERROR -- UNEXPECTED END-OF-FILE WHILE READING CAPITAL',
                $ ' COST RECORDS,'/
                $ ' EXECUTION HALTED.')
0070            STOP
0071            END
```

ROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	694	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	680	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	176	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	FILES	4	PIC OVR REL GBL SHR NOEXE RD WRT LONG

NTRY POINTS

Address	Type	Name
0-00000000		CINPUT

ARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
AP-00000180	R*4	CAMT	2-00000064	R*4	CLIFE	AP-00000080	CHAR	CNAME	AP-000001C0	R*4	CSAL
2-00000068	R*4	CYR1	2-0000006C	R*4	CYR2	AP-00000280	L*4	END	AP-00000240	L*4	ERROR
AP-00000040	L*4	FULL	2-00000050	I*4	I1	2-0000005C	I*4	I2	AP-000000C0	I*4	ICLIFE
2-00000058	I*4	ICOLON	AP-00000100	I*4	ICYR1	AP-00000140	I*4	ICYR2	3-00000000	I*4	ISCRCH
2-00000054	I*4	L	2-00000000	CHAR	LINE	2-00000060	I*4	LM	AP-00000200	L*4	REPEAT

ABELS

Address	Label	Address	Label	Address	Label	Address	Label	Address	Label	Address	Label
0-0000023A	900	0-00000264	910	0-0000028E	920	1-0000012E	1000'	1-00000000	5000'	1-00000003	6900'
1-00000036	6905'	1-00000094	6907'	1-000000E3	6910'	1-00000131	6920'	1-0000018D	6930'	1-000001E3	6940'

UNCTIONS AND SUBROUTINES REFERENCED

IBSINDEX NBLNK1 NBLNKL

otal Space Allocated = 1454 Bytes

```
0001          SUBROUTINE OINPUT(FULL,ONAME,OAMT,OINF,ERROR,END,EOF)
              C     THIS ROUTINE PROCESSES INPUT RECORDS FOR OPERATING & MAINTENANCE
              C     (O & M) COSTS ON A FREE-FIELD BASIS.
              C
              C     WILLIAM A. STOCK, JUNE 1982
              C
0002          CHARACTER*20 ONAME
0003          LOGICAL FULL,ERROR,END,EOF
0004          CHARACTER*80 LINE
0005          INCLUDE 'FILCOM.FOR'
              * C
              * C     FILES AND SUCH:
0006          *     COMMON/FILES/ISCRCH
              * C
0007          END=.FALSE.
0008          EOF=.FALSE.
0009          ERROR=.FALSE.
0010          READ(5,5000,END=920)LINE
0011           5000 FORMAT(A80)
              C     FIND START (I1) OF O & M TITLE
0012          I1=NBLNK1(LINE)
0013          IF(I1 .EQ. 0)THEN
0014            WRITE(6,6900)
0015           6900   FORMAT(/' ERROR -- ALL BLANK RECORD IN O & M COST DATA')
0016            ERROR=.TRUE.
0017            RETURN
0018          END IF
              C     CHECK FOR END OF O & M COST RECORDS DELIMITER
0019          IF(LINE(I1:I1) .EQ. '#')THEN
0020            END=.TRUE.
0021            RETURN
0022          END IF
              C     FIND ACTUAL LINE LENGTH (L)
0023          L=NBLNKL(LINE)
              C     FIND END (I2) OF O & M TITLE
0024          ICOLON=INDEX(LINE,':')
0025          IF(ICOLON .EQ. 0)THEN
0026            WRITE(6,6905)LINE(1:L)
0027           6905   FORMAT(/' ERROR -- THE FOLLOWING O & M COST RECORD CONTAINS',
                   $   ' NO COLON TO DELIMIT TITLE:'/
                   $   1X,A<L>)
0028            ERROR=.TRUE.
0029            RETURN
0030          END IF
0031          I2=ICOLON-1
              C
              C     AFTER EASTBLISHING THAT O & M COST ARRAYS HAVE ROOM,
              C     WE CAN START LOADING THEM
              C
0032          IF(FULL)THEN
0033            WRITE(6,6907)LINE(1:L)
0034           6907   FORMAT(/' ERROR -- O & M COST ARRAY SIZES EXCEEDED',
                   $   ' AT RECORD:'/1X,A<L>)
0035            ERROR=.TRUE.
0036            RETURN
0037          END IF
              C     O & M NAME
```

```
0038          IF(I2 .EQ. I1)THEN
0039            ONAME=' '
0040          ELSE
0041            ONAME=LINE(I1:I2)
0042          END IF
              C     LINE(ICOLON+1:L)SHOULD BE NUMERIC ONLY AND SHOULD HAVE
              C     SUFFICIENT CHARACTERS
0043          IF(L-(ICOLON+1)+1 .LE. 0)THEN
0044            WRITE(6,6910)LINE(1:L)
0045   6910     FORMAT(/' ERROR -- NO NUMERIC FIELD IN FOLLOWING O & M COST',
             $  ' RECORD:'/1X,A<L>)
0046            ERROR=.TRUE.
0047            RETURN
0048          END IF
              C     WRITE NUMERIC PART OF INPUT RECORD TO SCRATCH FILE SO WE CAN
              C     RE-READ AS LIST DIRECTED
0049          REWIND 1SCRCH
0050          WRITE(1SCRCH,1000)LINE(1COLON+1:L)
0051   1000   FORMAT(A80)
0052          REWIND 1SCRCH
0053          READ(1SCRCH,*,ERR=900,END=910)OAMT,OINF
0054          RETURN
0055   900    WRITE(6,6920)LINE(1:L)
0056   6920   FORMAT(' ERROR -- THE FOLLOWING O & M COST RECORD HAS ',
             $ 'INCOMPREHENSIBLE NUMERIC DATA:'/1X,A<L>)
0057          ERROR=.TRUE.
0058          RETURN
0059   910    WRITE(6,6930)LINE(1:L)
0060   6930   FORMAT(/' ERROR -- THE FOLLOWING O & M COST RECORD CONTAINS',
             $  ' INSUFFICIENT DATA:'/1X,A<L>)
0061          ERROR=.TRUE.
0062          RETURN
0063   920    END=.TRUE.
0064          EOF=.TRUE.
0065          RETURN
0066          END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	672	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	463	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	160	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	FILES	4	PIC OVR REL GBL SHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000		O1NPUT

VARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
AP-000000180	L*4	END	AP-0000001C0	L*4	EOF	AP-000000140	L*4	ERROR	AP-00000040	L*4	FULL
2-00000050	I*4	I1	2-0000005C	I*4	I2	2-00000058	I*4	ICOLON	3-00000000	I*4	ISCRCH
2-00000054	I*4	L	2-00000000	CHAR	LINE	AP-0000000C0	R*4	OAMT	AP-000000100	R*4	OINF
AP-000000000	CHAR	ONAME									

