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SPACELAB EXPERIMENT COMPUTER STUDY
Vol V: Spacelab User Cost Data (Distributed Computer)

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Data Systems Laboratory

April 1976

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This is Volume V of five volumes.

16. ABSTRACT

The purpose of this study was to provide a quantitative cost for various Spacelab flight hardware configurations, along with varied software development options. The three major conclusions reached as a result of this study are as follows:

1. Spacelab program cost for software development and maintenance is independent of experimental hardware and software options.

2. Distributed standard computer concept simplifies software integration without a significant increase in cost.

3. Decision on flight computer hardware configuration should not be made until payload selection for a given mission and a detailed analysis of the mission requirements are completed.

This report is published in five volumes: Volume I contains the Executive Summary (Presentation); Volume II, Study Elements and Approach; Volume III, Spacelab Cost Data; Volume IV, Spacelab User Cost Data (Central Experiment Computer); and Volume V, Spacelab User Cost Data (Distributed Computer).

This is Volume V: Spacelab User Cost Data (Distributed Computer).

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SPACELAB EXPERIMENT COMPUTER STUDY

Volume V: Spacelab User Cost Data (Distributed Computer)

SECTION 1 Option IIA1 - Distributed, Non-Standard Mini Central Software Development by Central Group

1.1 Costing Method - Not included.

1.2 Cost Data - Not included.

ASSUMPTIONS

1. This option was not priced because:

   a. It is illogical for a central software development group to implement software for PI's who are otherwise procuring and developing mini computers and their support software independently.

   b. The development cost for the mini's would be exorbitant.

SECTION 2 Option IIA2A - Distributed Non-Standard Mini, Central Software Development by PI Local

2.1 Costing Method - Not included.

2.2 Cost Data - Not included.

ASSUMPTIONS

1. This option was not priced because:

   a. It was illogical for a PI to travel to a central facility to use for development of software for a mini when there is not an attempt to standardize the mini's, so that the support software for the mini is compatible with the STIL. The cost that would be incurred in developing the support software to execute on the STIL for all the different mini's would be exorbitant.

   b. The cost of developing the potentially forty-five different mini's would be exorbitant.

SECTION 3 Option IIA2B - Distributed Non-Standard Mini, Central Software Development by PI - Remote

3.1 Costing Method. - Not included.

3.2 Cost Data - Not included.

ASSUMPTIONS

1. This option was not priced because:

   a. It is illogical for a PI to use a host computer facility that is not compatible with executing the support software of the mini DEP utilized. The support software would have to be developed, at an exorbitant cost, to execute on the STIL host.

   b. The cost of developing the mini computer hardware would be exorbitant if each PI operated independently.

SECTION 4 Option IIA3A - Distributed Non-Standard Mini, Software Development by PI at his Facility, Real-Time Simulation at Central Facility

4.1 Costing Method - Not included.

4.2 Cost Data - Not included.

ASSUMPTIONS

1. This option was not priced because:

a. If the PI's facility is compatible with STIL then an exorbitant cost would be incurred developing the DEP support software for execution on the STIL Host.

SECTION 5 Option IIA3B - Distributed Non-Standard Mini, Software Development by PI at His Facility, Real-Time Simulation Testing on RTSTS

5.1 Costing Method - Not included.

5.2 Cost Data - Not included.

ASSUMPTIONS

1. This option was not priced because:

   a. This option is identical to Option IIA4 which is priced.

SECTION 6 Option IIA4 - Distributed Non-Standard Mini Software Development by PI at His Non-Compatible Facility

6.1 Costing Method

ASSUMPTIONS

Assume PI procures a RTSTS and mini that are compatible for support software. The PI software developer would use the RTSTS for coding and real-time simulation checkout.

Assume each PI selects a different independently developed mini and RTSTS.

Each PI would independently develop an operating system.

All EAS unique software would be implemented in the mini's.

No integration PI/PI required due to no CPU resource sharing. Central computer integration is still required for the resource sharing.

DEP available at Level 4 for hardware integration.

Cost Element 4.1 Experiment Application Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel
8. Training

(1) Software Development

(A) = ((Number of Statements) (Cost/Statement) Per Flight Per Yr.

Number of Statements = #3 + #4

Cost/Statement = $45

(1) Total = ((#3 + #4) ($45)) Per Yr.

(2) (3) (4) (5) (6) (7) (8) Total = 0 for This Option

Cost Element 4.2 <u>Experiment Application Software Maintenance</u>

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel

(1) <u>Experiment Unique Software</u>

(A) = (# of Statements) (Rate of Change) (Cost/Statement)

Rate of Change = Engineering Estimate Based on Past Programs = 40% for 1st Re-Fly, 30% for 2nd Re-Fly, 20% for 3rd Re-Fly, 10% for all Subsequent Re-Flys.

(# of Statements) (Rate of Change) = #13

Cost/Statement = $45 (See 4.1 for Rationale)

(1) Total = ((#13) ($45)) Per Yr.

(2) (3) (4) (5) (6) (7) Total = 0 for This Option

Cost Element 4.3 <u>EAS Software Integrated Verification</u>

Cost Factors

1. Integrated Verification
2. Host Computer Time
3. Simulation Computer Time
4. Integrated Verification Simulation Software

(1) (2) (3) (4) Total = 0 for This Option

Cost Element 4.4 Preflight Checkout Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Software Development

(A) = ((Number of HOL Statements) (Cost/Statement)) Per Yr.

Number of Statements = #22

Cost/Statement = $30

(1) Total = ((#22) ($30))/Yr.

(2) (3) (4) (5) Total = 0 for This Option

PREFLIGHT SOFTWARE SIZING RATIONALE

Saturn History

LVDC/DA interface signals	=	86
LVDC/DA # instructions	=	4,650
average # instructions/signal	=	54

ATM History

ATMDC interface signals	=	275
ATMDC # instructions	=	7,897
average # instructions/signal	=	29

Mission 8 of Spacelab

# interface signals	=	81.6
# payload elements	=	1.3
average # interface signals	=	62.77

Assume preflight job for each payload element is the same and equivalent to Saturn LVDC = 4,650 instructions.

$$= \frac{4,650}{5} = 930 \text{ HOL statements at a cost of \$30/Statement.}$$

Number of Statements = Number of HOL Statements per Payload Element X # Payload Elements = 930 X PE/Yr. (New Flight)

Cost/Statement = $30

Cost Element 4.5 Preflight Checkout Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Experiment Unique Software

(A) = ((# of Statements) (Change Rate) (Cost/Statement) Per Yr.

Number of Statements = (930) (# Payload Elements/Yr.) (Maintenance Flights)

Change Rate = 10% for Each Flight

Cost/Statement = $30 Ref. 4.4 (1)

(1) Total = ((#23) ($30)) Per Yr.

(2) (3) (4) (5) Total = 0 for This Option

Cost Element 4.6 <u>EAS Dependent STIL Hardware Modifications</u>

Cost Factors

1. Host Main Memory
2. Remote Job Entry
3. Display Terminals
4. Maintenance Added Hardware
5. Telecommunications

(1) (2) (3) (4) (5) Total = 0 for This Option

Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factors

1. Software Development
2. Host Computer Time
3. Simulation Computer Time
4. Travel

(1) Software Development

((# of Statements) (Cost/Statement)) Per Yr.

# of Statement = (1.4K) (Payload Elements/Yr.) (New Flights)

Cost/Statement = $45 Due to Less Documentation and No Integration

# of Statements = #24

(1) Total = ((#24) ($45)) Per Yr.

(2) (3) (4) Total = 0 for This Option

Rationale for Simulation Software Required for Payload Elements

Engineering Estimate - 21K Table Words Per Payload Element for Simulation Software.

Engineering Estimate that 21K Table Words Equates to Approximately 1/3 X 21K = 7K Machine Language Instructions.

7K ÷ 5 = 1.4K HOL Statements

1.4K X $45/Statement = $63K/Payload Element

Cost Element 4.9 Experiment Real-Time Simulation Software Maintenance

Cost Factors

1. Maintenance
2. Host Computer Time
3. Simulation Computer Time
4. Travel

(1) Maintenance

(# of Statements) (Change Rate) (Cost/Statement)

# of Statements = #25

Change Rate = Engineering Estimate = 10%/Flight

Cost/Statement = $45 Same as 4.8 (1) (3)

(1) Total = ((#25) ($45)) Per Yr.

(2) (3) (4) Total = 0 for This Option

Cost Element 5.1 <u>Experiment Processor Acquisition</u>

Cost Factors

1. Processor Hardware (I/O Included)

2. Development and Oualification

3. Special Test Equipment

(1) <u>Processor Hardware (I/O Included)</u>

((# of Processors) (Cost/Processor)

# of Processors = #31

Cost/Processor = $51K

(1) Total = ((#31) ($51K)) Per Yr.

(2). <u>Development and Qualification</u>

((# Qualifications) (Cost/Qualification) Per Yr.

(2) Total = ((#31) ($520.3K)) Per Yr.

(3) <u>Special Test Equipment</u>

Engineering Estimate = $5K/Unit

Units = #31

(# Units) ($5K) Per Yr.

(3) Total = (#31) ($5K)) Per Yr.

GROUND RULES FOR DEDICATED EXPERIMENT PROCESSOR

I. Central Experiment Computer Capacity = (Speed) and (Memory)

Speed = (500K Adds per Second) X 65%

(A) = 325 KADS

500 KADS = CII Specifications

65% = 100% - (15% Overhead) - (20% Contingency)

Memory = (Total Capacity) - (Contingency) - (Operating System)

Total Capacity = 64K CII Specification

Contingency = 30% Engineering Estimate

Note: Low compared to industry (50 - 100%)
Operating System = 20K ESA Estimate

(A) = 64K - 19.2K - 20K
= 24.8K

II. When a new payload exceeds central computer capacity, a DEP will be selected for that element that has the greatest capacity requirement. Each element having this requirement will be assigned a different DEP, except the case where one DEP is used on multiple missions.

III. Assume all Spacelab's Review Item Disposition (RID's) for CDMS modifications are incorporated for mass memory, data bus, etc.

IV. *Two classes of DEP's were considered:

1) Micro Processor

2) Mini Processor

* Only 1 DEP will be specified

V. Assume any non-standard DEP's selected will have support software that is executable on STIL simulation computer.

VI. For any mission, assume that the required number of data bus RAU's can be provided.

VII. Number of processors = determined by applying "Ground Rules for DEP" to GDC provided software.

Cost/processor = determined by: processor class, configuration.

((Processor hardware) + (Qualification) + (Special I/O (RAU equivalent) + (Special Test Equipment) + (Peripherals*) + (Peripherals Qualification).

Each element will be determined according to selected processor class and configuration.

Cost Element 5.2 Experiment Processor Maintenance

Cost Factors

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. for Each Yr. Used

(1) Total = ((8% ($51K) (#30)) Per Yr.

(2) Distribution

(2) Total = 0 for This Option

(3) Re-Furbishment

(A) = ((Number of DEP's) (Cost/Unit for Re-Furbishment)) Per Flight Per Yr.

Number of DEP's = Determined From Mission Model Requirements

(3) Total = Cost/Unit for Re-Furbishment = 0 Assumes DEP's Will Meet Spacelab Lifetime Requirements.

Cost Element 5.3 DEP Software

Cost Factors

1. Operating System Development

2. Support Software Procurement

(1) Operating Software Development

(A) = ((Number of Instructions) (Cost Per Instruction))
# of Instructions = 4K (M&S Study)

Cost Per Instruction = $100 (Assembly Language)

(1) Total = (4K) ($100) = (($400K) (#31)) Per Yr.

(2) Support Software Procurement

(A) = (Vendor Lease) or ((Number of Statements) (Cost Per Statement)

Assume Vendor Lease - $5K for Link Editor
$25K for Cross Assembler
$25K for Cross Compiler
$55K (Engineering Estimate)

(2) Total = (($55K) (#31)) Per Yr.

Cost Element 5.4 DEP Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement)

Number of Statements = 4.0K Operating System

Line #30 = # of DEP's Used/Yr.

Rate of Change = 5% Per Yr. When Used - (Engineering Estimate)

Cost Per Statement = $45

(1) Total = ((4K) (5%) ($45) (#30)) Per Yr.

(2) Distribution

(A) = 0 for This Option

Cost Element 6.1 <u>Real-Time Simulation Test Set Acquisition (RTSTS)</u>

Cost Factors

1. Engineering Design
2. Simulation Computer
3. Dedicated Experiment Processor (DEP) Interface
4. RTSTS Integration
5. Consumable Stock

(1) (2) (3) & (4) = Engineering Estimate = $330K/RTSTS

#RTSTS = #31

(1) (2) (3) (4) Total = (($330K) (#31)) Per Yr.

(5) <u>Consumable Stock</u>

(5) Total = 0 for This Option

Cost Element 6.2 Real-Time Simulation Test Set Maintenance and Operation

Cost Factors

1. Maintenance
2. Distribution
3. Operation
4. Special Purpose Equipment
5. Consumables
6. Re-Furbishment
7. Facility Modifications

(1) Maintenance and (4) Special Test Equipment

(Cost/Yr.) (#RTSTS's Used/Yr.)

(8%) (Purchase Cost) (#RTSTS's Used/Yr.)

(8%) ($187K) (#RTSTS's Used/Yr.)

(1) & (4) Total = $15K) (#30)

(2) Distribution

Total = (Cost/Yr. for Distribution/Sustaining Engineering) (#RTSTS's Used/Yr.

(2) Total = 0 for This Option

(3) Operation

Total = (Operation Cost/Yr.) (#RTSTS's Used/Yr.) (Operation Cost/Yr.) (#RTSTS's Used/Yr.)

(3) Total = 0 for This Option

Note: No Operations Cost for RTSTS - Operated by Programming Staff.

(4) Special Purpose Equipment

Included as part of 6.2 (1)

(5) Consumables

Total = (Cost/Yr.) (#RTSTS's Used/Yr.)

Cost/Yr. = Engineering Estimate = $12,250

(5) Total = ($12,250) (#30)

(6) Re-Furbishment

Assumed Covered by Maintenance in Item 6.2 (1)

(7) Facility Modifications

Assume Space Available and no Cost Associated With A/C and Power Service Room A/C Adequate and Standard Power Service Available.

Cost Element 6.3 Simulation Computer Software Development and Procurement

Cost Factors

1. Simulation Computer Software Development

2. Simulation Computer Software Procurement

(1) Simulation Computer Software Development

Engineering Estimate = Same as Rationale on 3-3 (1) for STIL Simulation Computer

Total = (# Modules) (100 Statements/Module) (Cost/Statement) (#RTSTS's)

(58) (100) ($60) (#RTSTS's)

= ($348K) (#RTSTS's)

(1) Total = ($348K) (#31)

(2) Simulation Computer Software Procurement

Engineering Estimate = Real-Time Operating System = $4K (Simulation Computer)

($4K) (#RTSTS's)

(2) Total = ($4K) (#31)

Cost Element 6.4 RTSTS Support Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

Total = (Number of Instructions) (Rate of Change) (Cost/Instruction)

The above was considered but an Engineering Estimate was made instead which is one Man Per Yr. of Usage. This is compatible with the level of effort charged for the STIL Simulation Computer Software in 3.4

(A) = ((1 Man Yr.) (#RTSTS's Used)) Per Yr.

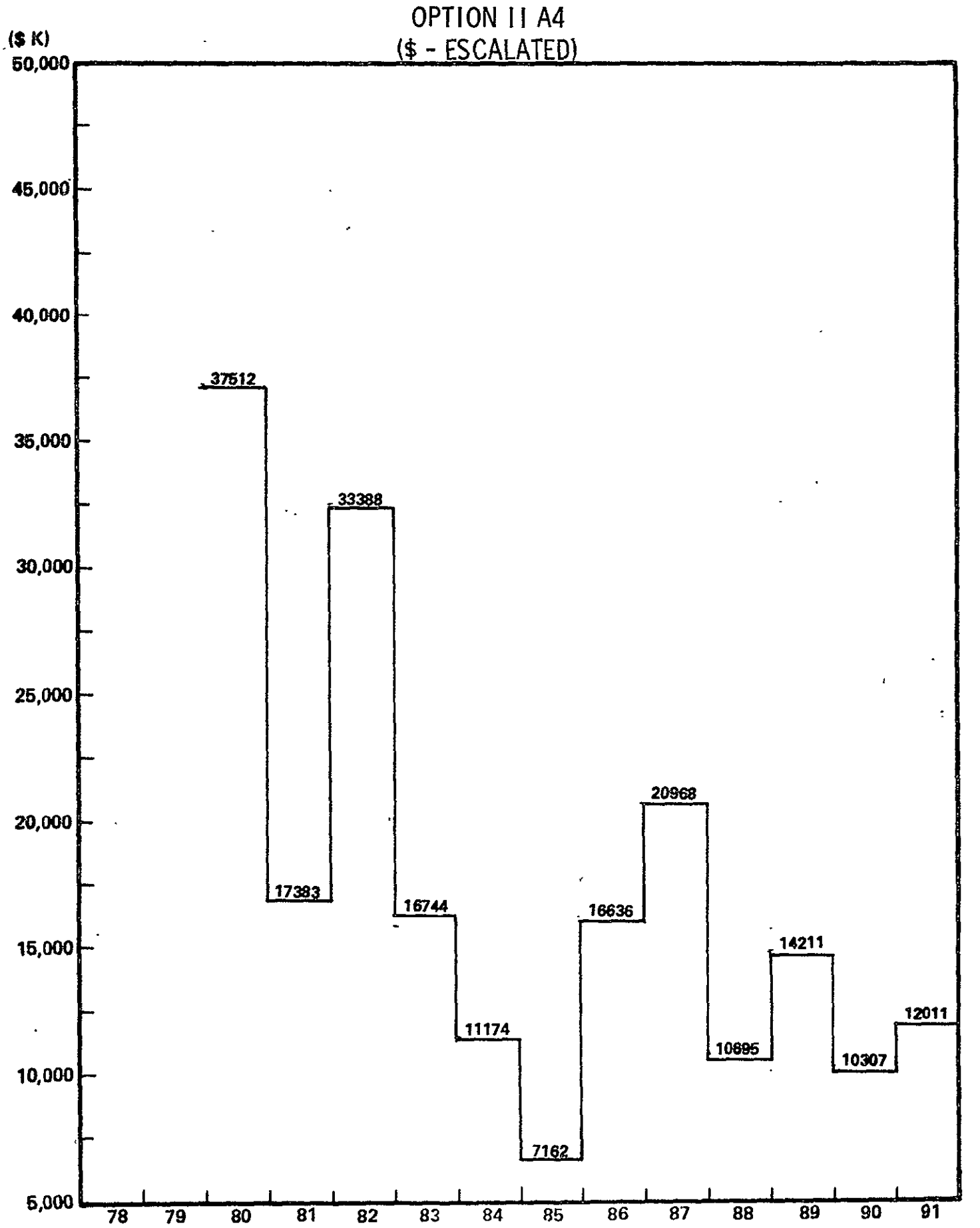
(1) Total = (($50K) (#30)) Per Yr.

(2) Distribution

(2) Total = 0 for This Option

SECTION 6 Option IIA4 - Distributed Non-Standard Mini Software Development by PI at his Non-Compatible Facility

6.2 Cost Data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11174
7162
16636
20968
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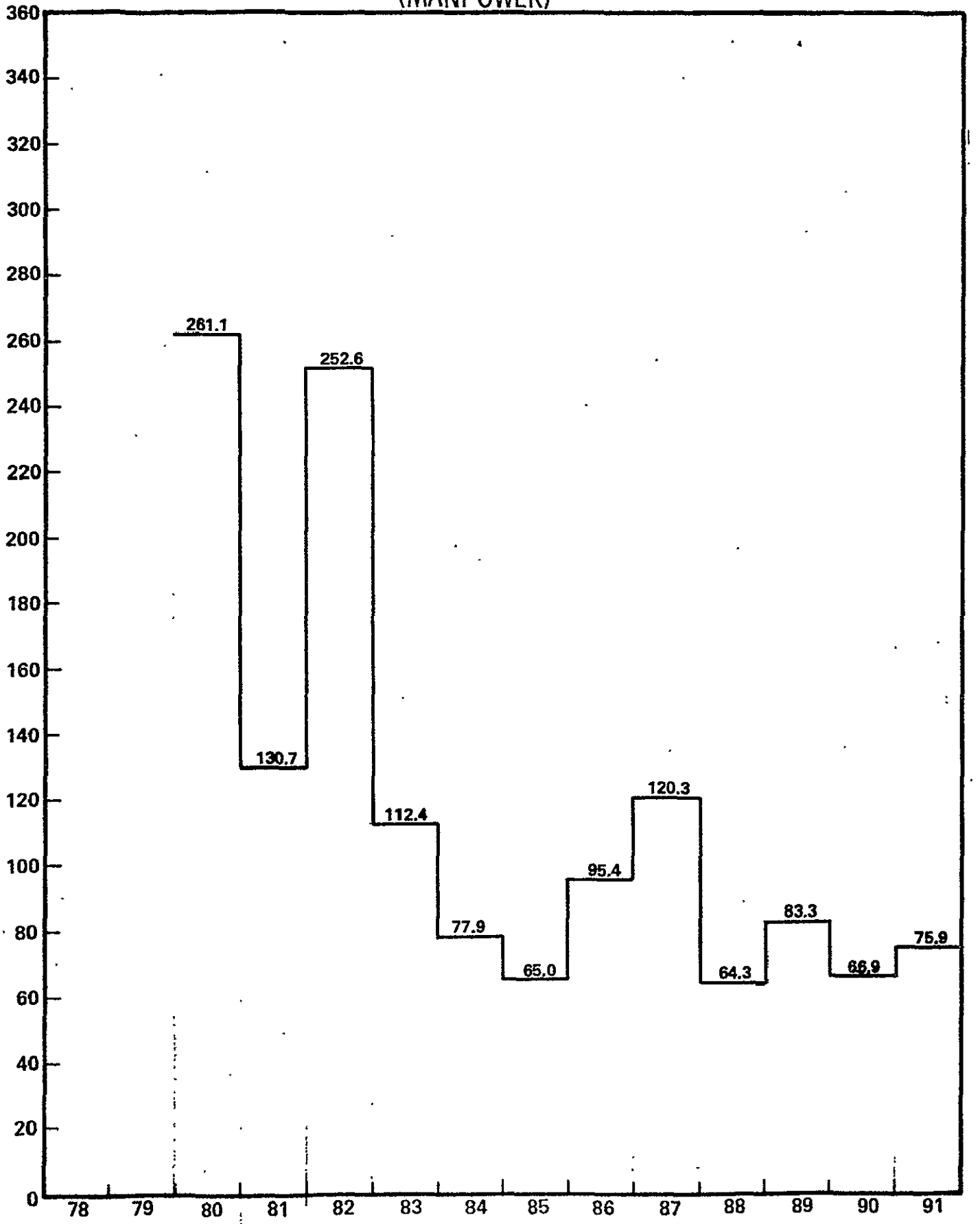
OPTION II A4
(MANPOWER)



OPTION IIA4 TOTAL COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1					222.30	656.82	372.69	55.80
4.2					0	151.70	199.94	358.02
4.3					0	0	0	0
4.4					390.60	139.50	418.50	111.60
4.5					0	39.06	16.74	66.96
4.6					0	0	0	0
4.7								
4.8					882.00	315.00	945.00	252.00
4.9					0	88.20	37.80	151.20
5.1					8068.20	2881.50	6915.60	2305.20
5.2					57.12	73.44	81.60	85.68
5.3					6370.00	2275.00	5460.00	1820.00
5.4					126.00	162.00	180.00	189.00
6.1					4620.00	1650.00	396.00	1320.00
6.2					381.50	490.50	545.00	572.75
6.3					4928.00	1760.00	4224.00	1408.00
6.4					700.00	900.00	1000.00	1050.00
7.								
TOTAL					26745.82	11582.72	20792.87	9745.70
ESCALATED TOTAL					37512.40	17382.52	33388.81	16744.93

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OPTION IIA4 TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	177.17	0	233.24	203.67	39.06	69.75	0	0
4.2	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31
4.3	0	0	0	0	0	0	0	0
4.4	55.80	0	83.70	83.70	27.90	27.90	0	0
4.5	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
4.6	0	0	0	0	0	0	0	0
4.7								
4.8	126.00	0	189.00	189.00	63.00	63.00	0	0
4.9	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
5.1	1152.60	0	1728.90	1728.90	576.30	576.30	0	0
5.2	81.60	130.56	81.60	134.64	89.76	130.56	130.56	142.80
5.3	910.00	0	1365.00	1365.00	455.00	455.00	0	0
5.4	180.00	288.00	180.00	297.00	198.00	288.00	288.00	315.00
6.1	660.00	0	990.00	990.00	330.00	330.00	0	0
6.2	545.00	872.00	545.00	899.25	599.50	872.00	872.00	953.75
6.3	704.00	0	1056.00	1056.00	352.00	352.00	0	0
6.4	1000.00	1600.00	1000.00	1650.00	1100.00	1600.00	1600.00	1750.00
7.								
TOTAL	6078.08	3641.19	7903.75	9310.41	4437.89	5511.42	3735.89	4068.62
ESCALATED TOTAL	11174.00	7162.00	16636.00	20968.00	10694.00	14211.00	10307.00	12011.00
TOTAL COST		113554.36						
ESCALATED TOTAL COST		208195.47						

AVERAGE COST PER FLIGHT 921.22

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OPTION IIA4 TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1					4.5	13.1	7.5	1.1
4.2					0	3.0	4.0	7.2
4.3					0	0	0	0
4.4					7.8	2.8	8.4	2.2
4.5					0	.8	.3	1.3
4.6					---	---	---	---
4.7					---	---	---	---
4.8					17.6	6.3	18.9	5.0
4.9					0	1.8	.8	3.0
5.1					---	---	---	---
5.2					1.1	1.5	1.6	1.7
5.3					112.0	40.0	96.0	32.0
5.4					2.5	3.2	3.6	3.8
6.1					---	---	---	---
6.2					4.2	5.4	6.0	6.3
6.3					97.4	34.8	85.5	27.8
6.4					14.0	18.0	20.0	21.0
7.								
TOTAL MANPOWER					261.10	130.70	252.60	112.40

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OPTION IIA4 TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	3.5	0	4.7	4.1	.8	1.4	0	0
4.2	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
4.3	0	0	0	0	0	0	0	0
4.4	1.1	0	1.7	1.7	.6	.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
4.6	---	---	---	---	---	---	---	---
4.7	---	---	---	---	---	---	---	---
4.8	2.5	0	3.8	3.8	1.3	1.3	0	0
4.9	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
5.1	---	---	---	---	---	---	---	---
5.2	1.6	2.6	1.6	2.7	1.8	2.6	2.6	2.9
5.3	16.0	0	24.0	24.0	8.0	8.0	0	0
5.4	3.6	5.8	3.6	5.9	4.0	5.8	5.8	6.3
6.1	---	---	---	---	---	---	---	---
6.2	6.0	9.6	6.0	9.9	6.6	9.6	9.6	10.5
6.3	13.9	0	20.9	20.9	7.0	7.0	0	0
6.4	20.0	32.0	20.0	33.0	22.0	32.0	32.0	35.0
7.								
TOTAL MANPOWER	77.90	65.00	95.40	120.30	64.30	83.30	66.90	75.90

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1 Experiment Application Software Development								
(1) Software Development					222.30	656.82	372.69	55.80
(2) Common Software					0	0	0	0
(3) Host Computer Time					0	0	0	0
(4) Simulation Computer Time					0	0	0	0
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	0	0	0
(8) Training					0	0	0	0
LABOR COST								
MANPOWER					4.5	13.1	7.5	1.1
TOTAL COST					222.30	656.82	372.69	55.80

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1 Experiment Application Software Development								
(1) Software Development	177.17	0	233.23	203.67	39.06	69.75	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	0	0	0	0	0	0	0	0
(4) Simulation Computer Time	0	0	0	0	0	0	0	0
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	0	0	0	0	0	0	0	0
(8) Training	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	3.5	0	4.7	4.1	.8	1.4	0	0
TOTAL COST	177.17	0	233.24	203.67	39.06	69.75	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software					0	151.70	199.94	358.02
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	0	0	0
(4) Simulation Computer Time					0	0	0	0
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	0	0	0
LABOR COST								
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	151.70	199.94	358.02

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	0	0	0	0	0	0	0	0
(4) Simulation Computer Time	0	0	0	0	0	0	0	0
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
TOTAL COST	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS Software Integrated Verification								
(1) Integrated Verification					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Integrated Verification Simulation Software					0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST					0	0	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS Software Integrated Verification								
(1) Integrated Verification	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Integrated Verification Simulation Software	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 Preflight Checkout Software Development								
(1) Software Development					390.60	139.50	418.50	111.60
(2) Common Software					0	0	0	0
(3) Host Computer Time					0	0	0	0
(4) Simulation Computer Time					0	0	0	0
LABOR COST								
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					390.60	139.50	418.50	111.60

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 Preflight Checkout Software Development								
(1) Software Development	55.80	0	83.70	83.70	27.90	27.90	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	0	0	0	0	0	0	0	0
(4) Simulation Computer Time	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	1.1	0	1.7	1.7	.6	.6	0	0
TOTAL COST	55.80	0	83.70	83.70	27.90	27.90	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software					0	39.06	16.74	66.96
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	0	0	0
(4) Simulation Computer Time					0	0	0	0
(5) Travel					0	0	0	0
LABOR COST								
MANPOWER					0	.8	.3	1.3
TOTAL COST					0	39.06	16.74	66.96

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	0	0	0	0	0	0	0	0
(4) Simulation Computer Time	0	0	0	0	0	0	0	0
(5) Travel	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory					0	0	0	0
(2) Remote Job Entry					0	0	0	0
(3) Display Terminals					0	0	0	0
(4) Maintenance					0	0	0	0
(5) Telecom-munications					0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST					0	0	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory	0	0	0	0	0	0	0	0
(2) Remote Job Entry	0	0	0	0	0	0	0	0
(3) Display Terminals	0	0	0	0	0	0	0	0
(4) Maintenance	0	0	0	0	0	0	0	0
(5) Telecom-munications	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development					882.00	315.00	945.00	252.00
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Travel					0	0	0	0
LABOR COST								
MANPOWER					17.6	6.3	18.9	5.0
TOTAL COST					882.00	315.00	945.00	252.00

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development	126.00	0	189.00	189.00	63.00	63.00	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Travel	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	2.5	0	3.8	3.8	1.3	1.3	0	0
TOTAL COST	126.00	0	189.00	189.00	63.00	63.00	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance					0	88.20	37.80	151.20
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Travel					0	0	0	0
LABOR COST								
MANPOWER					0	1.8	.8	3.0
TOTAL COST					0	88.20	37.80	151.20

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Travel	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
TOTAL COST	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 Experiment Processor Acquisition								
(1) Processor Hardware					714.00	255.00	612.00	204.00
(2) Qualification					7284.20	2601.50	6243.60	2081.20
(3) Special Test Equipment					70.00	25.00	60.00	20.00
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST					8068.20	2881.50	6915.60	2305.20

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 Experiment Processor Acquisition								
(1) Processor Hardware	102.00	0	153.00	153.00	51.00	51.00	0	0
(2) Qualification	1040.60	0	1560.90	1560.90	520.30	520.30	0	0
(3) Special Test Equipment	10.00	0	15.00	15.00	5.00	5.00	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST	1152.60	0	1728.90	1728.90	576.30	576.30	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 Experiment Processor Maintenance								
(1) Maintenance					57.12	73.44	81.60	85.68
(2) Distribution					0	0	0	0
(3) Re-Furbishment					0	0	0	0
LABOR COST								
MANPOWER					1.1	1.5	1.6	1.7
TOTAL COST					57.12	73.44	81.60	85.68

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 Experiment Processor Hardware								
(1) Maintenance	81.60	130.56	81.60	134.64	89.76	130.56	130.56	142.80
(2) Distribution	0	0	0	0	0	0	0	0
(3) Re-Furbishment	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	1.6	2.6	1.6	2.7	1.8	2.6	2.6	2.9
TOTAL COST	81.60	130.56	81.60	134.64	89.76	130.56	130.56	142.80

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP Software								
(1) Operating System Development					5600.00	2000.00	4800.00	1600.00
(2) Support Software Procurement					770.00	275.00	660.00	220.00
LABOR COST					5600.00	2000.00	4800.00	1600.00
MANPOWER					112.0	40.0	96.0	32.0
TOTAL COST					6370.00	2275.00	5460.00	1820.00

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP Software								
(1) Operating System Development	800.00	0	1200.00	1200.00	400.00	400.00	0	0
(2) Support Software Procurement	110.00	0	165.00	165.00	55.00	55.00	0	0
LABOR COST	800.00	0	1200.00	1200.00	400.00	400.00	0	0
MANPOWER	16.0	0	24.0	24.0	8.0	8.0	0	0
TOTAL COST	910.00	0	1365.00	1365.00	455.00	455.00	0	0

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance					126.00	162.00	180.00	189.00
(2) Distribution					0	0	0	0
LABOR COST								
MANPOWER					2.5	3.2	3.6	3.8
TOTAL COST					126.00	162.00	180.00	189.00

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance	180.00	288.00	180.00	297.00	198.00	288.00	288.00	315.00
(2) Distribution	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	3.6	5.8	3.6	5.9	4.0	5.8	5.8	6.3
TOTAL COST	180.00	288.00	180.00	297.00	198.00	288.00	288.00	315.00

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OPTION IIA4 ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.1 Real-Time Simulation Test Set (RTSTS) Acquisition								
(1) Engineering Design								
(2) Simulation Computer								
(3) Dedicated Experiment Processor (DEP) Interface					4620.00	1650.00	396.00	1320.00
(4) RTSTS Integration								
(5) Consumable Stock					0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST					4620.00	1650.00	396.00	1320.00

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.1 Real-Time Simulation Test Set (RTST) Acquisition								
(1) Engineering Design								
(2) Simulation Computer								
(3) Dedicated Experiment Processor (DEP) Interface	660.00	0	990.00	990.00	330.00	330.00	0	0
(4) RTSTS Integration								
(5) Consumable Stock	0	0	0	0	0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST	660.00	0	990.00	990.00	330.00	330.00	0	0

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OPTION IIA4 ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.2 RTSTS Maintenance, Operation & Distribution								
(1) Maintenance					210.00	270.00	300.00	315.00
(2) Distribution					0	0	0	0
(3) Operation					---	---	---	---
(4) Special Purpose Equipment					---	---	---	---
(5) Consumables					171.50	220.50	245.00	257.25
(6) Re-Furbishment					---	---	---	---
(7) Facility Modifications					0	0	0	0
LABOR COST					210	270	300	315
MANPOWER					4.2	5.4	6.0	6.3
TOTAL COST					381.50	490.50	545.00	572.25

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OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.2 RTSTS Maintenance Operation & Distribution								
(1) Maintenance	300.00	480.00	300.00	495.00	330.00	480.00	480.00	525.00
(2) Distribution	0	0	0	0	0	0	0	0
(3) Operation	---	---	---	---	---	---	---	---
(4) Special Purpose Equipment	245.00	392.00	245.00	404.25	269.50	392.00	392.00	428.75
(5) Consumables	---	---	---	---	---	---	---	---
(6) Re-Furbishment	0	0	0	0	0	0	0	0
(7) Facility Modifications								
LABOR COST	300	480	300	495	330	480	480	525
MANPOWER	6.0	9.6	6.0	9.9	6.6	9.6	9.6	10.5
TOTAL COST	545	872	545	899.25	599.50	872	872	953.75

EF-One Time Form 4 (March 25, 1976)

OPTION IIA4 ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.3 RTSTS Support Software Development & Procurement								
(1) Simulation Computer Software Development					4872.00	1740.00	4176.00	1392.00
(2) Simulation Computer Software Procurement					56.00	20.00	48.00	16.00
LABOR COST					4872.00	1740.00	4176.00	1392.00
MANPOWER					97.4	34.8	83.5	27.8
TOTAL COST					4928.00	1760.00	4224.00	1408.00

EF-One Time Form 3 (March 25, 1976)

OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.3 RTSTS Support Software Development & Procurement								
(1) Simulation Computer Software Development	696.00	0	1044.00	1044.00	348.00	348.00	0	0
(2) Simulation Computer Software Procurement	8.00	0	12.00	12.00	4.00	4.00	0	0
LABOR COST	696.00	0	1044.00	1044.00	348.00	348.00	0	0
MANPOWER	13.9	0	20.9	20.9	7.0	7.0	0	0
TOTAL COST	704.00	0	1056.00	1056.00	352.00	352.00	0	0

EF-One Time Form 4 (March 25, 1976)

OPTION IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.4 RTSTS Support Software Maintenance & Distribution								
(1) Maintenance					700.00	900.00	1000.00	1050.00
(2) Distribution					0	0	0	0
LABOR COST								
MANPOWER					14.0	18.0	20.0	21.0
TOTAL COST					700.00	900.00	1000.00	1050.00

EF-One Time Form 3 (March 25, 1976)

OPTION: IIA4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.4 RTSTS Support Maintenance & Distribution								
(1) Maintenance	1000.00	1600.00	1000.00	1650.00	1100.00	1600.00	1600.00	1750.00
(2) Distribution	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER	20.0	32.0	20.0	33.0	22.0	32.0	32.0	35.0
TOTAL COST	1000.00	1600.00	1000.00	1650.00	1100.00	1600.00	1600.00	1750.00

EF-One Time Form 4 (March 25, 1976)

SECTION 7 Option IIB1 - Distributed Standard Mini, Central Software Development by Central Group

7.1 Costing Method

ASSUMPTIONS

- All experiment application dependent software will be implemented in DEP's.
- STIL facility used for all EAS software development.
- DEP is available at Level 4 checkout area.
- Common library evolvement possible due to central EAS development group.
- Only one mini development/qualification required.
- Only one RTSTS required for STIL software development.
- No PI/PI integration required due to independence of EAS from resource sharing. Central computer integration testing still required.
- Fewer total mini's required due to sharing of pool of processors.
- Only one DEP operating system development is required.

Cost Element 4.1 Experiment Application Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel
8. Training

(1) Software Development

(A) = ((Number of Statements) (Cost/Statement)) Per Flight Per Yr.

Number of Statements = GDC Estimate = ((New Flights) - (Previous Yr. Common)) Per Yr.

Cost/Statement = $45 (Requirements, Code, and Verification) $15 Per Statement is Applied to Integrated Verification (See 4.3 (1))

(1) Total = ((#10) ($45)) Per Yr.

(2) Common Software

(A) = ((Number of Statements) (Cost/Statement)) Per Yr. for 5 Yrs. Starting in FY81.

Number of Statements = 10% of new Development per Flight per year. Reducing 2% per year to 0% - Yearly Totals are Accumulative and Accumulated Total is Subtracted from Subsequent Years Required Development.

Cost/Statement = $5 (Document and Place in Library)

(2) Total = ((#5) ($5)) Per Yr.

(3) Host Computer Time

(A) = ((Host Time) (Cost/Hr.)) Per New Flight Per Yr.

Host Time = ((# of Instructions) ÷ ((# Instructions/Module)

(Hrs. /Module))

= (# of Modules) (Hrs. /Module)

Hrs. /Module = 18 Compiles/Module @ 3 Mins. /Compile
+ 9 Functional Simulations @ 12 Mins. /
Run + 1 Data Reduction for 75% of
Simulation Runs @ 10 Mins. Each

= (54 Mins.) + (108 Mins.) + (70 Mins.)

= 3.87

Host Cost/Hr. = ((10% Maintenance) + (Operations)
+ (Consumables)) ÷ (2080 Hrs. /Shift)

= (2.43) + (57.69) + (63.05) = $123.22/Hr.

# of Modules = #10 ÷ 100

(3) Total = (3.87) (#10 ÷ 100) ($123.22)/Yr.

(4) Simulation Computer Time

(A) = (# of Hrs. /Module) (Cost/Hr.) (# of Modules)

# of Hrs. = 4 Simulations at 60 Min. /Simulation
(Includes Set-Up, Runs, and Run Evaluations)

Cost/Hr. = ((10% (Maintenance (CDMS, CID,
SIMULATION COMPUTER)) + (Consumables)
+ (Operations)) ÷ 2080 Hrs.

= ($8) + (0) + ((2) ($40K)) ÷ 2080

= ($8) + ($38.46)

= $46.46/Hr.

# of Modules = #8 + #9

(4) Total = (($46.46) (#8 + #9) (4 Hrs.)) Per Yr.

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr.)) Per Flight/Yr.

(5) Total = 0 for This Option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs.) (Cost/Hr.) (# of Modules)) Per Flight/Yr.

(6) Total = 0 for This Option

(7) Travel

(A) = ((Number of Man Yrs.) (Travel Cost/Man Yr.))/Yr.

(7) Total = 0 for This Option

(8) Training

(A) = (Number of Programmers) (Cost/Programmer)

(8) Total = 0 for This Option

Cost Element 4.2 Experiment Application Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel

(1) Experiment Unique Software

(A) = (# of Statements) (Rate of Change) (Cost/Statement)

(Number of Statements) (Rate of Change) = #13

Rate of Change = Engineering Estimate Based on Past Programs = 40% for 1st Re-Fly, 30% for 2nd Re-Fly, 20% for 3rd Re-Fly, 10% for all Subsequent Re-Flys.