LABELS

Address	Label	Address	Label	Address	Label	Address	Label	Address	Label	Address	Label
0-000001D5	900	0-000001FF	910	0-00000229	920	1-0000011C	1000'	1-00000000	5000'	1-00000003	6900'
1-00000034	6906'	1-00000090	6907'	1-000000D3	6910'	1-0000011F	6920'	1-00000179	6930'		

FUNCTIONS AND SUBROUTINES REFERENCED

I8$INDEX NBLNK1 NBLNKL

Total Space Allocated = 1199 Bytes

```
0001          SUBROUTINE NEXGRP(EOF)
              C     THIS ROUTINE READS FORWARD THRU ALL COMMENT/DELIMITER RECORDS
              C     (RECORDS WITH 1ST NON BLANK CHARACTER A "@") UNTIL EITHER A END
              C     OF FILE OR A DATA RECORD IS FOUND.  IN FORMER CASE, LOGICAL
              C     FLAG "EOF" IS SET TRUE, IN LATTER CASE, A BACKSPACE
              C     IS PERFORMED TO READY INPUT FILE FOR NEXT DATA READING ROUTINE.
              C
              C      WILLIAM A. STOCK, JUNE 1982
              C
0002          CHARACTER*80 LINE
0003          LOGICAL EOF
0004          EOF=.FALSE.
0005        10 READ(5,5000,END=100)LINE
0006      5000 FORMAT(A80)
0007          I1=NBLNK1(LINE)
0008          IF(LINE(I1:I1) .EQ. '@')GO TO 10
0009          BACKSPACE 5
0010          RETURN
0011       100 EOF=.TRUE.
0012          RETURN
0013          END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	86	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	3	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	100	PIC CON REL LCL NOSHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000		NEXGRP

VARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name
AP-00000040	L*4	EOF	2-00000050	I*4	I1	2-00000000	CHAR	LINE

LABELS

Address	Label	Address	Label	Address	Label
0-0000000C	10	0-00000051	100	1-00000000	5000'

UNCTIONS AND SUBROUTINES REFERENCED

BLNK1

otal Space Allocated = 189 Bytes

```
0001          FUNCTION NBLNK1(LINE)
              C     FUNCTION TO SEARCH FOR 1ST NON-BLANK CHARACTER IN AN INPUT RECORD
              C
              C     WILLIAM A. STOCK, JUNE 1982
              C
0002          CHARACTER*80 LINE
0003          DO 10 I=1,80
0004          IF(LINE(I:I) .NE. ' ')GO TO 20
0005       10 CONTINUE
0006          NBLNK1=0
0007          RETURN
0008       20 NBLNK1=I
0009          RETURN
0010          END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	56	PIC CON REL LCL SHR EXE RD NOWRT LONG
2	$LOCAL	16	PIC CON REL LCL NOSHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000	I*4	NBLNK1

VARIABLES

Address	Type	Name	Address	Type	Name
2-00000004	I*4	I	AP-00000040	CHAR	LINE

LABELS

Address	Label	Address	Label
0-0000001F	10	0-0000002F	20

Total Space Allocated = 72 Bytes

```
0001          FUNCTION NBLNKL(LINE)
              C     FUNCTION TO FIND LAST NON-BLANK CHARACTER IN AN INPUT RECORD
              C
              C     WILLIAM A. STOCK, JUNE 1982
              C
0002          CHARACTER*80 LINE
0003          CALL STRSTRIM(LINE,LINE,N)
0004          NBLNKL=N
0005          RETURN
0006          END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	34	PIC CON REL LCL SHR EXE RD NOWRT LONG
2	$LOCAL	32	PIC CON REL LCL NOSHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000	I*4	NBLNKL

VARIABLES

Address	Type	Name	Address	Type	Name
AP-00000004	CHAR	LINE	2-00000004	I*4	N

FUNCTIONS AND SUBROUTINES REFERENCED

STRSTRIM

Total Space Allocated = 66 Bytes

```
0001          SUBROUTINE CALC
              C
              C     THIS ROUTINE PERFORMS ALL COST CALCULATIONS
              C
              C     WILLIAM A. STOCK, JUNE 1982
              C
0002          INCLUDE 'LCCCOM.FOR'
            * C
            * C     COMMON BLOCKS --
            * C
            * C     CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003        *       COMMON/CCHAR/CNAME(3,20)
0004        *       CHARACTER*20 CNAME
            * C     NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005        *       COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
            *      $ REPEAT(3,20),CLIFE(3,20),
            *      $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
            *      $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006        *       INTEGER CYR1,CYR2,CLIFE,CNUM
0007        *       LOGICAL REPEAT
            * C     CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008        *       COMMON/OCHAR/ONAME(3,20)
0009        *       CHARACTER*20 ONAME
            * C     NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010        *       COMMON/OCOSTS/OAMT(3,20),OINF(3,20),
            *      $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
            *      $ ONUM(3),IO,NO,MAXNO
0011        *       INTEGER ONUM
            * C     OTHER ITEMS IN COMMON:
0012        *       COMMON/CHARS/ANAME(3),RNAME
0013        *       CHARACTER*80 ANAME,RNAME
0014        *       COMMON INTRT(3),CINF(3),TLCCV(3,60),LCCV(3),
            *      $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015        *       REAL INTRT,LCCV
0016        *       INTEGER STRTYR,BASEYR,ENDYR
            * C
            * C     VARIABLE NAMING CONVENTION:
            * C       VARIABLES WITH "...YR..." CONTAIN AN ACTUAL CALANDER YEAR,
            * C       VARIABLES WITH ONLY "...Y..." ARE RELATIVE YEARS WITH "BASEYR"
            * C         AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS.
            * C
              C     ZERO ACCUMULATIVE ARRAYS
              C
0017          CALL ZERO(CCOST,MAXNA*MAXNC*MAXNY)
0018          CALL ZERO(OCOST,MAXNA*MAXNO*MAXNY)
0019          CALL ZERO(AEC,MAXNA*MAXNY)
              C
              C     REPEAT FOR EACH ALTERNATIVE
              C
0020          DO 600 IA=1,NA
0021          LCCV(IA)=0.
              C
              C     DETERMINE YEARLY COSTS --
              C
              C     FIRST FOR CAPITAL COSTS--ANNUAL EQUIVALENT COST (A.E.C.)
              C     CALCULATION IS ALSO DONE HERE, SINCE RATHER COMPLEX LOOP
              C     CONTROL LOGIC IS THE SAME.
```