Cost/Statement = $45 (See 4.1 for Rationale)

(1) Total = ((#13) ($45)) Per Yr.

(2) Experiment Common Software

(A) = ((# of Statements) (Change Rate) (Cost/Statement)) Per Yr.

Rate of Change = Engineering Estimate = 1%

Cost/Statement = $60 (Due to Verification Necessary for Multi-Use)

(2) Total = ((#6) (1%) ($60)) Per Yr.

(3) Host Computer Time

(A) = (# Modules) (# Hrs. /Module) (Cost/Hr.)

Modules = #13 ÷ 100

Hrs. /Module = 3.87 (See 4.1 for Rationale)

Cost/Hr. = $123.22 (See 4.1 for Rationale)

(3) Total = ((#13 ÷ 100) (3.87) ($123.22)) Per Yr.

(4) Simulation Computer Time

(A) = ((# Modules) (# of Hrs. /Module) (Cost/Hr.)) Per Yr.

Modules = #13 ÷ 100

Hrs. /Module = 4 Hrs. (See 4.1 for Rationale)

(4) Total = ((#13 ÷ 100) (4) ($46.46)) Per Yr.

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr.)) Per Yr.

(5) Total = 0 for This Option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs.) (Cost/Hr.) (# Modules)) Per Yr.

(6) Total = 0 for This Option

(7) Travel

(A) = ((# Man Yrs.) (Travel Cost/Man Yr.)) Per Yr.

(7) Total = 0 for This Option

Cost Element 4.3 EAS Software Integrated Verification

Cost Factors

1. Integrated Verification
2. Host Computer Time
3. Simulation Computer Time
4. Integrated Verification Simulation Software

(1) Integrated Verification

(A)= ((# of Modules) (Cost/Module)) Per Flight/Yr.

(1) Total = 0 for This Option

(2) Host Computer Time

(A) = (# Hrs.) (Cost/Hr.)

(2) Total = 0 for This Option

(3) Simulation Hardware Time

(A) = (# Hrs./Module) (Cost/Hr.) (# Module)

(3) Total = 0 for This Option

(4) Integrated Verification Simulation Software

(A) = ((# of Modules) (Cost/Module)) Per Yr.

(4) Total = 0 for This Option

Cost Element 4.4 Preflight Checkout Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Software Development

(A) = ((Number of HOL Statements) (Cost/Statement)) Yr.

(1) Total = ((#22) ($30))/Yr.

(2) Common Software

(2) Total = 0 for This Element

(3) Host Computer Time

Host Computer Time = ((Host Time)) (Cost/Hr.)
Ref. 4.1 (3)

(A) = ((3.87) (# Modules) ($123.22))/Yr.

(3) Total = ((3.87) (#22 ÷ 100) ($123.22)) Per Yr.

(4) Simulation Computer Time

(A) = (# Hrs./Module) (Cost/Hr.) (# Modules)
Ref. 4.1 (4)

(4) Total = (4) ($46.46) (#22 ÷ 100) Per Yr.

(5) Travel

(5) Total = 0 for This Option

PREFLIGHT SOFTWARE SIZING RATIONALE

Saturn History

LVDC/DA interface signals	=	86
LVDC/DA # instructions	=	4,650
average # instructions/signal	=	54

ATM History

ATMDC interface signals	=	275
ATMDC # instructions	=	7,897
average # instructions/signal	=	29

Mission 8 of Spacelab

# interface signals	=	81.6
# payload elements	=	1.3
average # interface signals	=	62.77

Assume preflight job for each payload element is the same and equivalent to Saturn LVDC = 4,650 instructions.

$= \frac{4,650}{5} = 930$ HOL statements at a cost of $30/Statement.

Number of Statements = Number of HOL Statements per Payload Element X # Payload Elements = 930 X PE/Yr. (New Flight)

Cost/Statement = $30

Cost Element 4.5 Preflight Checkout Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Experiment Unique Software

(A) = ((# of Statements) (Change Rate) (Cost/Statement))/Yr.

Number of Statements = #23

Cost of Statement = $30 Ref. 4.4 (1)

(1) Total = ((#23) ($30)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 for This Element

(3) Host Computer Time

(A) = (Host Time) (Cost/Hr.)

(A) = ((# Modules) (3.87) ($123.22)) Ref. 4.2 (3)

(3) Total = (#23 ÷ 100) (3.87) ($123.22)

(4) Simulation Computer Time

(A) = (Simulation Computer Time) (Cost/Hr.)

(A) = ((# Modules ÷ 100) (4) ($46.46)

(4) Total = ((#23 ÷ 100) (4) ($46.46) Ref. 4.2 (4)

(5) <u>Travel</u>

(A) = (Number of Man Yrs.) ($9,725)/Yr.

(5) Total = 0 for This Option

Cost Element 4.6 EAS Dependant STIL Hardware Modifications

Cost Factors

1. Host Main Memory
2. Remote Job Entry (RJE)
3. Display Terminals
4. Maintenance Added Hardware

(1) Host Main Memory

(A) = (GSA Price) (Memory Size)

(1) Total = 0 for This Option

(Has Been Sized In Host Hardware)

(2) RJE

(A) = (GSA Price) (# RJE)

(2) Total = 0 for This Option

(3) Display Terminals

(A) = (GSA Price) (# Terminals)

GSA Price = $989

Terminals = 8

6 Prog. /1 Terminal

Total Required # of People = 48

(3) Total = ($989) (8) = $7,912

(4) Maintenance Added Hardware

(A) = GSA

(4) Total = ((8) ($66)) = $528 Per Yr.

Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factors

1. Software Development

2. Host Computer Time

3. Simulation Computer Time

4. Travel

(1) Software Development

(A) = (# of Statements) (Cost/Statement))

# of Statements = #24

Cost/Statement = $45 Due to Less Documentation and no Integration.

(1) Total = ((#24) ($45)) Per Yr.

(2) Host Computer Time

(A) = Ref. 4.1 (5)

Modules = #24 ÷ 100

(2) Total = (1.4) (#24 ÷ 100) ($123.22)) Per Yr.

(3) Simulation Computer Time

(A) = Ref. 4.1 (6)

Modules = (#24 ÷ 100)

(3) Total = ((7) (#24 ÷ 100) ($46.46)) Per Yr.

(4) Travel

(A) = ((# of Man Yrs.) ($9,725)) Per Yr.

(4) Total = 0 for This Option

Rationale for Simulation Software Required for Payload Elements

Engineering Estimate - 21K Table Words Per Payload Element for Simulation Software.

Engineering Estimate that 21K Table Words Equates to Approximately 1/3 X 21K = 7K Machine Language Instructions.

7K ÷ 5 = 1.4K HOL Statements

1.4K X $45/Statement = $63K/Payload Element

Cost Element 4.9 Experiment Real-Time Simulation Software Maintenance

Cost Factors

1. Maintenance

2. Host Computer Time

3. Simulation Computer Time

4. Travel

(1) Maintenance

(A) = (# of Statements) (Change Rate) (Cost/Statement)

# of Statements = 1.4K X Payload Elements/Yr. (Maintenance Flights)

(# of Statements) (Change Rate) = #25

Change Rate = Engineering Estimate = 10%/Flight

Cost/Statement = $45 Same as 4.8 (1)

(1) Total = ((#25) ($45)) Per Yr.

(2) Host Computer Time

(A) = Ref. 4.8 (2)

(2) Total = ((1.4) (#25 ÷ 100) ($123.22)) Per Yr.

(3) Simulation Computer Time

(A) = Ref. 4.8 (3)

(3) Total = ((7) (#25 ÷ 100) ($46.46)) Per Yr.

(4) Travel

(A) = ((# Man Yrs.) ($9,725)) Per Yr.

(4) Total = 0 for This Option

C.2

Cost Element 5.1 Experiment Processor Acquisition

Cost Factors

1. Processor (I/O Included)

2. Qualification

3. Special Test Equipment

(1) Processor

(A) = ((Number of Processors) (Cost/Processor)) Per Flight Per Yr.

# of Processors = #34

Cost/Processor = $46K

(1) Total = ((#34) ($46K)) Per Yr.

(2) Qualification

(A) = ((# Qualifications) (Cost/Qualification)) Per Yr.

Cost/Qualification = $520.3K

(2) Total = ((1) ($520.3K)) Per Yr. (1 Time Cost)

(3) Special Test Equipment

Engineering Estimate = $5K/Unit

(# Units) ($5K) Per Yr.

(3) Total = ((#34) ($5K)) Per Yr.

GROUNDRULES FOR DEDICATED EXPERIMENT PROCESSOR

I. Central Experiment Computer Capacity = (Speed) and (Memory)

Speed = (500K Adds Per Second) (65%) 325 KADS

500 KADS = CII Specifications

65% = 100% - (15% Overhead) = (20% Contingency)

Memory = (Total Capacity) - (Contingency) - (Operating System)

Total Capacity = 64K CII Specifications

Contingency = 30% Engineering Estimate

Note: Low Compared to Industry Estimates (50% - 100%)

Operating System = 20K Memory Requirement ESA Estimate

(A) = 64K - 19.2K - 20K
= 24.8K

II. When a new payload exceeds central computer capacity, a DEP will be selected for the element that has the greatest capacity requirement. Each element having this requirement will be assigned a different DEP, except the case where one DEP is used on multiple missions.

III. Assume all Spacelab Review Item Disposition (RID's) for CDMS modifications are incorporated for mass memory, data bus, etc.

IV. Two classes of DEP's were considered:

(1) Micro Processor

(2) Mini Processor

Only 1 DEP will be specified.

V. Assume any non-standard DEP's selected will have support software that is executable on STIL host or STIL simulation computer.

VI. For any mission, assume that the required number of data bus RAU's can be provided.

ORIGINAL PAGE IS
POOR QUALITY

VII. Number of processors is determined by applying "Groundrules for DEP" to GDC provided software requirements.

Cost/Processor is determined by: processor class and configuration.

((Processor Hardware) + (Qualification) (Special I/O (RAU Equivalent) + (Special Test Equipment) + (Peripherals*) + (Peripherals Qualification))

Each element will be determined according to selected processor class and configuration.

*For Option IA1 only applies when central computer cannot support requirements.

Cost Element 5.2 Experiment Processor Maintenance

Cost Factor

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. for Each Yr. Used

(1) Total = ((8% ($46K)) (#35)) Per Yr.

(2) Distribution

(2) Total = (($500) (#36)) Per Yr.

(3) Re-Furbishment

(A) = ((Number of DEP's) (Cost/Unit for Re-Furbishment)) Per Flight Per Yr.

Number of DEP's = Determined from Mission Model Requirements

Cost/Unit for Re-Furbishment = 0

Assume DEP's will meet Spacelab Lifetime Requirements

(3) Total = 0 for This Option

Cost Element 5.3 DEP Software

Cost Factors

1. Operating System Development

2. Support Software Development

(1) Operating System Development

(A) = ((Number of Instructions) (Cost/Per Instruction))

(Number of DEP's)

Number of Instructions = 4K Engineering Estimate (M&S Study)

Number of DEP's = #26

Cost Per Instruction = $100 Assembly Language

(1) Total = (4K) ($100) = $400K (1 Time Cost)

(2) Support Software Development

(A) = (Vendor Lease) or ((Number of Statements) (Cost Per Statement) (Number of DEP's)

Number of DEP's = #26

Assume Vendor Lease - $25K For Cross Assembler
$25K For Cross Compiler
$50K (Engineering Estimate)

(2) Total = $50K (1 Time Cost)

Cost Element 5.4 DEP Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement)

Number of Statements =	4.0K	Operating System
	2.4K	Cross Assembler
	9.0K	Cross Compiler
Total	15.4K	(Engineering Estimate)

#27 = # of DEP's Used Per Yr.

Rate of Change = 5% Per Yr. When Used - Engineering Estimate

Cost Per Statement = $45

(1) Total = $34.65K Per Yr.

(2) Distribution

(2) Total = ($50) (#36)) Per Yr.

Cost Elements 6.1, 6.2, 6.3, 6.4, & 7 - Real-Time Simulation Test Set (Not Required for This Option - Use STIL)

SECTION 7 - Option IIB1 - Distributed Standard Mini, Central Software Development by Central Group

7.2 Cost Data

OPTION IIB1 TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				------	255.43	760.34	362.13	39.01
4.2				------	0	174.23	230.55	412.10
4.3				------	0	0	0	0
4.4				------	476.89	170.31	510.94	136.25
4.5				------	0	47.69	20.44	81.75
4.6				------	400.91	.53	.53	.53
4.7				------	------	------	------	------
4.8				------	978.55	349.85	1049.53	279.87
4.9				------	0	97.95	41.62	167.93
5.1				1234.30	204.00	102.00	51.00	510.00
5.2				------	58.52	69.24	85.60	78.60
5.3				------	450.00	0	0	0
5.4				------	35.35	34.95	35.85	35.15
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL				1234.30	2859.65	1807.09	2388.19	1741.19
ESCALATED TOTAL				1617.92	4010.81	2711.95	3834.91	2991.69

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OPTION IIB1 TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	122.72	0	172.25	158.38	45.02	48.48	0	0
4.2	277.35	403.53	206.25	298.33	291.72	305.37	407.96	374.20
4.3	0	0	0	0	0	0	0	0
4.4	68.13	0	102.18	102.18	34.06	34.06	0	0
4.5	91.97	149.87	102.18	170.31	132.85	180.53	183.94	218.0
4.6	.53	.53	.53	.53	.53	.53	.53	.53
4.7	------	------	------	------	------	------	------	------
4.8	139.94	0	209.91	209.91	69.97	69.97	0	0
4.9	188.91	308.13	209.91	349.85	271.33	370.83	377.83	477.80
5.1	0	0	0	0	0	0	0	0
5.2	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
5.3	0	0	0	0	0	0	0	0
5.4	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL	1007.53	1028.05	1124.11	1452.90	968.96	1173.56	1111.80	1234.70
ESCALATED TOTAL	1852.30	2022.33	2366.08	3272.21	2335.04	3026.06	3067.49	3645.04

TOTAL COST	19, 132.03
ESCALATED TOTAL COST	36,753.83

AVERAGE COST PER FLIGHT 162.63

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OPTION IIB1 TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				------	4.4	13.3	6.3	.7
4.2				------	0	3.	4.	7.2
4.3				------	0	0	0	0
4.4				------	7.8	2.8	8.4	2.2
4.5				------	0	.8	.3	1.3
4.6				------	------	------	------	------
4.7				------	------	------	------	------
4.8				------	17.6	6.3	18.9	5.0
4.9				------	0	1.8	.8	3.
5.1				------	------	------	------	------
5.2				------	1.2	1.4	1.7	1.6
5.3				8.0	0	0	0	0
5.4				------	.7	.7	.7	.7
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL MANPOWER				8.0	31.7	30.1	41.1	21.7

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OPTION IIB1 TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	2.1	0	3.0	2.8	.8	.8	0	0
4.2	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
4.3	0	0	0	0	0	0	0	0
4.4	1.1	0	1.7	1.7	.6	.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
4.6	------	------	------	------	------	------	------	------
4.7	------	------	------	------	------	------	------	------
4.8	2.5	0	3.8	3.8	1.3	1.3	0	0
4.9	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
5.1	------	------	------	------	------	------	------	------
5.2	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
5.3	0	0	0	0	0	0	0	0
5.4	.7	.7	.7	.7	.7	.7	.7	.7
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL MANPOWER	17.8	18.3	20.0	25.9	17.4	21.0	19.7	21.5

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
1. Experiment Application Software Development								
(1) Software Development					222.3	656.82	313.52	33.48
(2) Common Software					0	6.58	2.23	.23
(3) Host Computer Time					23.84	69.62	33.38	3.81
(4) Simulation Computer Time					9.29	27.32	13.00	1.49
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	0	0	0
(8) Training					0	0	0	0
LABOR COST					222.30	663.40	315.75	33.71
MANPOWER					4.4	13.3	6.3	.7
TOTAL COST					255.43	760.34	362.13	39.01

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OPTION IIB1 ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
1. Experiment Application Software Development								
(1) Software Development	106.34	0	149.72	137.84	39.06	41.85	0	0
(2) Common Software	.48	0	0	0	0	0	0	0
(3) Host Computer Time	11.44	0	16.21	14.78	4.29	4.77	0	0
(4) Simulation Computer Time	4.46	0	6.32	5.76	1.67	1.86	0	0
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	0	0	0	0	0	0	0	0
(8) Training	0	0	0	0	0	0	0	0
LABOR COST	106.82	0	149.72	137.84	39.06	41.85	0	0
MANPOWER	2.1	0	3.0	2.8	.8	.8	0	0
TOTAL COST	122.72	0	172.25	158.38	45.02	48.48	0	0

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software					0	151.70	199.94	358.02
(2) Experiment Common Software					0	0	0.79	1.06
(3) Host Computer Time					0	16.21	21.46	38.15
(4) Simulation Computer Time					0	6.32	8.36	14.87
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	0	0	0
LABOR COST					0	151.70	200.73	359.08
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	174.23	230.55	412.10

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software	240.48	350.69	178.61	258.75	252.81	265.14	354.47	325.31
(2) Experiment Common Software	1.08	1.14	1.14	1.14	1.14	1.14	1.14	1.14
(3) Host Computer Time	25.75	37.20	19.07	27.66	27.18	28.13	37.67	34.18
(4) Simulation Computer Time	10.04	14.50	7.43	10.78	10.59	10.96	14.68	13.57
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	0	0	0	0	0	0	0	0
LABOR COST	241.56	351.83	179.75	259.89	253.95	266.28	355.61	326.45
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
TOTAL COST	277.35	403.53	206.25	298.33	291.72	305.37	407.96	374.20

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS Software Integrated Verification								
(1) Integrated Verification					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Integrated Verification Simulation Software					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS Software Integrated Verification								
(1) Integrated Verification	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Integrated Verification Simulation Software	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 Preflight Checkout Software Development								
(1) Software Development					390.60	139.50	418.50	111.60
(2) Common Software					0	0	0	0
(3) Host Computer Time					62.09	22.17	66.52	17.74
(4) Simulation Computer Time					24.20	8.64	25.92	6.91
LABOR COST					390.60	139.50	418.50	111.60
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					476.89	170.31	510.94	136.25

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 Preflight Checkout Software Development								
(1) Software Development	55.80	0	83.70	83.70	27.90	27.90	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	8.87	0	13.30	13.30	4.43	4.43	0	0
(4) Simulation Computer Time	3.46	0	5.18	5.18	1.73	1.73	0	0
LABOR COST	55.80	0	83.70	83.70	27.90	27.90	0	0
MANPOWER	1.1	0	1.7	1.7	.6	.6	0	0
TOTAL COST	68.13	0	102.18	102.18	34.06	34.06	0	0

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software					0	39.06	16.74	66.96
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	6.21	2.66	10.64
(4) Simulation Computer Time					0	2.42	1.04	4.15
(5) Travel					0	0	0	0
LABOR COST					0	39.06	16.74	66.96
MANPOWER					0	.8	.3	1.3
TOTAL COST					0	47.69	20.44	81.75

OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	11.97	19.51	13.30	22.17	17.30	23.50	23.95	28.38
(4) Simulation Computer Time	4.67	7.60	5.18	8.64	6.74	9.16	9.33	11.06
(5) Travel	0	0	0	0	0	0	0	0
LABOR COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	91.97	149.87	102.18	170.31	132.85	180.53	183.94	218.00

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory					393.00	------	------	------
(2) Remote Job Entry					0	0	0	0
(3) Display Terminals					7.91	------	------	------
(4) Maintenance					------	.53	.53	.53
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST					400.91	0.53	0.53	0.53

OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory	------	------	------	------	------	------	------	------
(2) Remote Job Entry	0	0	0	0	0	0	0	0
(3) Display Terminals	------	------	------	------	------	------	------	------
(4) Maintenance	.53	.53	.53	.53	.53	.53	.53	.53
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
MANPOWER								
TOTAL COST								

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development					882.0	315.0	945.0	252.0
(2) Host Computer Time					33.81	12.08	36.23	9.66
(3) Simulation Computer Time					62.74	22.77	68.30	18.21
(4) Travel					0	0	0	0
LABOR COST					882.00	315.00	945.00	252.00
MANPOWER					17.6	6.3	18.9	5.0
TOTAL COST					978.55	349.85	1049.53	279.87

OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development	126.0	0	189.0	189.0	63.0	63.0	0	0
(2) Host Computer Time	4.83	0	7.25	7.25	2.42	2.42	0	0
(3) Simulation Computer Time	9.11	0	13.66	13.66	4.55	4.55	0	0
(4) Travel	0	0	0	0	0	0	0	0
LABOR COST	126.00	0	189.00	189.00	63.00	63.00	0	0
MANPOWER	2.5	0	3.8	3.8	1.3	1.3	0	0
TOTAL COST	139.94	0	209.91	209.91	69.97	69.97	0	0