```
      C
0022          NC=CNUM(1A)
0023          DO 80 1C=1,NC
0024          1CYR1=CYR1(1A,1C)
0025          1CYR2=CYR2(1A,1C)
0026          1LYR1=STRTYR
0027          1LYR2=STRTYR+CLIFE(1A,1C)-1
0028       20 1CYR2X=1CYR2
0029          IF(1CYR2 .GT. ENDYR)1CYR2=ENDYR
0030          1LYR2X=1LYR2
0031          IF(1LYR2 .GT. ENDYR)1LYR2=ENDYR
0032          CY=1CYR2X-1CYR1+1
0033          CAMTP=CAMT(1A,1C)
      C       IF(1LYR1+CLIFE(1A,1C)-1 .GT. ENDYR)CAMTP=CAMTP*FLOAT(ENDYR-1LYR1+
      C      $ 1)/FLOAT(CLIFE(1A,1C))
0034          CSALP=CSAL(1A,1C)
      C       IF(1LYR1+CLIFE(1A,1C)-1 .GT. ENDYR)CSALP=CSALP*FLOAT(ENDYR-1LYR1+
      C      $ 1)/FLOAT(CLIFE(1A,1C))
      C       SUMMATION VARIABLES USED IN DETERMINING A.E.C.
0035          CSUM=0.
0036          1BX=0
0037          DO 40 1CYR=1CYR1,1CYR2
0038          1CY=1CYR-BASEYR+1
0039          CCOST(1A,1C,1CY)=(CAMTP/CY)*(1.+CINF(1A)/100.)**(1CY-1)
      C       A.E.C. SUMMATION VARIABLES AGAIN
0040          CSUM=CSUM+CCOST(1A,1C,1CY)*(1.+INTRT(1A)/100.)**(1LYR1-1CYR1-1BX)
0041          1BX=1BX+1
0042       40 CONTINUE
      C       SALVAGE VALUE
0043          1LY=1LYR2-BASEYR+1
0044          CVSAL=CSALP*(1.+CINF(1A)/100.)**(1LY-1)
0045          CCOST(1A,1C,1LY)=CCOST(1A,1C,1LY)-CVSAL
      C       VALUE OF REMAINING LIFE, IF ANY
0046          LREM=MAX(0,1LYR2X-ENDYR)
0047          CVLREM=(CAMTP-CSALP)*FLOAT(LREM)/FLOAT(CLIFE(1A,1C))*(1.+
             $ CINF(1A)/100.)**(ENDYR-BASEYR)
0048          CCOST(1A,1C,1LY)=CCOST(1A,1C,1LY)-CVLREM
      C       A.E.C COSTS ARE COMPUTED AT THIS POINT FOR CONVENIENCE
      C       A.E.C. SUMMATION
0049          CSUM=CSUM-(CVSAL+CVLREM)/(1.+INTRT(1A)/100.)**(1LYR2-1LYR1)
0050          AECV=CSUM*(INTRT(1A)/100.)/(1.-(1.+INTRT(1A)/100.)**(1LYR1-1LYR2-1
             $ ))
0051          DO 50 1LYR=1LYR1,1LYR2
0052          1LY=1LYR-BASEYR+1
0053          AEC(1A,1LY)=AEC(1A,1LY)+AECV
0054       50 CONTINUE
      C       REPEAT LOGIC
0055          IF(REPEAT(1A,1C))THEN
0056            1LYR1=1LYR1+CLIFE(1A,1C)
0057            1LYR2=1LYR2+CLIFE(1A,1C)
0058            1CYR1=1CYR1+CLIFE(1A,1C)
0059            1CYR2=1CYR2+CLIFE(1A,1C)
0060            IF(1CYR2 .LT. 1LYR1-1)THEN
0061              1CYR2=1LYR1-1
0062              1CYR1=1CYR2-(CYR2(1A,1C)-CYR1(1A,1C))
0063            END IF
0064            IF(1CYR1 .GT. ENDYR .OR. 1LYR1 .GT. ENDYR)GO TO 50
```

```
0065            GO TO 20
0066          END IF
0067       60 CONTINUE
0068       80 CONTINUE
           C
           C     NOW COMPUTE YEARLY COSTS FOR O & M
           C
0069          NO=ONUM(IA)
0070          DO 120 IO=1,NO
0071          IOYR1=STRTYR
0072          DO 100 IOYR=IOYR1,ENDYR
0073          IOY=IOYR-BASEYR+1
0074          OCOST(IA,IO,IOY)=OAMT(IA,IO)*(1.+OINF(IA,IO)/100.)**(IOY-1)
0075       100 CONTINUE
0076       120 CONTINUE
           C
           C     DETERMINE PRESENT VALUE FOR EACH COST STREAM --
           C
           C     FIRST FOR CAPITAL COSTS
           C
0077          NC=CNUM(IA)
0078          DO 160 IC=1,NC
0079          ICYEND=ENDYR-BASEYR+1
0080          DO 140 ICY=1,ICYEND
0081          PVCC(IA,IC,ICY)=CCOST(IA,IC,ICY)/(1.+INTRT(IA)/100.)**(ICY-1)
0082       140 CONTINUE
0083       160 CONTINUE
           C
           C     NOW PRESENT VALUE FOR O & M COSTS --
           C
0084          NO=ONUM(IA)
0085          IOYEND=ENDYR-BASEYR+1
0086          DO 200 IO=1,NO
0087          DO 180 IOY=1,IOYEND
0088          PVOC(IA,IO,IOY)=OCOST(IA,IO,IOY)/(1.+INTRT(IA)/100.)**(IOY-1)
0089       180 CONTINUE
0090       200 CONTINUE
           C
           C     TOTAL UP COSTS
           C
0091          DO 260 IYR=BASEYR,ENDYR
0092          IY=IYR-BASEYR+1
0093          TCCOST(IA,IY)=0.
0094          TPVCC(IA,IY)=0.
0095          DO 220 IC=1,NC
0096          TCCOST(IA,IY)=TCCOST(IA,IY)+CCOST(IA,IC,IY)
0097          TPVCC(IA,IY)=TPVCC(IA,IY)+PVCC(IA,IC,IY)
0098       220 CONTINUE
0099          TOCOST(IA,IY)=0.
0100          TPVOC(IA,IY)=0.
0101          DO 240 IO=1,NO
0102          TOCOST(IA,IY)=TOCOST(IA,IY)+OCOST(IA,IO,IY)
0103          TPVOC(IA,IY)=TPVOC(IA,IY)+PVOC(IA,IO,IY)
0104       240 CONTINUE
0105          LCCV(IA)=LCCV(IA)+TPVCC(IA,IY)+TPVOC(IA,IY)
0106          TLCCV(IA,IY)=LCCV(IA)
0107       260 CONTINUE
```