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance					0	88.20	37.80	151.20
(2) Host Computer Time					0	3.38	1.45	5.80
(3) Simulation Computer Time					0	6.37	2.37	10.93
(4) Travel					0	0	0	0
LABOR COST					0	88.20	37.80	151.20
MANPOWER					0	1.8	.8	3.0
TOTAL COST					0	97.95	41.62	167.93

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance	170.10	277.20	189.00	315.00	245.7	333.9	340.2	403.2
(2) Host Computer Time	6.52	10.63	7.25	12.08	7.87	12.80	13.04	15.46
(3) Simulation Computer Time	12.29	20.30	13.66	22.77	17.76	24.13	24.59	29.14
(4) Travel	0	0	0	0	0	0	0	0
LABOR COST.	170.10	227.20	189.00	315.00	245.70	333.90	340.20	403.20
MANPOWER	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
TOTAL COST	188.91	308.13	209.91	349.85	271.33	370.83	377.83	447.80

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 Experiment Processor Acquisition								
(1) Processor Hardware				644.00	184.00	92.00	46.00	460.00
(2) Qualification				520.30				
(3) Special Test Equipment*				70.00	20.00	10.00	5.00	50.00
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST				0	0	0	0	0
MANPOWER				0	0	0	0	0
TOTAL COST				1234.30	204.00	102.00	51.00	510.00

OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 Experiment Processor Acquisition								
(1) Processor Hardware	0	0	0	0	0	0	0	0
(2) Qualification								
(3) Special Test Equipment*	0	0	0	0	0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 Experiment Processor Maintenance								
(1) Maintenance					51.52	66.24	73.60	73.60
(2) Distribution					7.00	3.00	12.00	5.00
(3) Re-Furbishment					0	0	0	0
LABOR COST					58.52	69.24	85.60	78.60
MANPOWER					1.2	1.4	1.7	1.6
TOTAL COST					58.52	69.24	85.60	78.60

OPTION IIB1 ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 Experiment Processor Maintenance								
(1) Maintenance	77.28	121.44	73.60	117.76	77.28	121.44	103.04	125.12
(2) Distribution	5.50	9.00	11.50	10.00	10.50	7.00	3.50	4.00
(3) Re-Furbishment	0	0	0	0	0	0	0	0
LABOR COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
MANPOWER	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
TOTAL COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP Software Development & Procurement								
(1) Operating System Development					400.00	0	0	0
(2) Support Software Procurement					50.00	0	0	0
LABOR COST					400.00	0	0	0
MANPOWER					8.0	0	0	0
TOTAL COST					450.00	0	0	0

OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP Software Development & Procurement								
(1) Operating System Development	0	0	0	0	0	0	0	0
(2) Support Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance					34.65	34.65	34.65	34.65
(2) Distribution					0.70	0.30	1.20	0.50
LABOR COST					35.35	34.95	35.85	35.15
MANPOWER					.7	.7	.7	.7
TOTAL COST					35.35	34.95	35.85	35.15

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OPTION IIB1 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance	34.65	34.65	34.65	34.65	34.65	34.65	34.65	34.65
(2) Distribution	0.55	0.90	1.15	1.00	1.05	0.70	0.35	0.40
LABOR COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
MANPOWER	.7	.7	.7	.7	.7	.7	.7	.7
TOTAL COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05

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SECTION 8 Option IIB2A - Distributed Standard Mini Central Software Development by PI Local.

8.1 Costing Method

ASSUMPTIONS

- All experiment application dependent software will be implemented in DEP's.
- STIL facility used for all EAS software development.
- PI travels to STIL for software development.
- DEP is available at Level 4 checkout area.
- Common library evolvement is not possible due to independent PI development.
- Only one mini development/qualification required.
- Only one RTSTS required for software development.
- No PI/PI integration required due to independence of EAS from resource sharing. Central computer integration testing is still required.
- Fewer total mini's required due to sharing of pool of processors.
- Only one DEP operating system development is required.

Cost Element 4.1 Experiment Application Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel
8. Training

(1) Software Development

(A) = ((Number of Statements) (Cost/Statement)) Per Flight Per Yr.

Number of Statements = GDC Estimate = #3 + #4

Cost/Statement = $45 (Code and Verification)

(1) Total = ((#3 + #4) ($45)) Per Yr.

(2) Common Software

(2) Total = 0 for This Option

(3) Host Computer Time

(A) = ((Host Time) (Cost/Hr.)) Per New Flight Per Yr.

Host Time = ((# Instructions) (# Instructions/ Module)) (Hrs. /Module)

= (# of Modules) (Hrs. /Module)

Hrs. /Module = 18 Compiles/Module @ 3 Mins. / Compile + 9 Functional Simulations @ 12 Mins. / Run + Data Reduction for 75% of Simulation Runs @ 10 Mins. Each.

= (54 Mins.) + (108 Mins.) + (70 Mins.) = 3.87 Hrs.

Host Cost/Hr. = ((10% Maintenance) + (Operations) + (Consumables)) ÷ 2080 Hrs. /Shift

= $123.22/Hr.

(3) Total = ((3.87) ((#3 + #4) ÷ 100) ($123.22)) Per Yr.

(4) <u>Simulation Computer Time</u>

(A) = (# of Hrs. /Module) (Cost/Hr.) (# of Modules)

# of Hrs. = 4 Simulations at 60 Min. /Simulation (Includes Set Up, Runs, and Run Evaluations)

Cost/Hr. = (10% (Maintenance (CDMS, CID, SIM. COMP.)) + Consumables) + (Operations)) 2080 Hrs.

= ($8) + (0) + ((2 X $40K) ÷ 2080)

= ($8) + ($38.46).

= $46.46/Hr.

# of Modules = GDC Estimate = (#3 + #4) ÷ 100

(4) Total = (($46.46) ((#3 + #4) ÷ 100) (4 Hrs.)) Per Yr.

(5) <u>Host Computer Time DEP Software</u>

(5) Total = 0 for This Option

(6) Simulation Computer Time DEP Software

(6) Total = 0 for This Option

(7) Travel

(A) = (Number of Man Yrs.) (Travel Cost/Man Yr.)/Yr.

Number of Man Yrs. = Number of Man Yrs. Required as Determined by Number of New Instructions.

Travel/Man Yr. = (Number of Trips) (Cost of Ticket) + (Number of Days) (Cost Day)

Number of Trips = 4 Per Man/Yr.

Cost of Ticket = $150

Cost/Day = $12.50 Per Diem + $12.50 For Car = $25

Number of Days = 365

Travel = 4 ($150) + (365) (25)

= $600 + $9,125 = $9,725/Man Yr.

(7) Total = ((#16) ($9,725))/Yr.

(8) Training

(A) = (Number of Programmers) (Cost/Programmer)

Number of Programmers = Number of Programmers Required by Number of New Instructions

Cost of Programmer = Engineering Estimate $500/Man

(8) Total = (#16) ($500)

Cost Element 4.2 Experiment Application Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel

(1) Experiment Unique Software

(A) = (# of Statements) (Rate of Change) (Cost/Statement)

(Number of Statements) (Rate of Change) = #13

Rate of Change = Engineering Estimate Based on Past Programs = 40% for 1st Re-Fly, 30% for 2nd Re-Fly, 20% for 3rd Re-Fly, 10% for all Subsequent Re-Flys.

Cost/Statement = $45 (See 4.1 for Rationale)

(1) Total = ((#13) ($45)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 for This Option

(3) Host Computer Time

(A) = (# Modules) (# Hrs./Module) (Cost/Hr.)

Modules = #13 ÷ 100

Hrs. /Module = 3.87 (See 4.1 for Rationale)

Cost/Hr. = $123.22 (See 4.1 for Rationale)

(3) Total = ((#13 ÷ 100) (3.87) ($123.22)) Per Yr.

(4) Simulation Computer Time

(A) = ((# Modules) (# of Hrs. /Module) (Cost/Hr.)) Per Yr.

Modules = #13 ÷ 100

Hrs. /Module = 4 Hrs. (See 4.1 for Rationale)

Cost/Hr. = $46.46 (See 4.1 for Rationale)

(4) Total = ((#13 ÷ 100) (4) ($46.46)) Per Yr.

(5) Host Computer Time DEP Software

(5) Total = 0 for This Option

(6) Simulation Computer Time DEP Software

(6) Total = 0 for This Option

(7) Travel

(A) = ((Number of Man Yrs.) (Travel/Cost/Man Yr.))/Yr.

Number of Man Yrs. = Number of Man Yrs. Required as Determined by Number of Instructions to be Maintained.

Travel = $9,725 Man/Yr.

(7) Total = (#17) ($9,725)

Cost Element 4.3 <u>EAS Software Integrated Verification</u>

Cost Element

1. Integrated Verification
2. Host Computer Time
3. Simulation Computer Time
4. Integrated Verification Simulation Software

(1) (2) (3) & (4) Total = 0 for This Option

Cost Element 4.4 Preflight Checkout Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Software Development

(A) = ((Number of HOL Statements) (Cost/Statement)

Number of Statements = #22

Cost/Statements = $30

(1) Total = ((#22) ($30))/Yr.

(2) Common Software

(2) Total = 0 for This Option

(3) Host Computer Time

(Host Time) (Cost/Hr.) Ref. 4.1 (3)

(3.87) (# Modules) ($123.22) Per Flight/Yr.

(3) Total = ((3.87) (#22 ÷ 100) ($123.22)) Per Yr.

(4) Simulation Computer Time

(A) = (# Hrs./Module) (Cost/Hr.) (# Modules)
Ref. 4.1 (4)

(4) Total = (($46.46) (#22 ÷ 100)) Per Yr.

(5) <u>Travel</u>

(A) = ((# Man Yrs.) ($9,725)) Per Yr.

(5) Total = ((#22 ÷ 833) ($9.725)) Per Yr.

PREFLIGHT SOFTWARE SIZING RATIONALE

Saturn History

LVDC/DA interface signals	=	86
LVDC/DA # instructions	=	4,650
average # instructions/signal	=	54

ATM History

ATMDC interface signals	=	275
ATMDC # instructions	=	7,897
average # instructions/signal	=	29

Mission 8 of Spacelab

# interface signals	=	81.6
# payload elements	=	1.3
average # interface signals	=	62.77

Assume preflight job for each payload element is the same and equivalent to Saturn LVDC = 4,650 instructions.

$$= \frac{4,650}{5} = 930 \text{ HOL statements at a cost of \$30/Statement.}$$

Cost Element 4.5 Preflight Checkout Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Experiment Unique Software

(A) = ((# of Statements) (Change Rate) (Cost/Statement))

Number of statements = (930) (# Payload Elements/Yr.) (Maintenance Flights)

Change Rate = 10% for Each Flight

Cost Statement = $30 Ref. 4.4 (1)

(1) Total = ((#23) ($30)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 (No Common C/O Software)'

(3) Host Computer Time

(A) = (Host Time) (Cost/Hr.)

(3) Total = ((#23 ÷ 100) (3.87) ($123.22)) Ref. 4.2 (3)

(4) Simulation Computer Time

(4) Total = ((#23 ÷ 100) (4) ($46.46) Ref. 4.2 (4)

(5) <u>Travel</u>

(A) = (Number of Man Yrs.) ($9,725)/Yr.

(5) Total = ((#23 ÷ 833) ($9.725)) Per Yr.

Cost Element 4.6 EAS Dependent STIL Hardware Modifications

Cost Factors

1. Host Main Memory
2. Remote Job Entry (RJE)
3. Display Terminals
4. Maintenance Added Hardware

(1) Host Main Memory

(A) = (GSA Price) (Memory Size)

(1) Total = 0 for This Option

(2) Remote Job Entry

(A) = (GSA Price) (# RJE)

(2) Total = 0 for This Option

(3) Display Terminals

(A) = (GSA Price) (# Terminals)

GSA Price = $989

Terminals = Engineering Estimate = 8

(3) Total = ($989) (8)

(4) Maintenance Added Hardware

(A) = GSA

(4) Total = (($66) (8))/Yr.

Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factors

1. Software Development
2. Host Computer Time
3. Simulation Computer Time
4. Travel

(1) Software Development

(A) = (# of Statements) (Cost/Statement)

# of Statements = (1.4K) (Payload Elements/Yr.) (New Flights)

Cost/Statement = $45 Due to Less Documentation and No Integration

(1) Total = ((#24) ($45)) Per Yr.

(2) Host Computer Time

Same Formula as 4.1 (5)

# of Modules = #24 ÷ 100

(2) Total = ((1.4) (#24 ÷ 100) ($123.22)) Per Yr.

(3) Simulation Computer Time

Same Formula as 4.1 (6)

Modules = #24 ÷ 100

(3) Total = ((7) (#24 ÷ 100) ($46.46)) Per Yr.

(4) Travel

(A) = ((# Man Yrs.) ($9,725)) Per Yr.

(4) Total = ((#24 ÷ 833) ($9,725)) Per Yr.

Rationale for Simulation Software Required for Payload Elements

Engineering Estimate - 21K Table Words Per Payload Element for Simulation Software.

Engineering Estimate that 21K Table Words Equates to Approximately 1/3 X 21K = 7K Machine Language Instructions.

7K ÷ 5 = 1.4K HOL Statements

1.4K X $45/Statement = $63K/Payload Element

Cost Element 4.9 Experiment Real-Time Simulation Software Maintenance

Cost Factors

1. Maintenance
2. Host Computer Time
3. Simulation Computer Time
4. Travel

(1) Maintenance

(A) = (# of Statements) (Change Rate) (Cost/Statement)
(# of Statements) (Change Rate) = #25

Change Rate = Engineering Estimate = 10%/Flight

Cost/Statement = $45 Same as 4.8 (1) (3)

(1) Total = ((#25) ($45)) Per Yr.

(2) Host Computer Time

(A) = 10% of 4.1 (5) 4.8 (2)

(2) Total = ((1.4) (#25 ÷ 100) ($123.22)) Per Yr.

(3) Simulation Computer Time

(A) = 10% of 4.1 (6) 4.8 (3)

(3) Total = ((7) (#25 ÷ 100) ($46.46)) Per Yr.

(4) Travel

(A) = ((# Man-Yrs.) ($9,725)) Per Yr.

(4) Total = ((#25 ÷ 833) ($9,725)) Per Yr.

Cost Element 5.1 <u>Experiment Processor Acquisition</u>

Cost Factors

1. Processor Hardware (I/O Included)
2. Development and Qualification
3. Special Test Equipment

(1) <u>Processor Hardware (I/O Included)</u>

((# of Processors) (Cost/Processor))

# of Processors = #34

Cost/Processor = $46K

(1) Total = ((#34) ($46K)) Per Yr.

(2) <u>Development and Qualification</u>

((# of Qualification) (Cost/Qualification) Per Yr.

(2) Total = (1) ($250.3K) 1 Time Cost

(3) <u>Special Test Equipment</u>

Engineering Estimate = $5K/Unit

(# Units) ($5K) Per Yr.

(3) Total = ((#34) ($5K)) Per Yr.

GROUND RULES FOR DEDICATED EXPERIMENT PROCESSOR

I. Central Experiment Computer Capacity = (Speed) and (Memory)

Speed = (500K Adds per Second) X 65%

(A) = 325 KADS

500 KADS = CII Specifications

65% = 100% - (15% Overhead) - (20% Contingency)

Memory = (Total Capacity) - (Contingency) - (Operating System)

Total Capacity = 64K CII Specification

Contingency = 30% Engineering Estimate

Note: Low compared to industry estimates of (50 - 100%)
Operating System = 20K ESA Estimate of Memory Requirement

(A) = 64K - 19.2K - 20K
= 24,8K Available for EAS

II. When a new payload exceeds central computer capacity, a DEP will be selected for that element that has the greatest capacity requirement. Each element having this requirement will be assigned a different DEP, except the case where one DEP is used on multiple missions.

III. Assume all Spacelab's Review Item Disposition (RID's) for CDMS modifications are incorporated for mass memory, data bus, etc.

IV. Two classes of DEP's were considered:

1) Micro Processor

2) Mini Processor

Note: Only 1 DEP will be specified

V. Assume any non-standard DEP's selected will have support software that is executable on STIL simulation computer.

VI. For any mission, assume that the required number of data bus RAU's can be provided.

VII. Number of processors = determined by applying "Ground Rules for DEP" to GDC provided software.

Cost/processor = determined by: processor class, configuration.

((Processor hardware) + (Qualification) + (Special I/O (RAU equivalent) + (Special Test Equipment) + (Peripherals*) + (Peripherals Qualification).

Each element will be determined according to selected processor class and configuration.

Cost Element 5.2 Experiment Processor Maintenance

Cost Factors

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. for Each Year Used

(1) Total = ((8% ($46K) (#36)) Per Yr.

(2) Distribution

(2) Total = (($500) (#36)) Per Yr.

(3) Re-Furbishment

(A) = ((Number of DEP's) (Cost/Unit for Re-Furbishment)) Per Flight Per Yr.

Number of DEP's = Determined from Mission Model Requirements

(3) Total = Cost/Unit for Re-Furbishment = 0 Assumes DEP's will Meet Spacelab Lifetime Requirements

Cost Element 5.3 DEP Software

Cost Factors

1. Operating System Development

2. Support Software Development

(1) Operating System Development

(A) = ((Number of Instructions) (Cost Per Instruction))

Number of Instructions = 4K Engineering Estimate (M&S Study)

Cost Per Instruction = $100 Assembly Language

(1) Total = (4K) ($100) = $400K 1 Time Cost

(2) Support Software Development

(A) = (Vendor Lease) or ((Number of Statement) (Cost Per Statement)

Assume Vendor Lease - $25K For Cross Assembler
25K For Cross Compiler
$50K (Engineering Estimate)

(2) Total = $50K 1 Time Cost

Cost Element 5.4 DEP Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement))

Number of Statements	=	4.0K Operating System
		2.4K Cross Assembler
		9.0K Cross Compiler
		15.4K (Engineering Estimate)

Line #27 = # of DEP's Used/Yr.

Rate of Change = 5% Per Yr. When Used - (Engineering Estimate)

Cost Per Statement = $45

(1) Total = ((5%) ($45) (15.4K)) Per Yr.

(2) Distribution

(A) = ((Cost/Distribution) (# Distributions)) Per Yr.

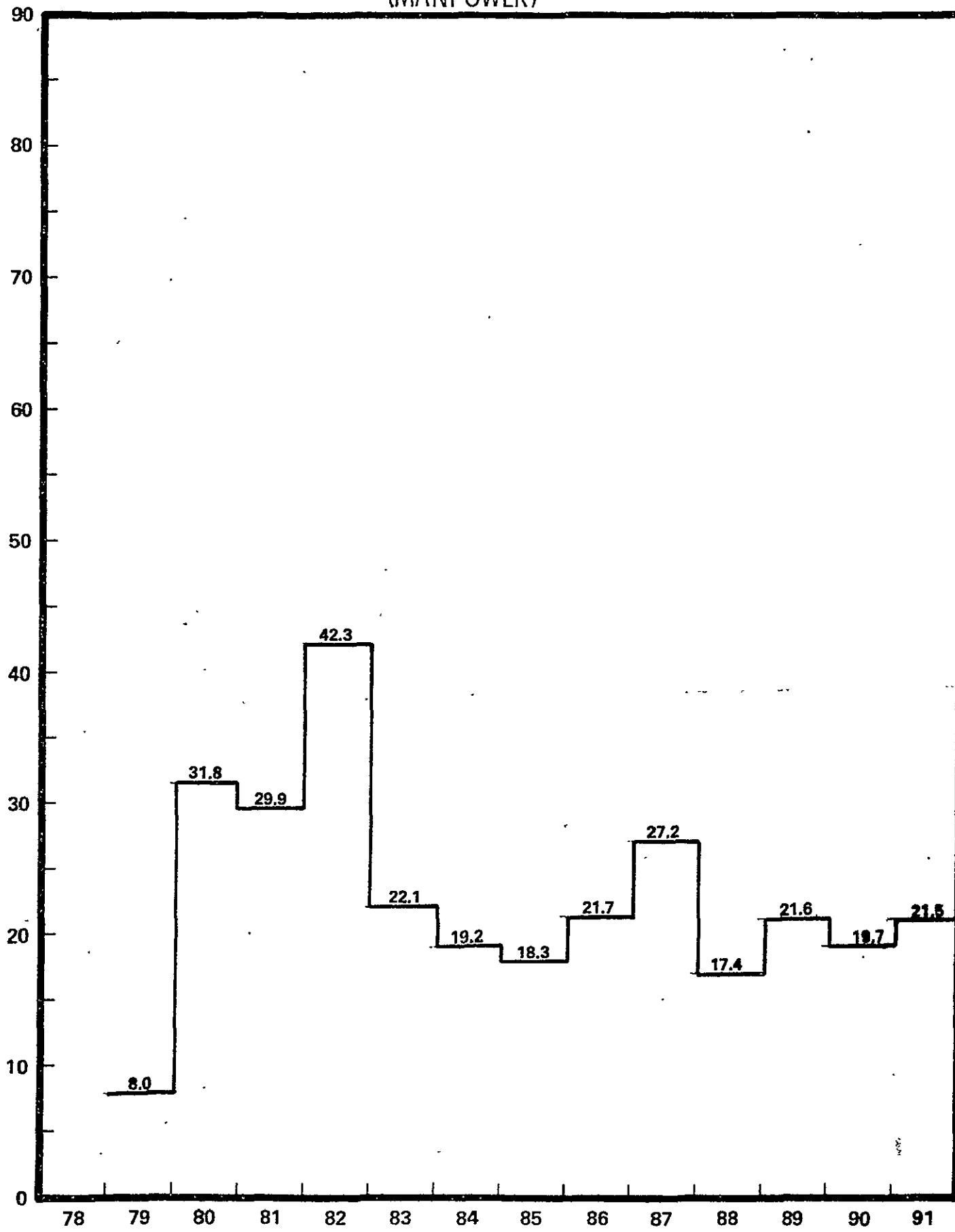
(2) Total = (($50) (#35)) Per Yr.