```
108       500 CONTINUE
109           RETURN
110           END
```

ROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	2856	PIC CON REL LCL SHR EXE RD NOWRT LONG
2	$LOCAL	196	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RD WRT LONG
5	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	780	PIC OVR REL GBL SHR NOEXE RD WRT LONG

NTRY POINTS

Address	Type	Name
0-00000000		CALC

ARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
2-00000044	R*4	AECV	0-000002F8	I*4	BASEYR	2-0000001C	R*4	CAMTP	2-00000020	R*4	CSALP
2-00000024	R*4	CSUM	2-00000040	R*4	CVLREM	2-00000038	R*4	CVSAL	2-00000018	R*4	CY
0-00000300	I*4	ENDYR	0-00000308	I*4	IA	2-00000028	I*4	IBX	4-00007E9C	I*4	IC
2-00000030	I*4	ICY	2-00000058	I*4	ICYEND	2-0000002C	I*4	ICYR	2-00000000	I*4	ICYR1
2-00000004	I*4	ICYR2	2-00000010	I*4	ICYR2X	2-00000034	I*4	ILY	2-00000048	I*4	ILYR
2-00000008	I*4	ILYR1	2-0000000C	I*4	ILYR2	2-00000014	I*4	ILYR2X	6-00007080	I*4	IO
2-00000054	I*4	IOY	2-0000005C	I*4	IOYEND	2-00000050	I*4	IOYR	2-0000004C	I*4	IOYR1
2-00000064	I*4	IY	2-00000060	I*4	IYR	2-0000003C	I*4	LREM	0-00000310	I*4	MAXNA
4-00007EA4	I*4	MAXNC	6-00007814	I*4	MAXNO	0-00000304	I*4	MAXNY	0-00000300	I*4	NA
4-00007EA0	I*4	NC	6-00007810	I*4	NO	0-000002FC	I*4	NYEAR	7-000000F0	CHAR	RNAME
0-000002F4	I*4	STRTYR									

RRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-000001E0	R*4	CAMT	240	(3, 20)
4-000005A0	R*4	CCOST	14400	(3, 20, 60)
0-0000000C	R*4	CINF	12	(3)
4-000004B0	I*4	CLIFE	240	(3, 20)
3-00000000	CHAR	CNAME	1200	(3, 20)
4-00007E90	I*4	CNUM	12	(3)

4-000002D0	R*4	CSAL	240	(3, 20)
4-00000000	I*4	CYR1	240	(3, 20)
4-000000F0	I*4	CYR2	240	(3, 20)
8-00000000	R*4	INTRT	12	(3)
8-000002E8	R*4	LCCV	12	(3)
6-00000000	R*4	OAMT	240	(3, 20)
6-000001E0	R*4	OCOST	1440	(3, 20, 60)
6-000000F0	R*4	OINF	240	(3, 20)
6-00000000	CHAR	ONAME	1200	(3, 20)
6-00007800	I*4	ONUM	12	(3)
4-00003DE0	R*4	PVCC	1440	(3, 20, 60)
6-00003A20	R*4	PVOC	1440	(3, 20, 60)
4-000003C0	L*4	REPEAT	240	(3, 20)
4-00007620	R*4	TCCOST	720	(3, 60)
8-00000018	R*4	TLCCV	720	(3, 60)
6-00007260	R*4	TOCOST	720	(3, 60)
4-000078F0	R*4	TPVCC	720	(3, 60)
6-00007630	R*4	TPVOC	720	(3, 60)

LABELS

Address	Label	Address	Label	Address	Label	Address	Label	Address	Label	Address	Label
0-0000013E	20	0-0000029B	40	0-0000047F	60	0-00000588	60	0-00000588	80	0-00000674	100
0-0000067D	120	0-00000764	140	0-0000076D	160	0-00000864	180	0-0000085D	200	0-0000097F	220
0-0000A77	240	0-00000B12	260	0-00000B1B	600						

FUNCTIONS AND SUBROUTINES REFERENCED

ZERO

Total Space Allocated = 69728 Bytes

```
0001          SUBROUTINE ZERO(ARRAY,N)
      C
      C       ROUTINE TO ZERO A CONTIGUOUS AREA OF STORAGE (DESIGNATED AS
      C       "ARRAY").  NUMBER OF ELEMENTS TO BE ZEROED IS "N".
0002          DIMENSION ARRAY(N)
0003          DO 10 I=1,N
0004       10 ARRAY(I)=0.
0005          RETURN
0006          END
```

ROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	62	PIC CON REL LCL SHR EXE RD NOWRT LONG
2	$LOCAL	48	PIC CON REL LCL NOSHR NOEXE RD WRT LONG

NTRY POINTS

Address	Type	Name
0-00000000		ZERO

ARIABLES

Address	Type	Name	Address	Type	Name
2-00000000	I*4	I	AP-00000000	I*4	N

RRAYS

Address	Type	Name	Bytes	Dimensions
AP-00000040	R*4	ARRAY	**	(*)

ABELS

Address	Label
0-0000002B	10

otal Space Allocated = 110 Bytes

```
0001          SUBROUTINE OUTPUT
              C
              C     ROUTINE TO CONTROL PRINTING OF ALL OUTPUT REPORTS
              C
              C     WILLIAM A. STOCK, JUNE 1982
0002          INCLUDE 'LCCCOM.FOR'
            * C
            * C     COMMON BLOCKS --
            * C
            * C     CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003        *       COMMON/CCHAR/CNAME(3,20)
0004        *       CHARACTER*20 CNAME
            * C     NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005        *       COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
            *      $ REPEAT(3,20),CLIFE(3,20),
            *      $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
            *      $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006        *       INTEGER CYR1,CYR2,CLIFE,CNUM
0007        *       LOGICAL REPEAT
            * C     CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008        *       COMMON/OCHAR/ONAME(3,20)
0009        *       CHARACTER*20 ONAME
            * C     NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010        *       COMMON/OCOSTS/OAMT(3,20),OINF(3,20),
            *      $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
            *      $ ONUM(3),IO,NO,MAXNO
0011        *       INTEGER ONUM
            * C     OTHER ITEMS IN COMMON:
0012        *       COMMON/CHARS/ANAME(3),RNAME
0013        *       CHARACTER*80 ANAME,RNAME
0014        *       COMMON INTRT(3),CINF(3),TLCCV(3,60),LCCV(3),
            *      $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015        *       REAL INTRT,LCCV
0016        *       INTEGER STRTYR,BASEYR,ENDYR
            * C
            * C     VARIABLE NAMING CONVENTION:
            * C       VARIABLES WITH "..YR.." CONTAIN AN ACTUAL CALANDER YEAR,
            * C       VARIABLES WITH ONLY "..Y.." ARE RELATIVE YEARS WITH "BASEYR"
            * C         AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS.
            * C
0017          DO 20 IA=1,NA
0018          CALL TABLE1
0019          CALL TABLE2
0020        20 CONTINUE
0021          RETURN
0022          END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	55	PIC CON REL LCL SHR EXE RD NOWRT LONG
2	$LOCAL	4	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RD WRT LONG
5	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	788	PIC OVR REL GBL SHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000		OUTPUT

VARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
8-000002F8	I*4	BASEYR	8-00000300	I*4	ENDYR	8-00000308	I*4	IA	4-00007E9C	I*4	IC
6-0000780C	I*4	IO	8-00000310	I*4	MAXNA	4-00007EA4	I*4	MAXNC	6-00007814	I*4	MAXNO
8-00000304	I*4	MAXNY	8-0000030C	I*4	NA	4-00007EA0	I*4	NC	6-00007810	I*4	NO
8-000002FC	I*4	NYEAR	7-000000F0	CHAR	RNAME	8-000002F4	I*4	STRTYR			

ARRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-000001E0	R*4	CAMT	240	(3, 20)
4-000005A0	R*4	CCOST	14400	(3, 20, 60)
8-0000000C	R*4	CINF	12	(3)
4-000004B0	I*4	CLIFE	240	(3, 20)
3-00000000	CHAR	CNAME	1200	(3, 20)
4-00007E90	I*4	CNUM	12	(3)
4-000002D0	R*4	CSAL	240	(3, 20)
4-00000000	I*4	CYR1	240	(3, 20)
4-000000F0	I*4	CYR2	240	(3, 20)
8-00000000	R*4	INTRT	12	(3)
8-000002E8	R*4	LCCV	12	(3)
6-00000000	R*4	OAMT	240	(3, 20)
6-000001E0	R*4	OCOST	14400	(3, 20, 60)
6-000000F0	R*4	OINF	240	(3, 20)
5-00000000	CHAR	ONAME	1200	(3, 20)
6-00007800	I*4	ONUM	12	(3)
4-00003DE0	R*4	PVCC	14400	(3, 20, 60)
6-00003A20	R*4	PVOC	14400	(3, 20, 60)
4-000003C0	L*4	REPEAT	240	(3, 20)
4-00007620	R*4	TCCOST	720	(3, 60)

```
 8-00000018  R*4  TLCCV                72@  (3, 6@)
 6-00007260  R*4  TOCOST               72@  (3, 6@)
 4-000078F0  R*4  TPVCC                72@  (3, 6@)
 6-00007530  R*4  TPVOC                72@  (3, 6@)

LABELS

   Address   Label

 0-0000002E  2@

UNCTIONS AND SUBROUTINES REFERENCED

ABLE1          TABLE2

otal Space Allocated = 66735 Bytes
```

```
0001          SUBROUTINE TABLE1
              C
              C     THIS ROUTINE PRINTS OUTPUT TABLE 1 (MAINLY AN ECHO-BACK OF INPUT
              C     DATA) PLUS THE "LCC" VALUE (MAIN MEASURE OF EFFECTIVENESS) FOR
              C     EACH ALTERNATIVE.
              C
              C     WILLIAM A. STOCK, MAY 1982
0002          INCLUDE 'LCCCOM.FOR'
            * C
            * C     COMMON BLOCKS --
            * C
            * C     CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003        *       COMMON/CCHAR/CNAME(3,20)
0004        *       CHARACTER*20 CNAME
            * C     NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005        *       COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
            *      $ REPEAT(3,20),CLIFE(3,20),
            *      $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
            *      $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006        *       INTEGER CYR1,CYR2,CLIFE,CNUM
0007        *       LOGICAL REPEAT
            * C     CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008        *       COMMON/OCHAR/ONAME(3,20)
0009        *       CHARACTER*20 ONAME
            * C     NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010        *       COMMON/OCOSTS/OAMT(3,20),OINF(3,20),
            *      $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
            *      $ ONUM(3),IO,NO,MAXNO
0011        *       INTEGER ONUM
            * C     OTHER ITEMS IN COMMON:
0012        *       COMMON/CHARS/ANAME(3),RNAME
0013        *       CHARACTER*80 ANAME,RNAME
0014        *       COMMON INTRT(3),CINF(3),TLCCV(3,60),LCCV(3),
            *      $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015        *       REAL INTRT,LCCV
0016        *       INTEGER STRTYR,BASEYR,ENDYR
            * C
            * C     VARIABLE NAMING CONVENTION:
            * C       VARIABLES WITH "..YR.." CONTAIN AN ACTUAL CALANDER YEAR,
            * C       VARIABLES WITH ONLY "...Y..." ARE RELATIVE YEARS WITH "BASEYR"
            * C         AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS.
            * C
0017          CHARACTER*3 YESNO
0018          IRND(X)=INT(X+SIGN(.6,X))
              C
              C     HEADING
              C
0019          CALL PTITLE
0020          WRITE(7,7010)ANAME(IA)
0021       7010 FORMAT(/' TITLE OF ALTERNATIVE -- ',A80)
0022          WRITE(7,7020)BASEYR,STRTYR,NYEAR
0023       7020 FORMAT(/' BASE YEAR',T47,I6/
             $ ' FIRST YEAR OF OPERATIONS',T47,I6/
             $ ' PROJECT LIFE (YEARS)',T47,I5)
0024          WRITE(7,7030)INTRT(IA),CINF(IA)
0025       7030 FORMAT(/' ALTERNATIVE''S ASSUMPTIONS:'//
             $ ' INTEREST RATE (PERCENT)',T47,F7.1/
```

```
     $ ' CAPITAL COST INFLATION RATE (PERCENT)',T47,F7.1)
026       WRITE(7,7040)BASEYR
027  7040 FORMAT(/' CAPITAL COST OUTLAYS IN',I5,' DOLLARS:'//
     $'           NAME          LIFE   FIRST YR.   LAST YR.   AMOUNT  SALVA
     $GE   REPEATED'/
     $'                       (YEARS)   OF CAP.     OF CAP.      K$       K$
     $'/
     $'                                 OUTLAY      OUTLAY'/)
028       NC=CNUM(IA)
029       DO 20 IC=1,NC
030       YESNO=' NO'
031       IF(REPEAT(IA,IC))YESNO='YES'
032       WRITE(7,7050)CNAME(IA,IC),CLIFE(IA,IC),CYR1(IA,IC),CYR2(IA,IC),
     $ CAMT(IA,IC),CSAL(IA,IC),YESNO
033  7050 FORMAT(1X,A20,I4,II0,III,F12.2,F9.2,6X,A3)
034    20 CONTINUE
035       WRITE(7,7060)BASEYR
036  7060 FORMAT(/' OPERATING & MAINTENANCE COST OUTLAYS IN',I5,' DOLLARS:'
     $//
     $'           NAME            ANNUAL    INFLATION'/
     $'                           OUTLAY       RATE'/
     $'                             K$          %'/)
037       NO=ONUM(IA)
038       DO 40 IO=1,NO
039       WRITE(7,7070)ONAME(IA,IO),OAMT(IA,IO),OINF(IA,IO)
040  7070 FORMAT(1X,A20,F9.2,F11.2)
041    40 CONTINUE
042       WRITE(7,7500)IRND(LCCV(IA))
043  7500 FORMAT(////' NET PRESENT VALUE OF ENTIRE PROJECT',T42,I10)
044       RETURN
045       END
```

ROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	961	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	738	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	48	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RD WRT LONG
5	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	788	PIC OVR REL GBL SHR NOEXE RD WRT LONG

NTRY POINTS

Address	Type	Name
0-00000000		TABLE1

TATEMENT FUNCTIONS

Address	Type	Name
0-000003AA	I*4	IRND

ARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
8-000002F8	I*4	BASEYR	8-00000300	I*4	ENDYR	8-00000308	I*4	IA	4-00007E9C	I*4	IC
6-0000780C	I*4	IO	8-00000310	I*4	MAXNA	4-00007EA4	I*4	MAXNC	6-00007814	I*4	MAXNO
8-00000304	I*4	MAXNY	8-00000308	I*4	NA	4-00007EA0	I*4	NC	6-00007810	I*4	NO
8-000002FC	I*4	NYEAR	7-000000F0	CHAR	RNAME	8-000002F4	I*4	STRTYR	AP-00000040	R*4	X
2-00000000	CHAR	YESNO									

RRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-000001E0	R*4	CAMT	240	(3, 20)
4-000006A0	R*4	CCOST	14400	(3, 20, 60)
8-0000000C	R*4	CINF	12	(3)
4-000004B0	I*4	CLIFE	240	(3, 20)
3-00000000	CHAR	CNAME	1200	(3, 20)
4-00007E90	I*4	CNUM	12	(3)
4-000002D0	R*4	CSAL	240	(3, 20)
4-00000000	I*4	CYR1	240	(3, 20)
4-000000F0	I*4	CYR2	240	(3, 20)
8-00000000	R*4	INTRT	12	(3)
8-000002E8	R*4	LCCV	12	(3)

6-00000000	R*4	OAMT	240	(3, 20)
6-000001E0	R*4	OCOST	14400	(3, 20, 60)
6-000000F0	R*4	OINF	240	(3, 20)
5-00000000	CHAR	ONAME	1200	(3, 20)
6-00007000	I*4	ONUM	12	(3)
4-00003DE0	R*4	PVCC	14400	(3, 20, 60)
6-00003A20	R*4	PVOC	14400	(3, 20, 60)
4-000003C0	L*4	REPEAT	240	(3, 20)
4-00007620	R*4	TCCOST	720	(3, 60)
8-00000018	R*4	TLCCV	720	(3, 60)
6-00007260	R*4	TOCOST	720	(3, 60)
4-00007BF0	R*4	TPVCC	720	(3, 60)
6-00007530	R*4	TPVOC	720	(3, 60)

ABELS

Address	Label	Address	Label	Address	Label	Address	Label	Address	Label	Address	Label
0-0000026F	20	0-00000366	40	1-00000000	7010'	1-0000001F	7020'	1-0000006D	7030'	1-000000DB	7040'
1-000001CD	7060'	1-000001E2	7060'	1-0000029E	7070'	1-000002A9	7080'				