Cost Elements 6.1, 6.2, 6.3, and 6.4 - Real-Time Simulation Test Set (Not Required for this Option - Use STIL)

SECTION 8 Option IIB2A - Distributed Standard Mini Central Software Development by PI Local

8.2 Cost Data

OPTION II B2A
(MANPOWER)



OPTION II.B.2A TOTAL COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1					312.20	932.69	513.05	73.12
4.2					0	213.62	281.59	503.91
4.3					0	0	0	0
4.4					628.89	224.60	673.80	179.68
4.5					0	62.89	27.30	107.81
4.6					400.91	.53	.53	.53
4.7								
4.8					1208.37	431.57	1294.70	345.25
4.9					0	120.83	51.79	207.16
5.1				1234.30	204.00	102.00	51.00	510.00
5.2					58.52	69.24	85.60	78.60
5.3					450.00	0	0	0
5.4					35.35	34.95	35.85	35.15
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL				1234.30	3298.24	2192.92	3015.21	2041.21
ESCALATED TOTAL				1617.92	4625.95	3290.98	4841.77	3507.18

EF-One Time Form 1 (March 25, 1976)

OPTION II.B.2A TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	232.30	0	309.00	271.09	55.44	91.47	0	0
4.2	338.51	493.41	251.45	364.29	356.13	372.99	498.82	458.10
4.3	0	0	0	0	0	0	0	0
4.4	89.84	0	134.75	134.75	44.92	44.92	0	0
4.5	121.29	197.64	134.75	224.60	175.19	238.07	242.51	287.17
4.6	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
4.7								
4.8	172.63	0	258.94	258.94	86.31	86.31	0	0
4.9	233.05	379.77	258.94	431.57	336.63	457.46	466.09	552.41
5.1	0	0	0	0	0	0	0	0
5.2	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
5.3	0	0	0	0	0	0	0	0
5.4	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL	1306.13	1237.34	1469.26	1849.18	1178.63	1455.54	1349.49	1462.38
ESCALATED TOTAL	2401.27	2434.03	3092.57	4164.71	2840.31	3753.16	3723.28	4317.13
TOTAL COST		23,089.83						
ESCALATED TOTAL COST		44,610.26						

AVERAGE COST PER FLIGHT 197.39

[redacted]

OPTION II.B.2A TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1					4.5	13.1	7.5	1.1
4.2					0	3.0	4.0	7.2
4.3					0	0	0	0
4.4					7.8	2.8	8.4	2.2
4.5					0	0.8	0.3	1.3
4.6								
4.7								
4.8					17.6	6.3	18.9	5.0
4.9						1.8	0.8	3.0
5.1								
5.2					1.2	1.4	1.7	1.6
5.3				8.0	0	0	0	0
5.4					0.7	0.7	0.7	0.7
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL MANPOWER				8.0	31.8	29.9	42.3	22.1

EF-One Time Form 6 (March 25, 1976)

OPTION II.B.2A TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	3.5	0	4.7	4.1	0.8	1.4	0	0
4.2	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
4.3	0	0	0	0	0	0	0	0
4.4	1.1	0	1.7	1.7	0.6	0.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
4.6								
4.7								
4.8	2.5	0	3.8	3.8	1.3	1.3	0	0
4.9	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
5.1								
5.2	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
5.3	0	0	0	0	0	0	0	0
5.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL MANPOWER	19.2	18.3	21.7	27.2	17.4	21.6	19.7	21.5

[illegible] Time Form 5 (March 25, 1976)

OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1 Experiment Application Software Development								
(1) Software Development					222.3	656.82	372.69	55.80
(2) Common Software					0	0	0	0
(3) Host Computer Time					23.56	69.60	39.49	5.91
(4) Simulation Computer Time					9.18	27.13	15.39	2.30
(5) Host Computer Time, DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					54.36	170.38	81.30	8.66
(8) Training					2.80	8.76	4.18	0.45
LABOR COST					222.30	656.82	372.69	55.80
MANPOWER					4.5	13.1	7.5	1.1
TOTAL COST					312.20	932.69	513.05	73.12

EF-One Time Form 3 (March 25, 1976)

OPTION II.B.2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1 Experiment Application Software Development								
(1) Software Development	177.17	0	233.24	203.67	39.06	69.75	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	18.77	0	24.71	21.58	4.14	7.39	0	0
(4) Simulation Computer Time	7.32	0	9.63	8.41	1.61	2.88	0	0
(5) Host Computer Time, DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	27.62	0	39.39	35.79	10.11	10.89	0	0
(8) Training	1.42	0	2.03	1.84	0.52	0.56	0	0
LABOR COST	177.17	0	233.24	203.67	39.06	69.75	0	0
MANPOWER	3.5	0	4.7	4.1	0.8	1.4	0	0
TOTAL COST	232.30	0	309.00	271.09	55.44	91.47	0	0

EF-One Time Form 4 (March 25, 1976)

OPTION II. B. 2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software					0	151.70	199.94	358.02
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	16.21	21.46	38.15
(4) Simulation Computer Time					0	6.32	8.36	14.87
(5) Host Computer Time, DEP Software					0	0	0	0
(6) Simulation Computer Time, DEP Software					0	0	0	0
(7) Travel					0	39.39	51.83	92.87
LABOR COST					0	151.70	199.94	358.02
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	213.62	281.59	503.91

EF-One Time Form 3 (March 25, 1976)

OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software	240.48	350.68	178.61	258.75	252.81	265.14	354.47	325.31
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	25.75	37.20	19.07	27.66	27.18	28.13	37.67	34.81
(4) Simulation Computer Time	10.04	14.50	7.43	10.78	10.59	10.96	14.68	13.57
(5) Host Computer Time, DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time, DEP Software	0	0	0	0	0	0	0	0
(7) Travel	62.24	91.03	46.29	67.10	65.55	68.76	92.00	84.41
LABOR COST	240.48	350.68	178.61	258.75	252.81	265.14	354.47	325.31
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
TOTAL COST	338.51	493.41	251.45	364.29	356.13	372.99	498.82	458.10

EE-One Time Form 4 (March 25, 1976)

OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS Software Integrated Verification								
(1) Integrated Verification					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Integrated Verification Simulation Software					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

EF-One Time Form 3 (March 25, 1976)

OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS Software Integrated Verification								
(1) Integrated Verification	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Integrated Verification Simulation Software	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

EF-One Time Form 4 (March 25 1976)

OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 Preflight Checkout Software Development								
(1) Software Development					390.60	139.50	418.50	111.60
(2) Common Software					0	0	0	0
(3) Host Computer Time					62.09	22.17	66.52	17.74
(4) Simulation Computer Time					24.20	8.64	25.92	6.91
(5) Travel					152.00	54.29	162.86	43.43
LABOR COST					390.60	139.50	418.50	111.60
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					628.89	224.60	673.80	179.68

EF-One Time Form 3 (March 25, 1976)

OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 Preflight Checkout Software Development								
(1) Software Development	55.80	0	83.70	83.70	27.90	27.90	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	8.87	0	13.30	13.30	4.43	4.43	0	0
(4) Simulation Computer Time	3.46	0	5.18	5.18	1.73	1.73	0	0
(5) Travel	21.71	0	32.57	32.57	10.86	10.86	0	0
LABOR COST	55.80	0	83.70	83.70	27.90	27.90	0	0
MANPOWER	1.1	0	1.7	1.7	0.6	0.6	0	0
TOTAL COST	89.84	0	134.75	134.75	44.92	44.92	0	0

EF-One Time Form 4 (March 25, 1976)

OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software					0	39.06	16.74	66.96
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	6.21	2.66	10.64
(4) Simulation Computer Time					0	2.42	1.04	4.15
(5) Travel					0	15.20	6.86	26.06
LABOR COST					0	39.06	16.74	66.96
MANPOWER					0	0.8	0.3	1.3
TOTAL COST					0	62.89	27.30	107.81

EF-One Time Form 3 (March 25, 1976)

OPTION II, B, 2A ELEMENT COST · PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software	75.33	122.76	83.70	139.50	108.81	147.81	150.66	178.56
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	11.97	19.51	13.30	22.17	17.30	23.50	23.95	28.38
(4) Simulation Computer Time	4.67	7.60	5.18	8.64	6.74	9.16	9.33	11.06
(5) Travel	29.32	47.77	32.57	54.29	42.34	57.54	58.63	69.17
LABOR COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	121.29	197.64	134.75	224.60	175.19	238.07	242.57	287.17

EF-One Time Form 4 (March 25, 1976)

OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory					393.00	0	0	0
(2) Remote Job Entry					0	0	0	0
(3) Display Terminals					7.91	0	0	0
(4) Maintenance					0	0.53	0.53	0.53
(5) Telecommunications					0	0	0	0
No Manpower Associated with this Cost Element.								
LABOR COST								
MANPOWER								
TOTAL COST					400.91	0.53	0.53	0.53

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OPTION II.B.2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory	0	0	0	0	0	0	0	0
(2) Remote Job Entry	0	0	0	0	0	0	0	0
(3) Display Terminals	0	0	0	0	0	0	0	0
(4) Maintenance	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
(5) Telecommunications	0	0	0	0	0	0	0	0
No Manpower Associated with this Cost Element								
LABOR COST								
MANPOWER								
TOTAL COST	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53

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OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 Experiment Real Time Simulation Software Development								
(1) Software Development					882.00	315.00	945.00	252.00
(2) Host Computer Time					33.81	12.08	36.23	9.66
(3) Simulation Computer Time					63.74	22.77	68.30	18.21
(4) Travel					228.82	81.72	245.17	65.38
LABOR COST					882.00	315.00	945.00	252.00
MANPOWER					17.6	6.3	18.9	5.0
TOTAL COST					1208.37	431.57	1294.70	345.25

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OPTION II, B, 2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 Experiment Real Time Simulation Software Development								
(1) Software Development	126.00	0	189.00	189.00	63.00	63.00	0	0
(2) Host Computer Time	4.83	0	7.25	7.25	2.42	2.42	0	0
(3) Simulation Computer Time	9.11	0	13.66	13.66	4.55	4.55	0	0
(4) Travel	32.69	0	49.03	49.03	16.34	16.34	0	0
LABOR COST	126.00	0	189.00	189.00	63.00	63.00	0	0
MANPOWER	2.5	0	3.8	3.8	1.3	1.3	0	0
TOTAL COST	172.63	0	258.94	258.94	86.31	86.31	0	0

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OPTION II. B. 2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 Experiment Real Time Simulation Software Maintenance								
(1) Maintenance					0	88.20	37.80	151.20
(2) Host Computer Time					0	3.38	1.45	5.80
(3) Simulation Computer Time					0	6.37	2.73	10.93
(4) Travel					0	22.88	9.81	39.23
LABOR COST					0	88.20	37.80	151.20
MANPOWER					0.	1.8	0.8	3.0
TOTAL COST					0	120.83	51.79	207.16

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OPTION II.B.2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 Experiment Real Time Simulation Software Maintenance								
(1) Maintenance	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
(2) Host Computer Time	6.52	10.63	7.25	12.08	9.42	12.8	13.04	15.46
(3) Simulation Computer Time	12.30	20.03	13.66	22.77	17.76	24.13	24.59	29.14
(4) Travel	44.13	71.91	49.03	81.72	63.75	86.63	88.26	104.61
LABOR COST	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
MANPOWER	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
TOTAL COST	233.05	379.77	258.94	431.57	336.63	457.46	466.09	552.41

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OPTION II. B. 2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 Experiment Processor Acquisition								
(1) Processor Hardware				644.00	184.00	92.00	46.00	460.00
(2) Qualification				520.30				
(3) Special Test Equipment *				70.00	20.00	10.00	5.00	50.00
No Manpower Associated with this Cost Element.								
LABOR COST				0	0	0	0	0
MANPOWER				0	0	0	0	0
TOTAL COST				1234.30	204.00	102.00	51.00	510.00

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OPTION II.B.2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 Experiment Processor Acquisition								
(1) Processor Hardware	0	0	0	0	0	0	0	0
(2) Qualification								
(3) Special Test Equipment	0	0	0	0	0	0	0	0
No Manpower Associated with this Cost Element.								
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION II.B.2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 Experiment Processor Maintenance								
(1) Maintenance					51.52	66.24	73.60	73.60
(2) Distribution					7.00	3.00	12.00	5.00
(3) Refurbishment					0	0	0	0
LABOR COST					58.52	69.24	85.60	78.60
MANPOWER					1.2	1.4	1.7	1.6
TOTAL COST					58.52	69.24	85.60	78.60

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OPTION II.B.2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 Experiment Processor Maintenance								
(1) Maintenance	77.28	121.44	73.60	117.76	77.28	121.44	103.04	125.12
(2) Distribution	5.50	9.00	11.50	10.00	10.50	7.00	3.50	4.00
(3) Refurbishment	0	0	0	0	0	0	0	0
LABOR COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
MANPOWER	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
TOTAL COST	82.78	130.44	85.10	127.76	87.78	128.44	106.44	129.12

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OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP Software Development & Procurement								
(1) Operating System Development				400.00	0	0	0	0
(2) Support Software Procurement				50.00	0	0	0	0
LABOR COST				400.00	0	0	0	0
MANPOWER				8.0	0	0	0	0
TOTAL COST				450.00	0	0	0	0

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OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP Software Development & Procurement								
(1) Operating System Development	0	0	0	0	0	0	0	0
(2) Support Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION II.B.2A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance					34.65	34.65	34.65	34.65
(2) Distribution					0.70	0.30	1.20	0.50
LABOR COST					35.35	34.95	35.85	35.15
MANPOWER					0.7	0.7	0.7	0.7
TOTAL COST					35.35	34.95	35.85	35.15

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OPTION II.B.2A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance	34.65	34.65	34.65	34.65	34.65	34.65	34.65	34.65
(2) Distribution	0.55	0.90	1.15	1.00	1.05	0.70	0.35	0.40
LABOR COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
MANPOWER	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
TOTAL COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05

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SECTION 9 Option IIB2B - Distributed Standard Mini, Central Software Development by PI Remote

9.1 Costing Method

ASSUMPTIONS

- All experiment application dependent software will be implemented in DEP's.
- STIL facility used for all EAS software development.
- PI develops EAS requirements analysis, coding and functional simulation through a remote terminal to the STIL.
- PI travels to STIL for real-time EAS checkout and integration.
- DEP is available at Level 4 checkout area.
- Common library evolvement is not possible due to independent PI software development.
- Only one mini development/qualification is required.
- Only one RTSTS is required and located at STIL.
- No PI/PI integration required to independence of resource sharing. Central computer integration testing is still required.
- Fewer total mini's are required due to sharing of a pool of processors.
- Only one DEP operating system development is required.

Cost Element 4.1 Experiment Application Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel
8. Training

(1) Software Development

(A) = ((Number of Statements) (Cost/Statement) Per Flight Per Yr.

Number of Statements = GDC Estimate = (#3 + #4)

Cost/Statement = $45 (Reauirements, Code and Verification) $15 Per Statement is Applied to Integrated Verification (See 4, 3, (1))

(1) Total = ((#3 + #4) ($45)) Per Yr.

(2) Common Software

(2) Total 0 for this Option

(3) Host Computer Time

(A) = ((Host Time) (Cost/Hr)) Per New Flight Per Yr.

Host Time = ((# Instructions) (# Instructions/ Module)) (Hrs/Module)

= (# of Modules) (Hrs/Module)

Hrs/Module = 18 Compiles/Module @ 3 Mins/ Compile + 9 Functional Simulations @ 12 Mins/ Run + Data Reduction for 75% of Simulation Runs @ 10 Min Each.

(54 Mins) + (108 Mins) + (70 Mins) = 3.87 Hrs/ Module Cost/Hr = $123.22 Ref. 4.1 (2) Option IA1

(1) Total = (3.87 Hrs/Module) (# Modules) ($123.22/Hr.)

= (3.87 (#3 + #4)÷100) ($123.22) Per Yr.

(4) Simulation Computer Time

(A) = (# of Hrs/Module) (Cost Hr) (# of Modules)

# of Hrs = 4 Simulations at 60 Min/Simulation (Includes Set Up, Runs and Run Evaluations)

Cost/Hr = 10% (Maintenance (CDMS, CID, SIM COMP)) + Consumables)+(Operations))÷2080 Hrs.

= ($8) = (0) + ((2 x $40K)÷2080)

= ($8) + ($38.46).

= $46.46/Hr.

# of Modules = (#3 + #4)÷100

(4) Total = (($46.46) (#3 + #4)÷100 (4 Hrs)) Per Yr.

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr)) Per Flight/Yr.

Host Time = (# Modules) (Time Module)

Time/Module = 18 Compiles/Module @ 3 Mins/Compile + 3 Data Reductions Runs/Module @ 10 Mins Run

+ 84 Mins/Module

Cost/Hr = $123.22 (Same as 4.1 (3))

(5) Total = 0 for this Option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs) (Cost/Hr)) (# of Modules))
Per Flight/Yr.

# of Hrs = 7 Simulations at 60 Mins/Simulation
(Includes Set Up, etc.)

9 Functional Simulations = 3 Real-Time Simulations.
Assume No Functional Simulations for DEP

Cost/Hr = $46.46 (Same as 4.1 (4))

# of Modules = 9

(6) Total = 0 for this Option

(7) Travel

(A) (Number of Man Yrs) (Travel Cost/Man Yr)/Yr.

Number of Man Yrs = Number of Man Yrs. Required as Determined by Number of New Instructions.

Travel/Man Yr. = (Number of Trips) Cost of Ticket) + (Number of Days) (Cost Day)

Number of Trips = 4/Man Yr.

Cost of Ticket = $150

Cost/Day = $12.50 Per Diem + 12.50 for Car $25

Number of Days = 365

Travel = (4 ($100) + (#65) (25)) Per Yr) * 30%

* 30% of Total - Travel Only Required for Real-Time Simulation Software

($600 + $9,125) = ($9,725/Man Yr.) 30%

(7) Total = ((#16) ($9,725) (30%)) Per Yr.

(8) Training

(A) = (Number of Programmers) (Cost/Programmer)

Number of Programmers = Number of Programmers Required by Number of New Instructions

Cost of Programmer = Engineering Estimate $500/Man

(8) Total = (#16) ($500)

Cost Element 4.2 Experiment Application Software Maintenance

Cost Factors

1. Experiment Unique Software

2. Experiment Common Software

3. Host Computer Time

4. Simulation Computer Time

5. Host Computer Time DEP Software

6. Simulation Computer Time DEP Software

7. Travel

(1) Experiment Unique Software

(A) = (# of Statements) (Rate of Change) (Cost/Statement)

Number of Statements = (See 4.1)

Rate of Change = Engineering Estimate Based on Past Programs = 40% for 1st Re-Fly, 30% for 2nd Re-Fly, 20% for 3rd Re-Fly, 10% for All Subsequent Re-Flys.

Cost/Statement = $45 (See 4.1 for Rationale)

(# of Statements) (Rate of Chagen = #13)

(1) Total = ((#13) ($45)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 This Option

(3) Host Computer Time

(A) = (# Modules) (# Hrs/Module) (Cost/Hr)

Modules = #13÷100

Hrs/Module = .87 (See 4.1 for Rationale)

Cost/Hr = $123.22 (See 4.1 for Rationale)

(3) Total = ((#13 100) (3.87) ($123.22)) Per Yr.

(4) Simulation Computer Time

(A) = ((# Modules) (# of Hrs/Module) (Cost/Hr)) Per Yr.

Modules = 13÷100

Hrs/Module = Hrs (See 4.1 for Rationale)

Cost/Hr = $46.46 (See 4.1 for Rationale)

(4) Total = #13÷ 100 (4) ($46.46)) Per Yr.

(5) Host Computer Time DEP Software

(A) ((Host Time/Module) (# Modules) (Cost/Hr)) Per Yr.

Host Time/Module = 1.4 Hrs (See 4.1 for Rationale)

# of Modules = #15

Cost/Hr = $123.22 (See 4.1 for Rationale)

(5) Total = 0 for this Option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs) (Cost/Hr) (# Modules)) Per Yr.

# of Hrs 7 (See 4.1 for Rationale)

Cost/Hr = $46.46 (See 4.1 for Rationale)

# of Modules = #15

(6) 0 for this Option

(7) Travel

(A) = ((Number of Man Yrs) (Travel/Cost/Man Yr.))/Yr.

Number of Man Yrs. = Number of Man Yrs. Required as Determined by Number of Instructions to be Maintained

Instructions to be Maintained = #17

(7) Total = ((#17) ($9,725) (30%)) Per Yr.

Note: See 4.1 (7) for 30% Rationale

C 13

Cost Element 4.3 EAS Software Integrated Verification

Cost Factors

1. Integrated Verification

2. Host Computer Time

3. Simulation Computer Time

4. Integrated Verification Sim S/W

(1) Integrated Verification

(A) = ((# of Modules) (Cost/Module))
Per Flight/Yr.

# of Modules = #21

Cost/Module = (# Statements) (Cost/Statement)

Cost/Statement = $15
Cost Per Statement for Central Development
Less $45 for Development

(1) Total = 0 for this Option

(2) Host Computer Time

= (# Hrs) (Cost/Hr)

(2) Total = 0 for this Function (Has been included in Required Host Runs in 4.1)

(3) Simulation Computer Hardware Time

(# of Hrs/Module) (Cost/Hr) (# Modules)

Hrs/Module = 2 Simulations/Module at 60 Min Per Simulation (Includes Set Up, etc.)

Cost/Hr = $46.46 (See 4.1 (4) B)

(3) Total = 0 for this Option

Cost Element 4.4 Preflight Checkout S/W Development

Cost Factors

1. Software Development

2. Common Software

3. Host Computer Time

4. Simulation Computer Time

5. Travel

(1) Software Development

(A) = ((Number of HOL Statements) (Cost/Statement))

Number of Statements = Number of HOL Statements Per Payload x # Payload Elements
= 930 x PE/Yr (New Flights)

Cost/Statements = $30

Statements = #22

(1) Total = ((#22) ($30))/Yr.

(2) Common Software

(2) Total = 0 for this Option

(3) Host Computer Time

(Host Time) (Cost/Hr) Ref. 4.1 (3)

(3.87) (# Modules) ($ 23.22) Per Flight/Yr.

Modules = #22÷100

(3) Total = ((3.87) (#22 ÷ 100) ($123.22)) Per Yr.

(4) Simulation Computer Time

(A) = (# Hrs/Module) (Cost/Hr.) (# Modules)
Ref 4.1 (4)

(4) Total = (46.46) (#22 ÷ 100) (4)) Per Yr.

(5) <u>Travel</u>

(A) = ((# Man Yrs) ($9,725)) Per Yr.

(5) Total = ((#22 ÷ 833) ($9,725) (30%)) Per Yr.

Note: See 4.1 (7) for 30% Rationale

Cost Element 4.5 Pre-Flight Checkout Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Experiment Unique Software

(A) = ((# of Statements) (Change Rate) (Cost Statement) Per Yr.

Number of Statements = #23

Change Rate = 10% for Each Flight

Cost Statement = $30 Ref. 4.4 (1)

(1) Total = ((#23) ($30)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 No Common Software this Element

(3) Host Computer Time

(A) = (Host Time) (Cost/Hr)

(3) Total = ((#23 ÷ 100) (3.87) ($123.22)) Ref. 4.2 (3)

(4) Simulation Computer Time

(4) Total = ((#23 ÷ 100) (4) ($26.46) Ref. 4.2 (4)

(5) Travel

(A) = (Number of Man Yrs) ($9,725)/Yr.

(5) Total = ((#23 ÷ 833) ($9,725) (30%)) Per Yr.

Note: See 4.1 (7) for 30% Rationale

Cost Element 4.6 EAS Dependent STIL HWD Modifications

Cost Factors

1. Host Main Memory

2. Remote Job Entry

3. Display Terminals

4. Maintenance Added Hardware

5. Telecommunications

(1) Host Main Memory

(A) = (GSA Price) (Memory Size)

(1) Total = 0 for this Option

(2) Renate Job Entry

(A) = (GSA Price) (# RJE)

GSA Price = $43,450

RJE = #31

(2) Total = (($43,450) (#31)) Per Yr.

(3) Display Terminals

(A) = (GSA Price) (# Terminals)

GSA Price = $989

Terminals = Engineering Estimate = 8

(3) Total 0 for this Option

(4) Maintenance Added Hardware

GSA = Terminals (0) + RJE ($3,180)

Terminals + RJE = #30

(4) Total = ((0 + $3,180) (#30)) Per Yr.

(5) <u>Telecommunications</u>

(A) = (Line Cost) (# of Lines)

Line Cost = $15,720

(5) Total = (($15,720) (#30)) Per Yr.

RJE PRICE DATA

1) Model 2780 - Data Transmission Terminal (RJE)

Basic Monthly Rental - 989.00

Purchase Price - 43,450.00

Maintenance/Month - 256.00

2) Transmission Lease Line - $35/Month + $.86/Mile/Month

3) Average distance = 1,500 miles

Transmission Lease Line - $35 + (.85) (1,500)
- $35 + 1,275 = $1,310/Month

GROUND RULES FOR DEDICATED EXPERIMENT PROCESSOR

I. Central Experiment Computer Capacity = (Speed) and (Memory)

Speed = (500K Adds per Second) X 65%

(A) = 325 KADS

500 KADS = CII Specifications

65% = 100% - (15% Overhead) - (20% Contingency)

Memory = (Total Capacity) - (Contingency) - (Operating System)

Total Capacity = 64K CII Specification

Contingency = 30% Engineering Estimate

Note: Low compared to industry (50 - 100%)
Operating System = 20K ESA Estimate

(A) = 64K - 19.2K - 20K
= 24.8K

II. When a new payload exceeds central computer capacity, a DEP will be selected for that element that has the greatest capacity requirement. Each element having this requirement will be assigned a different DEP, except the case where one DEP is used on multiple missions.

III. Assume all Spacelab's Review Item Disposition (RID's) for CDMS modifications are incorporated for mass memory, data bus, etc.

IV. *Two classes of DEP's were considered:

1) Micro Processor

2) Mini Processor

* Only 1 DEP will be specified

V. Assume any non-standard DEP's selected will have support software that is executable on STIL simulation computer.

VI. For any mission, assume that the required number of data bus RAU's can be provided.

VII. Number of processors = determined by applying "Ground Rules for DEP" to GDC provided software.

Cost/processor = determined by: processor class, configuration.

((Processor hardware) + (Qualification) + (Special I/O (RAU equivalent) + (Special Test Equipment) + (Peripherals*) + (Peripherals Qualification).

Each element will be determined according to selected processor class and configuration.

Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factors

1. Software Development

2. Host Computer Time

3. Simulation Time

4. Travel

(1) Software Development

(A) = (# of Statements) (Cost/Statement)

# of Statements = (1.4K) (Payload Elements/Yr) (New Flights)

Cost/Statement = $45 Due to Less Documentation and No Integration

(1) Total = ((#24) ($45)) Per Yr.

(2) Host Time

(A) = Same Formula as 4.1 (5)

# of Modules = #24 ÷ 100

(2) Total = ((1.4) (#24 ÷ 100) ($123.22)) Per Yr.

(3) Simulation Computer Time

(A) = Same Formula as 4.1 (6)

Modules = #24 ÷ 100

(3) Total = ((7) (#24 ÷ 100) ($46.46)) Per Yr.

(4) Travel

((# Man Yrs) (9,725)) Per Yr.

(4) Total = ((#24 ÷ 8 33) ($9,725) (30%)) Per Yr.

Note: See 4.1 (7) for 30% Rationale

Cost Element 4.9 Experiment Real-Time Simulation Software Maintenance

Cost Factors

1. Maintenance
2. Host Computer Time
3. Simulation Computer Time
4. Travel

(1) Maintenance

(A) = (# of Statements) (Change Rate) (Cost/Statement)

# of Statements = #25

Change Rate = Engineering Estimate = 10%/Flight

Cost/Statement = $45 Same as 4.8 (1) (3)

(1) Total = ((#25) ($45)) Per Yr.

(2) Host Computer Time

Ref. 4.8 (2)

(2) Total = ((1.4) (#25 ÷ 100) ($123.22)) Per Yr.

(3) Simulation Computer Time

Ref. 4.8 (3)

(3) Total = ((7) (#25 ÷ 100) ($46.46)) Per Yr.

(4) Travel

(A) = ((# Man Yr. ($9,725)) Per Yr.

(4) Total = (($24 ÷ 833) ($9,725) (30%)) Per Yr.

Note: See 4.1 (1) for 30% Rationale

Cost Element 5.1 Experiment Processor Acquisition

Cost Factors

1. Processor Hardware (I/O Included)

2. Development and Qualification

3. Special Test Equipment

(1) Processor Hardware

(A) = ((# of Processors) (Cost/Processor)

# of Processors = #24

Cost/Processor = $46

(1) Total = ((#34) ($46K)) Per Yr.

(2) Development and Qualification

(A) = ((# Qualifications) (Cost/Qualification) Per Yr.

(2) Total = $520.3K (1 Time Cost)

(3) Special Test Equipment

Engineering Estimate = $5K/Unit

(# Units) ($5K) Per Yr.

(3) Total = ((#34) ($5K)) Per Yr.

Cost Element 5.2 Experiment Processor Maintenance

Cost Factor

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. For Each Year Used

(1) Total = ((8% ($46K) (#35)) Per Yr.

(2) Distribution

(A) = (Cost/Distribution) (# Required/Yr.)

(2) Total = (($500) (#36)) Per Yr.

(3) Re-Furbishment

(A) = ((Number of DEPs) (Cost/Unit for Re-Furbishment) Per Flight Per Yr.

Number of DEPs = Determined from Mission Model Requirements

(3) Total = Cost/Unit for Re-Furbishment = 0 Assumes DEPs will meet Spacelab Lifetime Requirements

Cost Element 5.3 <u>DEP Software</u>

Cost Factors

1. Operating System Development

2. Support Software Development

(1) <u>Operating System Development</u>

(A) = ((Number of Instructions) (Cost Per Instruction))

Number of Instructions = 4K Engineering Estimate
(M & S Study)

Cost Per Instruction = $100 (Assembly Language)

(1) Total = (4K) ($100) (1 Time Cost)

(2) <u>Support Software Development</u>

(A) = (Vendor Lease) or ((Number of Statements)
(Cost Per Statement)

Assume Vendor Lease - $25K for Cross Assembler
25K for Cross Compiler
$50K Engineering Estimate

(2) Total = $50K (1 Time Cost)

Cost Element 5.4 DEP Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement)

Number of Statements = 4.0K OPS
2.4K Cross Assembler
9.0K Cross Compiler
15.4K Engineering Estimate

Rate of Change = 5%

Cost Per Statement = $45

(1) Total = (15.4K) (5%) ($45)

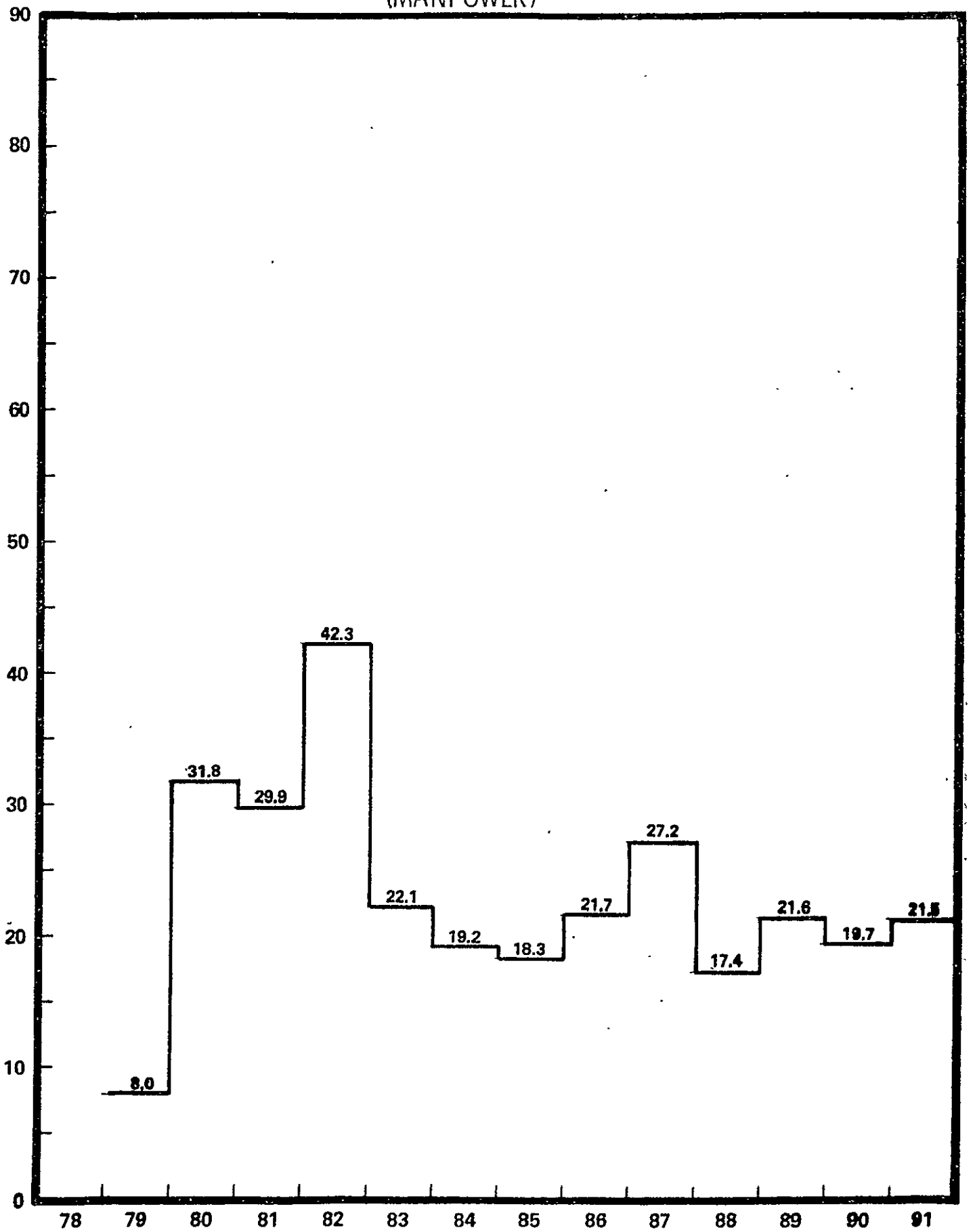
(2) Distribution

(2) Total = (($50) (#35)) Per Yr.

Cost Elements 6.1, 6.2, 6.3, 6.4 - Real-Time Simulation Test Set
(Not Required for this Option - Use STIL)

SECTION 9 Option IIB2B – Distributed Standard Mini, Central Software Development by PI Remote

OPTION II B2B
(MANPOWER)



OPTION IIB2B TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1					274.15	807.02	456.14	67.06
4.2					0	186.05	224.91	438.90
4.3					0	0	0	0
4.4					522.49	186.60	559.80	149.28
4.5					0	52.25	22.50	89.57
4.6					1274.74	557.98	899.93	571.23
4.7								
4.8					1048.20	374.37	1123.08	299.48
4.9					0	104.81	44.92	179.70
5.1				1234.30	204.00	102.00	51.00	510.00
5.2					58.52	69.24	85.60	78.60
5.3					450.00	0	0	0
5.4					35.35	34.95	35.85	35.15
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL				1234.30	3867.45	2475.27	3503.73	2418.97
ESCALATED TOTAL				1617.92	5424.30	3714.71	5626.22	4156.24

EF-One Time Form 1 (March 25, 1976)

OPTION IIB2B TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	212.97	0	281.43	246.24	48.36	83.85	0	0
4.2	294.94	429.69	219.00	317.32	310.25	324.86	434.42	399.01
4.3	0	0	0	0	0	0	0	0
4.4	74.64	0	111.95	111.95	37.32	37.32	0	0
4.5	100.77	164.22	111.95	186.60	145.55	197.79	201.53	238.75
4.6	465.43	605.33	508.88	574.58	459.78	648.78	605.33	662.03
4.7	-	-	-	-	-	-	-	-
4.8	149.75	0	224.62	224.62	74.87	74.87	0	0
4.9	202.16	329.43	224.62	374.37	292.01	396.82	404.31	479.18
5.1	0	0	0	0	0	0	0	0
5.2	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
5.3	0	0	0	0	0	0	0	0
5.4	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL	1618.64	1694.66	1803.35	2199.09	1491.62	1928.08	1787.13	1943.14
ESCALATED TOTAL	2975.80	3333.65	3795.81	4952.77	3594.57	4971.62	4930.75	5736.47
TOTAL COST		27,965.43						
ESCALATED TOTAL COST		54,830.83						

AVERAGE COST PER FLIGHT 242.61

EF11-One Time Form 2 (March 25, 1976)

OPTION IIB2B TOTAL MANPOWER PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1					4.5	13.1	7.5	1.1
4.2					0	3.	4.	7.2
4.3					0	0	0	0
4.4					7.8	2.8	8.4	2.2
4.5					0	.8	.3	1.3
4.6					-	-	-	-
4.7					-	-	-	-
4.8					17.6	6.3	18.9	5.0
4.9					0	1.8	.8	3.0
5.1					-	-	-	-
5.2					1.2	1.4	1.7	1.6
5.3				8.0	0	0	0	0
5.4					.7	.7	.7	.7
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL MANPOWER				8.0	31.8	29.9	42.3	22.1

EF-One Time Form 6 (March 25, 1976)

OPTION IIB2B TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	3.5	0	4.7	4.1	.8	1.4	0	0
4.2	4.8	7.	3.6	5.2	5.1	5.3	7.1	6.5
4.3	0	0	0	0	0	0	0	0
4.4	1.1	0	1.7	1.7	.6	.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
4.6	–	–	–	–	–	–	–	–
4.7	–	–	–	–	–	–	–	–
4.8	2.5	0	3.8	3.8	1.3	1.3	0	0
4.9	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
5.1	–	–	–	–	–	–	–	–
5.2	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
5.3	0	0	0	0	0	0	0	0
5.4	.7	.7	.7	.7	.7	.7	.7	.7
TOTAL MANPOWER	19.2	18.3	21.7	27.2	17.4	21.6	19.7	21.5

EF-One Time Form 5 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1 EXPERIMENT APPLICATION SOFTWARE DEVELOPMENT								
1) SOFTWARE DEVELOPMENT					222.30	656.82	372.69	55.80
2) COMMON SOFTWARE					0	0	0	0
3) HOST COMPUTER TIME					23.56	63.60	39.49	5.91
4) SIMULATION COMPUTER TIME					9.18	27.13	15.39	2.30
5) HOST COMPUTER TIME					0	0	0	0
6) SIMULATION COMPUTER TIME DEP SOFTWARE					0	0	0	0
7) TRAVEL					16.31	51.11	24.39	2.60
8) TRAINING					2.80	8.76	4.18	.45
LABOR COST					222.30	656.82	372.69	55.80
MANPOWER					4.5	13.1	7.5	1.1
TOTAL COST					274.15	807.02	456.14	67.06

EF-One Time Form 3 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1 EXPERIMENT APPLICATION SOFTWARE DEVELOPMENT								
1) SOFTWARE DEVELOPMENT	117.17	0	233.24	203.67	39.06	69.75	0	0
2) COMMON SOFTWARE	0	0	0	0	0	0	0	0
3) HOST COMPUTER TIME	18.77	0	24.71	21.58	4.14	7.39	0	0
4) SIMULATION COMPUTER TIME	7.32	0	9.63	8.41	1.61	2.88	0	0
5) HOST COMPUTER TIME DEP SOFTWARE	0	0	0	0	0	0	0	0
6) SIMULATION COMPUTER TIME DEP SOFTWARE	0	0	0	0	0	0	0	0
7) TRAVEL	8.29	0	11.82	10.74	3.03	3.27	0	0
8) TRAINING	1.42	0	2.03	1.84	.52	.56	0	0
LABOR COST	177.17	0	233.24	203.67	39.06	69.75	0	0
MANPOWER	3.5	0	4.7	4.1	.8	1.4	0	0
TOTAL COST	212.97	0	281.43	246.24	48.36	83.85	0	0