UNCTIONS AND SUBROUTINES REFERENCED

TH$SIGN PTITLE

otal Space Allocated = 68423 Bytes

```
0001          SUBROUTINE TABLE2
              C
              C     ROUTINE TO PRINT OUTPUT TABLE 2
              C
              C     WILLIAM A. STOCK, JUNE 1982
0002          INCLUDE 'LCCCOM.FOR'
          *   C
          *   C     COMMON BLOCKS --
          *   C
          *   C     CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003      *         COMMON/CCHAR/CNAME(3,20)
0004      *         CHARACTER*20 CNAME
          *   C     NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005      *         COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
          *        $ REPEAT(3,20),CLIFE(3,20),
          *        $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
          *        $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006      *         INTEGER CYR1,CYR2,CLIFE,CNUM
0007      *         LOGICAL REPEAT
          *   C     CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008      *         COMMON/OCHAR/ONAME(3,20)
0009      *         CHARACTER*20 ONAME
          *   C     NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010      *         COMMON/OCOSTS/OAMT(3,20),OINF(3,20),
          *        $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
          *        $ ONUM(3),IO,NO,MAXNO
0011      *         INTEGER ONUM
          *   C     OTHER ITEMS IN COMMON:
0012      *         COMMON/CHARS/ANAME(3),RNAME
0013      *         CHARACTER*80 ANAME,RNAME
0014      *         COMMON INTRT(3),CINF(3),TLCCV(3,60),LCCV(3),
          *        $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015      *         REAL INTRT,LCCV
0016      *         INTEGER STRTYR,BASEYR,ENDYR
          *   C
          *   C     VARIABLE NAMING CONVENTION:
          *   C       VARIABLES WITH "..YR.." CONTAIN AN ACTUAL CALANDER YEAR,
          *   C       VARIABLES WITH ONLY "..Y.." ARE RELATIVE YEARS WITH "BASEYR"
          *   C         AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS,
          *   C
0017          IRND(X)=INT(X+SIGN(.5,X))
0018          NPYEAR=ENDYR-BASEYR+1
0019          NPARTS=(NPYEAR+8)/9
0020          IYR1=BASEYR-9
0021          IYR2=BASEYR+8-9
0022          IY1=1-9
0023          IY2=9-9
0024          DO 500 IPART=1,NPARTS
0025          IYR1=IYR1+9
0026          IYR2=MIN(IYR2+9,ENDYR)
0027          IY1=IY1+9
0028          IY2=MIN(IY2+9,NPYEAR)
0029          CALL PTITLE
0030          WRITE(7,7010)ANAME(1A)
0031       7010 FORMAT(/' TITLE OF ALTERNATIVE -- ',A80)
0032          WRITE(7,7020)(IYR,IYR=IYR1,IYR2)
0033       7020 FORMAT(T42,9I10)
```

```
0034          WRITE(7,7030)
0035      7030 FORMAT(/' CAPITAL EXPENDITURES'/)
0036          NC=CNUM(IA)
0037          DO 40 IC=1,NC
0038          WRITE(7,7040)CNAME(IA,IC),(IRND(CCOST(IA,IC,IY)),IY=IY1,IY2)
0039      7040 FORMAT(1X,A20,' -- ACTUAL DOLLARS  ',9I10)
0040          WRITE(7,7050)(IRND(PVCC(IA,IC,IY)),IY=IY1,IY2)
0041      7050 FORMAT(21X,' -- PRESENT VALUE    ',9I10)
0042        40 CONTINUE
0043          WRITE(7,7060)(IRND(TCCOST(IA,IY)),IY=IY1,IY2)
0044      7060 FORMAT(/' TOTAL CAPITAL EXP.    -- ACTUAL DOLLARS  ',9I10)
0045          WRITE(7,7070)(IRND(TPVCC(IA,IY)),IY=IY1,IY2)
0046      7070 FORMAT(21X,' -- PRESENT VALUE    ',9I10)
0047          WRITE(7,7080)(IRND(AEC(IA,IY)),IY=IY1,IY2)
0048      7080 FORMAT(/' ANNUAL EQUIVALENT OF CAPITAL COSTS (AEC)',9I10)
0049          WRITE(7,7090)
0050      7090 FORMAT(///' OPERATING COSTS'/)
0051          NO=ONUM(IA)
0052          DO 60 IO=1,NO
0053          WRITE(7,7100)ONAME(IA,IO),(IRND(OCOST(IA,IO,IY)),IY=IY1,IY2)
0054      7100 FORMAT(1X,A20,' -- ACTUAL DOLLARS  ',9I10)
0055          WRITE(7,7050)(IRND(PVOC(IA,IO,IY)),IY=IY1,IY2)
0056        60 CONTINUE
0057          WRITE(7,7120)(IRND(TOCOST(IA,IY)),IY=IY1,IY2)
0058      7120 FORMAT(/' TOTAL OPER. COSTS     -- ACTUAL DOLLARS  ',9I10)
0059          WRITE(7,7060)(IRND(TPVOC(IA,IY)),IY=IY1,IY2)
0060          WRITE(7,7140)(IRND(AEC(IA,IY)+TOCOST(IA,IY)),IY=IY1,IY2)
0061      7140 FORMAT(/' SUM OF AEC AND OPERATING COSTS',T42,9I10)
0062          WRITE(7,7160)(IRND(TLCCV(IA,IY)),IY=IY1,IY2)
0063      7160 FORMAT(////' N.P.V. OF ENTIRE PROJECT Y.T.D.',T42,9I10)
0064       500 CONTINUE
0065          RETURN
0066          END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	1676	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	444	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	80	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	788	PIC OVR REL GBL SHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000		TABLE2

STATEMENT FUNCTIONS

Address	Type	Name
0-00000675	I*4	IRND

VARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
8-000002F8	I*4	BASEYR	8-00000300	I*4	ENDYR	8-00000308	I*4	1A	4-00007E9C	I*4	1C
6-0000780C	I*4	IO	2-00000018	I*4	IPART	2-00000020	I*4	IY	2-00000010	I*4	IY1
2-00000014	I*4	IY2	2-0000001C	I*4	IYR	2-00000008	I*4	IYRI	2-0000000C	I*4	IYR2
8-00000310	I*4	MAXNA	4-00007EA4	I*4	MAXNC	6-00007814	I*4	MAXNO	8-00000304	I*4	MAXNY
8-0000030C	I*4	NA	4-00007EA0	I*4	NC	6-00007810	I*4	NO	2-00000004	I*4	NPARTS
2-00000000	I*4	NPYEAR	8-000002FC	I*4	NYEAR	7-000000F0	CHAR	RNAME	8-000002F4	I*4	STRTYR
AP-00000040	R*4	X									

ARRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-000001E0	R*4	CAMT	240	(3, 20)
4-000005A0	R*4	CCOST	14400	(3, 20, 60)
8-0000000C	R*4	CINF	12	(3)
4-000004B0	I*4	CLIFE	240	(3, 20)
3-00000000	CHAR	CNAME	1200	(3, 20)
4-00007E90	I*4	CNUM	12	(3)
4-000002D0	R*4	CSAL	240	(3, 20)
4-00000000	I*4	CYR1	240	(3, 20)
4-000000F0	I*4	CYR2	240	(3, 20)

8-00000000	R*4	INTRT	12	(3)
8-000002E8	R*4	LCCV	12	(3)
6-00000000	R*4	OAMT	240	(3, 20)
6-000001E0	R*4	OCOST	14400	(3, 20, 60)
6-000000F0	R*4	OINF	240	(3, 20)
5-00000000	CHAR	ONAME	1200	(3, 20)
6-00007800	I*4	ONUM	12	(3)
4-00003DE0	R*4	PVCC	14400	(3, 20, 60)
6-00003A20	R*4	PVOC	14400	(3, 20, 60)
4-000003C0	L*4	REPEAT	240	(3, 20)
4-00007620	R*4	TCCOST	720	(3, 60)
8-00000018	R*4	TLCCV	720	(3, 60)
6-00007260	R*4	TOCOST	720	(3, 60)
4-00007BF0	R*4	TPVCC	720	(3, 60)
6-00007530	R*4	TPVOC	720	(3, 60)

ABELS

Address	Label	Address	Label	Address	Label	Address	Label	Address	Label	Address	Label
0-0000025C	40	0-000004D0	60	0-0000066C	500	1-00000000	7010'	1-0000001F	7020'	1-00000026	7030'
1-00000040	7040'	1-0000005F	7060'	1-0000007C	7060'	1-000000AD	7070'	1-000000CA	7080'	1-000000FB	7090'
1-00000112	7100'	1-00000131	7120'	1-00000162	7140'	1-000001BB	7160'				

UNCTIONS AND SUBROUTINES REFERENCED

THSSIGN PTITLE

otal Space Allocated = 68876 Bytes