FF-One Time Form 4 (March 25, 1976)

OPTION IIB3B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 EXPERIMENT APPLICATION SOFTWARE MAINTENANCE								
1) EXPERIMENT UNIQUE SOFTWARE					0	151.70	199.94	358.02
2) EXPERIMENT COMMON SOFTWARE					0	0	0	0
3) HOST COMPUTER TIME					0	16.21	21.46	38.15
4) SIMULATION COMPUTER TIME					0	6.32	8.36	14.87
5) HOST COMPUTER TIME DEP SOFTWARE					0	0	0	0
6) SIMULATION COMPUTER TIME DEP SOFTWARE					0	0	0	0
7) TRAVEL					0	11.82	15.15	27.86
LABOR COST					0	151.70	199.94	358.02
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	186.05	244.91	438.90

EF-One Time Form 3 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 EXPERIMENT APPLICATION SOFTWARE MAINTENANCE								
1) EXPERIMENT UNIQUE SOFTWARE	240.48	350.68	178.61	258.75	252.81	265.14	354.47	325.31
2) EXPERIMENT COMMON SOFTWARE	0	0	0	0	0	0	0	0
3) HOST COMPUTER TIME	25.75	37.20	19.07	27.66	27.18	28.13	37.67	34.81
4) SIMULATION COMPUTER TIME	10.04	14.50	7.43	10.78	10.59	10.96	14.68	13.57
5) HOST COMPUTER TIME DEP SOFTWARE	0	0	0	0	0	0	0	0
6) SIMULATION COMPUTER TIME DEP SOFTWARE	0	0	0	0	0	0	0	0
7) TRAVEL	18.67	27.31	13.89	20.13	19.67	20.63	27.60	25.32
LABOR COST	240.48	350.68	178.61	258.75	252.81	265.14	354.47	325.31
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
TOTAL COST	294.94	429.69	219.00	317.32	310.25	324.86	434.42	399.01

EF-One Time Form 4 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS SOFTWARE INTEGRATED VERIFICATION								
1) INTEGTATED VERIFICATION					0	0	0	0
2) HOST COMPUTER TIME					0	0	0	0
3) SIMULATION COMPUTER TIME					0	0	0	0
4) INTEGRATED VERIFICATION SIMULATION SOFTWARE					0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST					0	0	0	0

EF-One Time Form 3 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS SOFTWARE INTEGRATED VERIFICATION								
1) INTEGRATED VERIFICATION	0	0	0	0	0	0	0	0
2) HOST COMPUTER TIME	0	0	0	0	0	0	0	0
3) SIMULATION COMPUTER TIME	0	0	0	0	0	0	0	0
4) INTEGRATED VERIFICATION SIMULATION SOFTWARE	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

EF-One Time Form 4 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 PREFLIGHT CHECKOUT SOFTWARE DEVELOPMENT								
1) SOFTWARE DEVELOPMENT					390.60	139.50	418.50	111.60
2) COMMON SOFTWARE					0	0	0	0
3) HOST COMPUTER TIME					62.09	22.17	66.52	17.74
4) SIMULATION COMPUTER TIME					24.20	8.64	25.92	6.91
5) TRAVEL					45.60	16.29	48.86	13.03
LABOR COST					390.60	139.50	418.50	111.60
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					522.49	186.60	559.80	149.28

EF-One Time Form 3 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 PREFLIGHT CHECKOUT SOFTWARE DEVELOPMENT								
1) SOFTWARE DEVELOPMENT	55.80	0	83.70	83.70	27.90	27.90	0	0
2) COMMON SOFTWARE	0	0	0	0	0	0	0	0
3) HOST COMPUTER TIME	8.87	0	13.30	13.30	4.43	4.43	0	0
4) SIMULATION COMPUTER TIME	3.46	0	5.18	5.18	1.73	1.73	0	0
5) TRAVEL	6.51	0	9.77	9.77	3.26	3.26	0	0
LABOR COST	55.80	0	83.70	83.70	27.90	27.90	0	0
MANPOWER	1.1	0	1.7	1.7	0.6	0.6	0	0
TOTAL COST	74.64	0	111.95	111.95	37.32	37.32	0	0

FE-One Time Form 4 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 PREFLIGHT CHECKOUT SOFTWARE MAINTENANCE								
1) EXPERIMENT UNIQUE SOFTWARE					0	39.06	16.74	66.96
2) EXPERIMENT COMMON SOFTWARE					0	0	0	0
3) HOST COMPUTER TIME					0	6.21	2.66	10.64
4) SIMULATION COMPUTER TIME					0	2.42	1.04	4.15
5) TRAVEL					0	4.56	2.06	7.82
LABOR COST					0	39.06	16.74	66.96
MANPOWER					0	.8	.3	1.3
TOTAL COST					0	52.25	22.50	89.57

EF-One Time Form 3 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 PREFLIGHT CHECKOUT SOFTWARE MAINTENANCE								
1) EXPERIMENT UNIQUE SOFTWARE	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
2) EXPERIMENT COMMON SOFTWARE	0	0	0	0	0	0	0	0
3) HOST COMPUTER TIME	11.97	19.51	13.30	22.17	17.30	23.50	23.95	28.38
4) SIMULATION COMPUTER TIME	4.67	7.60	5.18	8.64	6.74	9.16	9.33	11.06
5) TRAVEL	8.80	14.33	9.77	16.29	12.70	17.26	17.59	20.75
LABOR COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	100.77	164.20	111.95	186.60	145.55	197.79	201.53	238.75

EF-One Time Form 4 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS DEPENDENT STIL HARDWARE SUPPLEMENT								
1) HOST MAIN MEMORY					393.00	0	0	0
2) Remote Job ENTRY					608.30	217.25	521.40	173.80
3) DISPLAY TERMINALS					7.91	0	0	0
4) MAINTENANCE					45.45	57.77	64.13	67.31
5) TELECOMMUNI-CATIONS					220.08	282.90	314.40	330.12
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST					1274.74	557.98	899.93	571.23

EF-One Time Form 3 (March 25, 1976)

OPTION IID2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS DEPENDENT STIL HARDWARE SUPPLEMENT								
1) HOST MAIN MEMORY	0	0	0	0	0	0	0	0
2) Remote Job ENTRY	86.90	0	130.35	130.35	43.45	43.45	0	0
3) DISPLAY TERMINALS	0	0	0	0	0	0	0	0
4) MAINTENANCE	64.13	102.29	64.13	105.47	70.49	102.29	102.29	111.88
5) TELECOMMUNI-CATIONS CHARGES	314.40	503.04	314.40	518.76	345.84	503.04	503.04	550.20
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST	465.43	605.33	508.88	574.58	459.78	648.78	605.33	662.03

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OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 EXPERIMENT REAL-TIME SIMULATION SOFTWARE DEVELOPMENT								
1) SOFTWARE DEVELOPMENT					882.00	315.00	945.00	252.00
2) HOST COMPUTER TIME					33.81	12.08	36.23	9.66
3) SIMULATION COMPUTER TIME					63.74	22.77	68.30	18.21
4) TRAVEL					68.65	24.52	73.55	19.61
LABOR COST					882.00	315.00	945.00	252.00
MANPOWER					17.6	6.3	18.9	5.0
TOTAL COST					1048.20	374.37	1123.08	299.48

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OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 EXPERIMENT REAL-TIME SIMULATION SOFTWARE DEVELOPMENT								
1) SOFTWARE DEVELOPMENT	126.00	0	189.00	189.00	63.00	63.00	0	0
2) HOST COMPUTER TIME	4.83	0	7.25	7.25	2.42	2.42	0	0
3) SIMULATION COMPUTER TIME	9.11	0	13.66	13.66	4.55	4.55	0	0
4) TRAVEL	9.81	0	14.71	14.71	4.90	4.90	0	0
LABOR COST	126.00	0	189.00	189.00	63.00	63.00	0	0
MANPOWER	2.5	0	3.8	3.8	1.3	1.3	0	0
TOTAL COST	149.75	0	224.62	224.62	74.87	74.87	0	0

EF-One Time Form 4 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 EXPERIMENT REAL-TIME SIMULATION SOFTWARE MAINTENANCE								
1) MAINTENANCE					0	88.20	37.80	151.20
2) HOST COMPUTER TIME					0	3.38	1.45	5.80
3) SIMULATION COMPUTER TIME					0	6.37	2.73	10.93
4) TRAVEL					0	6.86	2.94	11.77
LABOR COST					0	88.20	37.80	151.20
MANPOWER					0	1.8	0.8	3.0
TOTAL COST					0	104.81	44.92	179.70

EF-One Time Form 3 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 EXPERIMENT REAL-TIME SIMULATION SOFTWARE MAINTENANCE								
1) MAINTENANCE	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
2) HOST COMPUTER TIME	6.52	10.63	7.25	12.08	9.42	12.80	13.04	15.46
3) SIMULATION COMPUTER TIME	12.30	20.03	13.66	22.77	17.76	24.13	24.59	29.14
4) TRAVEL	13.24	21.57	14.71	24.52	19.13	25.99	26.48	31.38
LABOR COST	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
MANPOWER	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
TOTAL COST	202.16	329.43	224.62	374.37	292.01	396.82	404.31	479.18

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OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 EXPERIMENT PROCESSOR ACQUISITION								
1) PROCESSOR HARDWARE				644.00	184.00	92.00	46.00	460.00
2) QUALIFICATION				520.30				
3) SPECIAL TEST EQUIPMENT*				70.00	20.00	10.00	5.00	50.00
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST				1234.30	204.00	102.00	51.00	510.00

EF-One Time Form 3 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 EXPERIMENT PROCESSOR ACQUISITION								
1) PROCESSOR HARDWARE	0	0	0	0	0	0	0	0
2) QUALIFICATION	0	0	0	0	0	0	0	0
3) SPECIAL TEST EQUIPMENT*	0	0	0	0	0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

EF-One Time Form 5 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 EXPERIMENT PROCESSOR MAINTENANCE								
1) MAINTENANCE					51.52	66.24	73.60	73.60
2) DISTRIBUTION					7.00	3.00	12.00	5.00
3) RE-FURBISHMENT					0	0	0	0
LABOR COST					58.52	69.24	85.60	78.60
MANPOWER					1.2	1.4	1.7	1.6
TOTAL COST					58.52	69.24	85.60	78.60

EF-One Time Form 3 (March 25, 1976)

OPTION IIB2B ELEMENT COST PAGE ___ . OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 EXPERIMENT PROCESSOR MAINTENANCE								
1) MAINTENANCE	77.28	121.44	73.60	117.76	77.28	121.44	103.04	125.12
2) DISTRIBUTION	5.50	9.00	11.50	10.00	10.50	7.00	3.50	4.00
3) RE-FURBISHMENT	0	0	0	0	0	0	0	0
LABOR COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
MANPOWER	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
TOTAL COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12

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OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP SOFTWARE DEVELOPMENT & PROCUREMENT								
1) OPERATING SYSTEM DEVELOPMENT				400.00	0	0	0	0
2) SUPPORT SOFTWARE PROCUREMENT				50.00	0	0	0	0
LABOR COST				400.00	0	0	0	0
MANPOWER				8.0	0	0	0	0
TOTAL COST				450.00	0	0	0	0

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OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP SOFTWARE DEVELOPMENT & PROCUREMENT								
1) OPERATING SYSTEM DEVELOPMENT	0	0	0	0	0	0	0	0
2) SUPPORT SOFTWARE PROCUREMENT	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.4 DEP SOFTWARE MAINTENANCE & DISTRIBUTION								
1) MAINTENANCE					34.65	34.65	34.65	34.65
1) DISTRIBUTION					0.70	0.30	1.20	0.50
LABOR COST					35.35	34.95	35.85	35.15
MANPOWER					.7	.7	.7	.7
TOTAL COST					35.35	34.95	35.85	35.15

EF-One Time Form 3 (March 25, 1976)

OPTION II2B2 IIB2B ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.4 DEP SOFTWARE MAINTENANCE & DISTRIBUTION								
1) MAINTENANCE	34.65	34.65	34.65	34.65	34.65	34.65	34.65	34.65
2) DISTRIBUTION	0.55	0.90	1.15	1.00	1.05	0.70	0.35	0.40
LABOR COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
MANPOWER	.7	.7	.7	.7	.7	.7	.7	.7
TOTAL COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05

EF-One Time Form 4 (March [illegible], 1976)

SECTION 10 Option IIB3A - Distributed Standard Mini Software Development by PI at His Facility. Real-Time Simulation Testing at Central Facility

10.1 Costing Method

ASSUMPTIONS

- All experiment application dependent software will be implemented in DEP's.
- STIL facility used for all EAS software development.
- PI develops EAS requirements analysis, coding, and functional simulation checkout at his STIL compatible facility.
- PI is charged industry rate for HOST computer time.
- PI travels to STIL for real-time checkout of EAS.
- DEP is available at Level 4 for checkout of experiment hardware.
- Common library is not possible due to independent PI software development.
- Only one mini development/qualification is required.
- Only one RTSTS is required and located at STIL.
- No PI/PI integration required due to independence of resource sharing. Central computer integration testing is still required.
- Fewer total mini's are required due to sharing of a pool of processors.
- Only one DEP operating system development is required.

Cost Element 4.1 Experiment Application Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel
8. Training

(1) Software Development

(A) = ((Number of Statements) (Cost/Statement)) Per Flight Per Yr.

Number of Statements = #3 + #4

Cost/Statement — $45 (Requirements, Code and Verification) $15 Per Statement is Applied to Integrated Verification (See 4.3 (1))

(1) Total = ((#3 + #4) ($45)) Per Yr.

(2) Common Software

(2) Total = 0 for This Option

(3) Host Computer Time

(A) = ((Host Time) (Cost/Hr)) Per New Flight Per Yr.

Host Time = ((# Instructions) (# Instructions/Module)) (Hrs/Module)

= (# of Modules) (Hrs/Module)

Hrs/Module = 18 Compiles/Module @ 3 Mins/ Compile + 9 Functional Simulations @ 12 Mins/ Run + Data Reduction for 75% of Simulation Runs @ 10 Mins Each.

(54 Mins) + (108) + (70 Mins) = 3.87 Hours/Module Cost/ Hr =323 Based on Current Industrial Estimate of Cost Per Hr for Like Facility.

(3) Total = (3.87) (#3 + #4) ÷ 100) ($323) Per Yr.

(4) Simulation Computer Time

(A) = (# of Hrs/Module) (Cost/Hr) (# of Modules)

# of Hrs = 4 Simulations at 60 Min/Simulation (Includes Set Up, Runs, and Run Evaluations)

Cost/Hr = (10% (Maintenance (CDMS, CID, SIM COMP)) + Consumables) + (Operations))÷2080 Hrs.

= ($8) + (0) + ((2 x $40K)÷2080)

= $46.46/Hr.

# of Modules = (#3 + #4) 100)

(4) Total = (($46.46) (#3 + #4)÷ 100) (4 Hrs.)) Per Yr.

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr)) Per Flight/Yr.

Host Time = (# Modules) (Time/Module)

Time/Module = 18 Compiles/Module @ 3 Mins/ Compile + Data Reductions Runs/Module @ 10 Mins/Run

= 84 Mins/Module

Cost/Hr = $323 (Same as 4.1 (3))

# of Modules = #9

(5) Total = 0 for This Option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs) (Cost/Hr)) (# of Modules))
Per Flight Yr.

# of Hrs = 7 Simulations at 60 Mins/Simulation*
(Includes Set Up, etc.)

Note: 9 Functional Simulations = Real-Time Simulations.
Assume No Functional Simulations for DEP.

Cost/Hr = $46.46 (Same as 4.1 (4))

(6) Total = 0 for This Option

(7) Travel

(A) = (Number of Man Yrs) (Travel Cost/Man Yr)/Yr.

Number of Man Yrs = Number of Man Yrs Required as Determined by Number of New Instructions

Travel/Man Yr. = (Number of Trips) (Cost of Ticket) + (Number of Days) (Cost Day)

Number of Trips = 4 Per Man Yr.

Cost of Ticket = $150

Cost/Day $12.50 Per Diem + $12.50 for Car = $25

Number of Days = 365

Travel = 4 ($150) + (365) (25)

= 600 + $9,125 = $9,725/Man Yr.

(7) Total = (30%) ((#16) ($9,725))/Yr.

Note: 30% Travel Only for This Option for Real-Time Software Checkout and Integration.

(8) Training

(A) = (Number of Programmers) (Cost/Programmer)

Number of Programmers = Number of Programmers Required by Number of New Instructions

Cost of Programmer = Engineering Estimate $500/Man

(8) Total = (#16) ($500)

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Cost Element 4.2 Experiment Application Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel

(1) Experiment Unique Software

(A) = (# of Statements) (Rate of Change) (Cost/Statement)

Number of Statements = (See 4.1)

Rate of Change = Engineering Estimate Based on Past Programs = 40% for 1st Re-Fly, 30% for 2nd Re-Fly, 20% for 3rd Re-Fly, 10% for All Subsequent Re-Flys,

(# of Statements) (Rate of Change) = #13

Cost/Statement = $45)) Per Yr.

(1) Total = ((#13) ($45)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 This Option

(3) Host Computer Time

(A) = ((# Modules) (# Hrs/Module) (Cost/Hr)) Per Yr.

Modules = #13 ÷ 100

Hrs/Module = 3.87 (See 4.1 for Rationale)

Cost/Hr = $323 (See 4.1 for Rationale)

(3) Total = ((#13 ÷ 100 (3.87) ($323)) Per Yr.

(4) Simulation Computer Time

(A) = ((# Modules) (# of Hrs/Module) (Cost/Hr)) Per Yr.

Modules = #13 ÷ 100

Hrs/Module = 4 Hrs (See 4.1 for Rationale)

Cost/Hr = $46.46 (See 4.1 for Rationale)

(4) Total = ((#13 ÷ 100 (4) ($46.46)) Per Yr.

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr)) Per Yr.

Host Time/Module = 1.4 Hrs (See 4.1 for Rationale)

# of Modules = #15

Cost/Hr = $323 (See 4.1 for Rationale

(5) Total = 0 for This Option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs) (Cost/Hr) (# Modules) Per Yr.

# of Hrs = 7 (See 4.1 for Rationale)

Cost/Hr = $46.46 (See 4.1 for Rationale)

# of Modules = #15

(6) Total = 0 for This Option

(7) Travel

(A) = ((Number of Man Yrs) (Travel/Cost/Man Yr.))/Yr.

Number of Man Yrs. = Number of Man Yrs. Required as Determined by Number of Instructions to be Maintained

Instructions To Be Maintained = #17

Travel = $9,725 Man/Yr.

(7) Total = (#17) ($9,725) (30%)

Note: Travel Required Only for Real-Time Integration & Simulation = 30%.

Cost Element 4.3 EAS Software Integrated Verification

Cost Factors

1. Integrated Verification

2. Host Computer Time

3. Simulation Computer Time

4. Integrated Verification Simulation S/W

(1) Integrated Verification

(A) = ((# of Modules) (Cost/Module))
Per Flight/Yr.

# of Modules = #21

Cost/Module = (# Statement) (Cost/Statement)
Statement = 100 Module.

Cost/Statement = $15 ($60 Estimated Total)
Cost Per Statement for Central Development
Less $45 for Development)

(1) Total = 0 for this Option

* Rationale: Based on 1 Man/New Flight for Central Integration Activities (Coordination Function)
Av. Inst/New Flight = 24K = 6 Man Yrs.
1/6 = .15

(2) Host Computer Time

(A) = (# Hrs) (Cost/Hr.)

(2) Total = (0) For This Function (Has Been Included in Required Host Runs 4.1)

(3) Simulation Computer Hardware Time

(A) = (# of Hrs. /Module) (Cost/Hr.) (# Module)

Hrs/Module = 2 Simulations/Module at 60 Min Per Simulation (Includes Set Up, etc.)

Cost/Hr = $46.46 (See 4.1 (4) B)

Modules = Line #21

(3) Total = 0 for This Option

See 4.3 (1) for Rationale

(4) Integrated Verification Simulation S/W

(A) = ((# of Modules) (Cost/Module)) Per Yr.

# of Modules = (#24 + #25) ÷ 100

Cost/Module = $1,500 (See 4.3 (1) for Rationale

(4) Total = 0 for This Option

Cost Element 4.4 Preflight Checkout S/W Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Software Development

(A) = ((Number of HOL Statements) (Cost/Statement)) Per Yr.