```
0001          SUBROUTINE PTITLE
              C     ROUTINE TO PRINT A PAGE HEADING ON A NEW PAGE
              C
              C     WILLIAM A. STOCK, JUNE 1982
              C
0002          INCLUDE 'LCCCOM.FOR'
            * C
            * C     COMMON BLOCKS --
            * C
            * C
            * C     CHARACTER DATA FOR CAPITAL EQUIPMENT COSTS:
0003        *       COMMON/CCHAR/CNAME(3,20)
0004        *       CHARACTER*20 CNAME
            * C     NUMERIC DATA FOR CAPITAL EQUIPMENT COSTS:
0005        *       COMMON/CCOSTS/CYR1(3,20),CYR2(3,20),CAMT(3,20),CSAL(3,20),
            *      $ REPEAT(3,20),CLIFE(3,20),
            *      $ CCOST(3,20,60),PVCC(3,20,60),TCCOST(3,60),TPVCC(3,60),
            *      $ AEC(3,60),CNUM(3),IC,NC,MAXNC
0006        *       INTEGER CYR1,CYR2,CLIFE,CNUM
0007        *       LOGICAL REPEAT
            * C     CHARACTER DATA FOR OPERATING AND MAINTENANCE COSTS:
0008        *       COMMON/OCHAR/ONAME(3,20)
0009        *       CHARACTER*20 ONAME
            * C     NUMERIC DATA FOR OPERATING AND MAINTENANCE COST:
0010        *       COMMON/OCOSTS/OAMT(3,20),OINF(3,20),
            *      $ OCOST(3,20,60),PVOC(3,20,60),TOCOST(3,60),TPVOC(3,60),
            *      $ ONUM(3),IO,NO,MAXNO
0011        *       INTEGER ONUM
            * C     OTHER ITEMS IN COMMON:
0012        *       COMMON/CHARS/ANAME(3),RNAME
0013        *       CHARACTER*80 ANAME,RNAME
0014        *       COMMON INTRT(3),CINF(3),TLCCV(3,60),LCCV(3),
            *      $ STRTYR,BASEYR,NYEAR,ENDYR,MAXNY,IA,NA,MAXNA
0015        *       REAL INTRT,LCCV
0016        *       INTEGER STRTYR,BASEYR,ENDYR
            * C
            * C     VARIABLE NAMING CONVENTION:
            * C       VARIABLES WITH "..YR.." CONTAIN AN ACTUAL CALANDER YEAR,
            * C       VARIABLES WITH ONLY "..Y.." ARE RELATIVE YEARS WITH "BASEYR"
            * C         AS 1.  ONLY THESE VARIABLES MAKE LEGAL SUBSCRIPTS.
            * C
0017          CHARACTER*130 OUTLIN
              C     CENTERING LOGIC FOR RUN TITLE
0018          L=NBLNKL(RNAME)+13
0019          LOVER=(132-L)/2
0020          OUTLIN(1:LOVER)=' '
0021          OUTLIN(LOVER+1:130)='RUN TITLE -- '//RNAME
              C
              C     PRINT THE TITLE
              C
0022          WRITE(7,7000)OUTLIN
0023       7000 FORMAT('1',T47,'SOUTHERN CALIFORNIA RAPID TRANSIT DISTRICT'/
                  $ T47,5X,'METRO RAIL LIFE CYCLE COST MODEL'/
                  $ T47,8X,'(IN THOUSANDS OF DOLLARS)'//
                  $ 1X,A130)
0024          RETURN
0025          END
```

PROGRAM SECTIONS

	Name	Bytes	Attributes
0	$CODE	132	PIC CON REL LCL SHR EXE RD NOWRT LONG
1	$PDATA	142	PIC CON REL LCL SHR NOEXE RD NOWRT LONG
2	$LOCAL	164	PIC CON REL LCL NOSHR NOEXE RD WRT LONG
3	CCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
4	CCOSTS	32424	PIC OVR REL GBL SHR NOEXE RD WRT LONG
5	OCHAR	1200	PIC OVR REL GBL SHR NOEXE RD WRT LONG
6	OCOSTS	30744	PIC OVR REL GBL SHR NOEXE RD WRT LONG
7	CHARS	320	PIC OVR REL GBL SHR NOEXE RD WRT LONG
8	$BLANK	788	PIC OVR REL GBL SHR NOEXE RD WRT LONG

ENTRY POINTS

Address	Type	Name
0-00000000		PTITLE

VARIABLES

Address	Type	Name	Address	Type	Name	Address	Type	Name	Address	Type	Name
8-000002F8	I*4	BASEYR	8-00000300	I*4	ENDYR	8-00000308	I*4	IA	4-00007E9C	I*4	IC
6-00007800	I*4	IO	2-000000B4	I*4	L	2-000000B8	I*4	LOVER	8-00000310	I*4	MAXNA
4-00007EA4	I*4	MAXNC	6-00007814	I*4	MAXNO	8-00000304	I*4	MAXNY	8-0000030C	I*4	NA
4-00007EA0	I*4	NC	6-00007810	I*4	NO	8-000002FC	I*4	NYEAR	2-00000000	CHAR	OUTLIN
7-000000F0	CHAR	RNAME	8-000002F4	I*4	STRTYR						

ARRAYS

Address	Type	Name	Bytes	Dimensions
4-00007BC0	R*4	AEC	720	(3, 60)
7-00000000	CHAR	ANAME	240	(3)
4-00001E00	R*4	CAMT	240	(3, 20)
4-00005A00	R*4	CCOST	14400	(3, 20, 60)
8-0000000C	R*4	CINF	12	(3)
4-00004B00	I*4	CLIFE	240	(3, 20)
3-00000000	CHAR	CNAME	1200	(3, 20)
4-00007E90	I*4	CNUM	12	(3)
4-00002D00	R*4	CSAL	240	(3, 20)
4-00000000	I*4	CYR1	240	(3, 20)
4-0000F000	I*4	CYR2	240	(3, 20)
8-00000000	R*4	INTRT	12	(3)
8-00002E80	R*4	LCCV	12	(3)
6-00000000	R*4	OAMT	240	(3, 20)
6-00001E00	R*4	OCOST	14400	(3, 20, 60)
6-0000F000	R*4	OINF	240	(3, 20)
5-00000000	CHAR	ONAME	1200	(3, 20)
6-00007B00	I*4	ONUM	12	(3)
4-00003DE0	R*4	PVCC	14400	(3, 20, 60)
6-00003A20	R*4	PVOC	14400	(3, 20, 60)

4-000003C0	L*4	REPEAT	240	(3, 20)
4-00007620	R*4	TCCOST	720	(3, 60)
8-00000018	R*4	TLCCV	720	(3, 60)
6-00007260	R*4	TOCOST	720	(3, 60)
4-000078F0	R*4	TPVCC	720	(3, 60)
6-00007530	R*4	TPVOC	720	(3, 60)

ABELS

Address	Label
1-00000000	7000'

UNCTIONS AND SUBROUTINES REFERENCED

BLNKL

otal Space Allocated = 67114 Bytes