Number of Statements = #22

Cost/Statement = $30

(1) Total = ((#22) ($30))/Yr.

(2) Common Software

(2) Total = 0 No Common Software for This Element

(3) Host Computer Time

(Host Time) (Cost/Hr) Ref. 4.1 (3)

Modules = #22÷100

(3.87) (# Modules) ($232) Per Flight/Yr.

(3) Total = ((3.87) (#22÷100) ($323)) Per Yr.

(4) Simulation Computer Time

(A) = (# Hrs/Module) (Cost/Hr.) (# Modules) Ref 4.1 (4)

(4) Total = (($46.46) (#22÷100) (4)) Per Yr.

(5) <u>Travel</u>

(A) = ((.3) (# Man Yrs) ($9,725)) Per Yr.

(5) Total ← ((.30) (#22÷833) ($9,725)) Per Yr.

PREFLIGHT SOFTWARE SIZING RATIONALE

Saturn History

LVDC/DA interface signals	=	86
LVDC/DA # instructions	=	4,650
average # instructions/signal	=	54

ATM History

ATMDC interface signals	=	275
ATMDC # instructions	=	7,897
average # instructions/signal	=	29

Mission 8 of Spacelab

# interface signals	=	81.6
# payload elements	=	1.3
average # interface signals	=	62.77

Assume preflight job for each payload element is the same and equivalent to Saturn LVDC = 4,650 instructions.

$= \frac{4,650}{5} = 930$ HOL statements at a cost of $30/Statement.

Number of Statements = Number of HOL Statements per Payload Element X # Payload Elements = 930 X PE/Yr. (New Flight)

Cost/Statement = $30

Cost Element 4.5 Pre-Flight Checkout Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Experiment Unique Software

(A) = ((# of Statements) (Change Rate) (Cost Statement)) Per Yr.

Number of Statements = 930 x # Payload Elements/Yr Flights)

Change Rate = 10% for Each Flight

Cost Statement = $30 Ref. 4.4 (1)

(1) Total = ((#23) ($30)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 No Common Software This Element

(3) Host Computer Time

(A) = (Host Time) (Cost/Hr)

(3) Total = ((#23÷100) (3.87) ($323)) Ref. 4.2 (3)

(4) Simulation Computer Time

(4) Total = ((#23÷100) (4) ($46.46) Ref. 4.2 (4)

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(5) <u>Travel</u>

(A) = (Number of Man Yrs) ($9, 725)/Yr.

(5) Total = (30%) (#23$\frac{1}{2}$833) ($9, 725)) Per.

Cost Element 4.6 EAS Dependent STIL HDW Modifications

Cost Factors

1. Host Main Memory
2. Remote Job Entry
3. Display Terminals
4. Maintenance Added Hardware
5. Telecommunications

(1) Host Main Memory

(A) = (GSA Price) (Memory Size)

(1) Total — 0 for This Option

(2) RJE

(A) = (GSA Price) (# RJE)

(2) Total — 0 for This Option

(3) Display Terminals

(A) = (GSA Price) (# Terminals)

(3) Total = 0 for This Option

(4) Maintenance Added Hardware

(A) = GSA

(4) Total = 0 for This Option

(5) Telecommunications

(A) = (Line Cost) (# of Lines)

(5) Total — 0 for This Option

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Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factors

1. Software Development
2. Host Computer Time
3. Simulation Computer Time
4. Travel

(1) Software Development

(A) = ((# of Statements) (Cost/Statement)) Per Yr.

# of Statements = (1.4K) (Payload Elements/Yr.) (New Flights)

Cost/Statement = $45 Due to Less Documentation and No Integration

# of Statements = #24

(1) Total = ((#24) ($45)) Per Yr.

(2) Host Computer Time

# of Modules = #24 ÷ 100

(2) Total = ((1.4) (#24 ÷ 100) ($323)) Per Yr.

(3) Simulation Computer Time

= Same Formula as 4.1 (6)

Modules = #24 ÷ 100

(3) Total = ((7) (#24 ÷ 100) ($46.46)) Per Yr.

(4) Travel

((.3) (# Man Yr.) ($9,725)) Per Yr.

(4) Total = ((30%) (#24 ÷ 833) ($9,725)) Per Yr.

Rationale for Simulation Software Required for Payload Elements

Engineering Estimate - 21K Table Words Per Payload Element for Simulation Software.

Engineering Estimate that 21K Table Words Equates to Approximately 1/3 X 21K = 7K Machine Language Instructions.

7K ÷ 5 = 1.4K HOL Statements

1.4K X $45/Statement = $63K/Payload Element

Cost Element 4.9 Experiment Real-Time Simulation Software Maintenance

Cost Factors

1. Maintenance
2. Host Computer Time
3. Simulation Computer Time
4. Travel

(1) Maintenance

(# of Statements) (Change Rate) (Cost/Statement)

# of Statements = #25

Change Rate = Engineering Estimate = 10%/Flight

Cost/Statement = $45 Same as 4.8 (1) (3)

(1) Total = ((#25) ($45)) Per Yr.

(2) Host Computer Time

Ref. 4.8 (2)

(2) Total = ((1.4) (#25÷100) ($323)) Per Yr.

(3) Simulation Computer Time

Ref. 4.8 (3)

(3) Total ((7) (#25÷100) ($46.46)) Per Yr.

(4) Travel

(A) = ((.3) (# Man Yr.) ($9,725)) Per Yr.

(4) Total = ((30%) (#24÷833) ($9,725)) Per Yr.

Cost Element 5.1 Experiment Processor Acquisition

Cost Factors

1. Processor Hardware (I/O Included)

2. Development and Qualification

3. Special Test Equipment

(1) Processor Hardware

(A) = ((# of Processors) (Cost/Processor))

# of Processors = #34

Cost/Processor = $46K

(1) Total = ((#34) ($46K)) Per Yr.

(2) Development and Qualification

(A) = ((# Qualifications) (Cost/Qualification) Per Yr.

(2) Total =(1) ($520.3K) 1 Time Cost

(3) Special Test Equipment

Engineering Estimate = $5K/Unit

# of Units = #34

(# Units) ($5K) Per Yr.

(3) Total = ((#34) ($5K)) Per Yr.

GROUNDRULES FOR DEDICATED EXPERIMENT PROCESSOR

I. Central Experiment Computer Capacity = (Speed) and (Memory)

Speed = (500K Adds Per Second) (65%) 325 KADS

500 KADS = CII Specifications

65% = 100% - (15% Overhead) = (20% Contingency)

Memory = (Total Capacity) - (Contingency) -(Operating System)

Total Capacity = 64K CII Specifications

Contingency = 30% Engineering Estimate

Note: Low Compared to Industry Estimates (50% - 100%)

Operating System = 20K Memory Requirement ESA Estimate

(A) = 64K - 19.2K - 20K
= 24.8K

II. When a new payload exceeds central computer capacity, a DEP will be selected for the element that has the greatest capacity requirement. Each element having this requirement will be assigned a different DEP, except the case where one DEP is used on multiple missions.

III. Assume all Spacelab Review Item Disposition (RID's) for CDMS modifications are incorporated for mass memory, data bus, etc.

IV. Two classes of DEP's were considered:

(1) Micro Processor

(2) Mini Processor

Only 1 DEP will be specified.

V. Assume any non-standard DEP's selected will have support software that is executable on STIL host or STIL simulation computer.

VI. For any mission, assume that the required number of data bus RAU's can be provided.

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VII. Number of processors is determined by applying "Groundrules for DEP" to GDC provided software requirements.

Cost/Processor is determined by: processor class and configuration.

((Processor Hardware) + (Qualification) (Special I/O (RAU Equivalent) + (Special Test Equipment) + (Peripherals*) + (Peripherals Qualification))

Each element will be determined according to selected processor class and configuration.

*For Option IA1 only applies when central computer cannot support requirements.

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Cost Element 5.2 Experiment Processor Maintenance

Cost Factors

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. for Each Yr. Used

(1) Total = ((8% ($46K)) (#35)) Per Yr.

(2) Distribution

((Cost/Distribution) (# Required)) Per Yr.

(2) Total = ($500) (#36)

(3) Re-Furbishment

(A) = ((Number of DEPs) (Cost/Unit for Re-Furbishment)) Per Flight Per Yr.

Number of DEPs = Determined From Mission Model Requirements

(3) Total = Cost/Unit for Re-Furbishment = 0 Assumes DEPs will Meet Spacelab Lifetime Requirements

Cost Element 5.3 DEP Software

Cost Factors

1. Operating System Development

2. Support Software Development

(1) Operating System Development

(A) = ((Number of Instructions) (Cost Per Instruction))

Number of Instructions = 4K Engineering Estimate (M + S Study)

(1) Total = (4K) ($100) = 1 Time Cost

(2) Support Software Development

(A) = (Vendor Lease) or ((Number of Statements) (Cost Per Statement)

Assume Vendor Lease - $25K for Cross Assembler
25K for Cross Compiler
$50K (Engineering Estimate)

(2) Total = $50K 1 Time Cost.

Cost Element 5.4 DEP Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement))

Number of Statements = 4.0K Operating System
2.4K Cross Assembler
9.0K Cross Compiler
15.4K (Engineering Estimate)

Line #27 = # of DEPs Used/Yr.

Rate of Change = 5% Per Yr. When Used - (Engineering Estimate)

Cost Per Statement = $45

(1) Total = ((15.4K) (5%) ($45)) Per Yr.

(2) Distribution

(A) = (# Set Builds) (Cost/Set)-(# Deliveries)

(2) Total = (($50) (#35)) Per Yr.

Cost Elements 6.1, 6.2, 6.3, 6.4 - Real-Time Simulation Test Set
(Not Required for This Option - Use STIL)

Cost Element 7.1 PI Host Computer Software

Cost Factors

1. Distribution

2. Installation

3. Maintenance

(1) Distribution

(A) = (# Set Builds) (Cost/Set) (# Deliveries) Per Yr.

Set Builds = 2 (Support Software + Simulation Software)

Cost/Set = Engineering Estimate = 1 Man Week = $962

Deliveries = #34

(1) Total = ((2) ($962) (#34)) Per Yr.

(2) Installation

Engineering Estimate = 2 Man Weeks

= ($962) (2)

= $1924 Per Installation

(2) Total = (($1924) (#34)) Per Yr.

(3) Maintenance

Maintenance = Level of Effort*

*(Maintenance is Feed Back of Problems Encountered In Use of Distributed Software).

Level of Effort = Engineering Estimate

(3) Total = (($5K) (#35)) Per Yr.

SECTION 10 Option IIB3A - Distributed Standard Mini Software Development by PI at His Facility. Real-Time Simulation Testing at Central Facility

10.2 Cost Data

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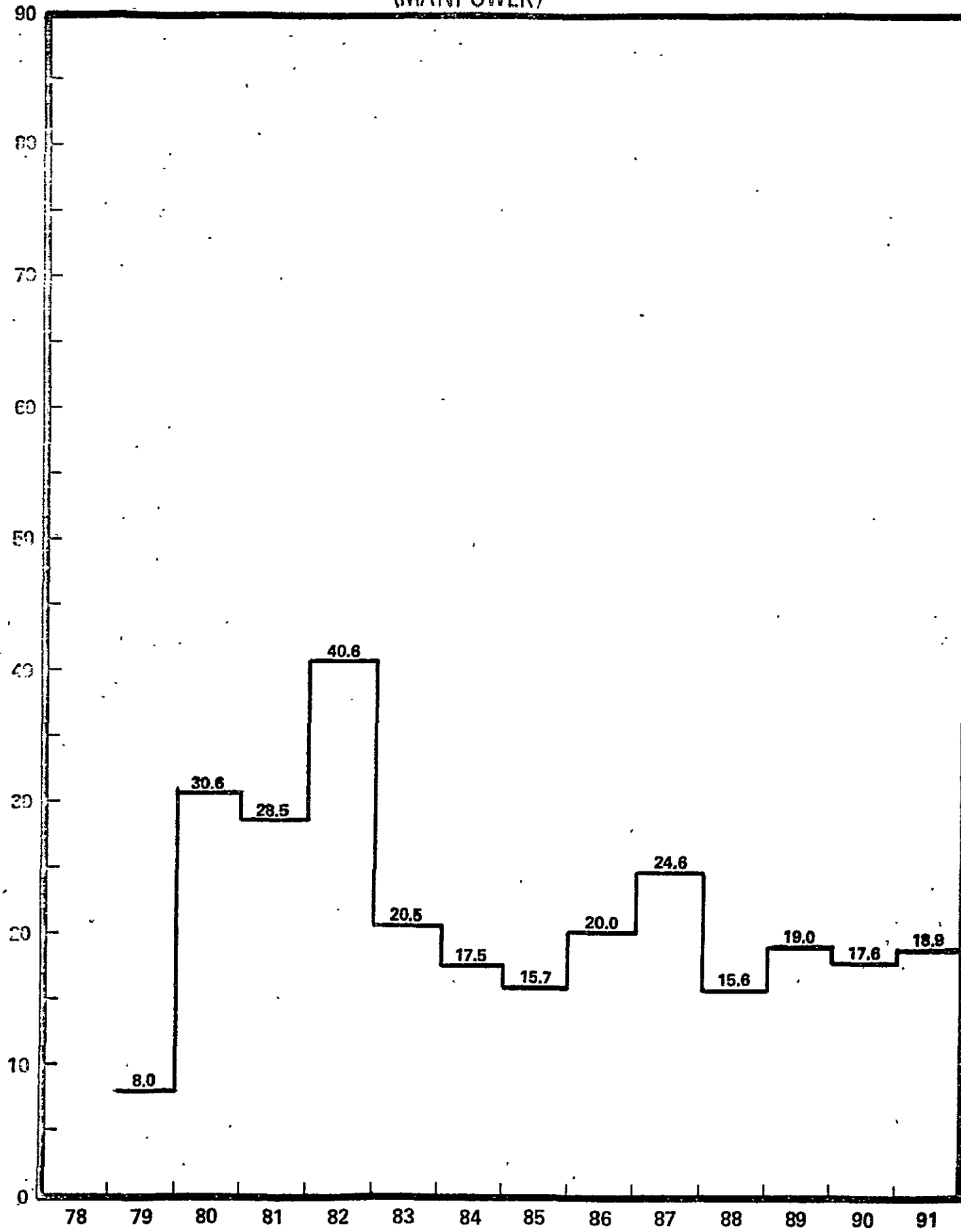
OPTION II B3A
(MANPOWER)



OPTION IIB3A TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1					312.34	926.29	520.18	76.65
4.2					0	213.34	279.27	500.12
4.3					0	0	0	0
4.4					623.15	222.56	667.66	178.04
4.5					0	62.32	26.82	106.83
4.6					7.91	0.53	-0.53	0.53
4.7					-	-	-	-
4.8					1103.02	393.94	1181.81	315.14
4.9					0	110.29	47.27	189.09
5.1				1234.30	204.00	102.00	51.00	510.00
5.2					58.52	69.24	85.60	78.60
5.3					450.00	0	0	0
5.4					35.35	34.95	35.85	35.15
6.1								
6.2								
6.3								
6.4								
7.1				53.88	85.40	97.70	103.84	138.48
TOTAL				1288.18	2879.69	2233.16	2999.83	2128.63
ESCALATED TOTAL				1688.54	4038.91	3351.67	4817.07	3657.38

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OPTION IIB3A TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	243.41	0	321.51	281.24	55.07	95.83	0	0
4.2	335.88	489.87	249.49	361.45	353.15	370.37	476.73	454.42
4.3	0	0	0	0	0	0	0	0
4.4	89.02	0	133.53	133.53	44.52	44.52	0	0
4.5	120.19	190.84	133.54	222.56	173.59	232.90	240.36	284.77
4.6	0.53	0.53	0.53	0.53	0.53	0.53	0.53	0.53
4.7	-	-	-	-	-	-	-	-
4.8	157.58	0	236.36	236.36	78.78	78.78	0	0
4.9	212.73	346.66	236.37	393.94	307.28	417.57	425.46	495.98
5.1	0	0	0	0	0	0	0	0
5.2	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
5.3	0	0	0	0	0	0	0	0
5.4	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
6.1								
6.2								
6.3								
6.4								
7.1	105.00	165.00	100.00	160.00	105.00	165.00	140.00	170.00
TOTAL	1382.32	1358.89	1532.23	1953.02	1241.40	1569.29	1424.62	1569.87
ESCALATED TOTAL	2541.34	2673.14	3225.12	4398.57	2991.58	4046.47	3930.57	4634.51
TOTAL COST		23,561.13						
ESCALATED TOTAL COST		45,994.87						

AVERAGE COST PER FLIGHT 203.52

EF11-One Time Form 2 (March 25, 1976)

OPTION IIB3A TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1					4.5	13.1	7.5	1.1
4.2					0	3.	4.	7.2
4.3								
4.4					7.8	2.8	8.4	2.2
4.5					0	.8	.3	1.3
4.6					-	-	-	-
4.7					-	-	-	-
4.8					17.6	6.3	18.9	5.0
4.9					0	1.8	.8	3.0
5.1					-	-	-	-
5.2								
5.3				8.0	0	0	0	0
5.4					.7	.7	.7	.7
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL MANPOWER				8.0	30.6	28.5	40.6	20.5

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OPTION IIB3A TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	3.5	0	4.7	4.1	.8	1.4	0	0
4.2	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
4.3								
4.4	1.1	0	1.7	1.7	.6	.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.	3.	3.6
4.6	-	-	-	-	-	-	-	-
4.7	-	-	-	-	-	-	-	-
4.8	2.5	0	3.8	3.8	1.3	1.3	0	0
4.9	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
5.1	-	-	-	-	-	-	-	-
5.2								
5.3	0	0	0	0	0	0	0	0
5.4	.7	.7	.7	.7	.7	.7	.7	.7
6.1								
6.2								
6.3								
6.4								
7.								
TOTAL MANPOWER	17.5	15.7	20.0	24.6	15.6	19.0	17.6	18.9

EF-One Time Form 5 (March 25, 1976)

OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1 EXPERIMENT APPLICATION SOFTWARE DEVELOPMENT								
1) SOFTWARE DEV.					222.30	656.82	372.69	55.80
2) COMMON SOFTWARE					0	0	0	0
3) HOST COMPUTER TIME					61.75	182.45	103.53	15.50
4) SIMULATION COMPUTER TIME					9.18	27.13	15.39	2.30
5) HOST COMPUTER TIME DEP SOFTWARE					0	0	0	0
6) SIMULATION COMPUTER TIME DEP SOFTWARE					0	0	0	0
7) TRAVEL					16.31	51.11	24.39	2.60
8) TRAINING					2.80	8.76	4.19	0.45
LABOR COST					222.30	656.82	372.69	55.80
MANPOWER					4.5	13.1	7.5	1.1
TOTAL COST					312.34	926.27	520.18	76.65

EF-One Time Form 3 (March 25, 1976)

OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1 EXPERIMENT APPLICATION SOFTWARE DEVELOPMENT								
1) SOFTWARE DEV.	177.17	0	233.24	203.67	39.06	60.75	0	0
2) COMMON SOFTWARE	0	0	0	0	0	0	0	0
3) HOST COMPUTER TIME	49.21	0	64.79	56.58	10.85	19.37	0	0
4) SIMULATION COMPUTER TIME	7.32	0	9.63	8.41	1.61	2.88	0	0
5) HOST COMPUTER TIME DEP SOFTWARE	0	0	0	0	0	0	0	0
6) SIMULATION COMPUTER TIME DEP SOFTWARE	0	0	0	0	0	0	0	0
7) TRAVEL	8.29	0	11.82	10.74	3.03	3.27	0	0
8) TRAINING	1.42	0	2.03	1.84	0.52	0.56	0	0
LABOR COST	177.17	0	233.24	203.67	39.06	69.75	0	0
MANPOWER	3.5	0	4.7	4.1	.8	1.4	0	0
TOTAL COST	243.41	0	321.51	281.24	55.07	95.83	0	0

EF-One Time Form 4 (March 25, 1976)

OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 EXPERIMENT APPLICATION SOFTWARE MAINTENANCE								
1) EXPERIMENT UNIQUE SOFTWARE					0	151.70	199.94	358.02
2) EXPERIMENT COMMON SOFTWARE					0	0	0	0
3) HOST COMPUTER TIME					0	42.50	55.52	99.45
4) SIMULATION COMPUTER TIME					0	6.32	8.26	14.79
5) HOST COMPUTER TIME DEP SOFTWARE					0	0	0	0
6) SIMULATION COMPUTER TIME DEP SOFTWARE					0	0	0	0
7) TRAVEL					0	11.82	15.55	27.86
LABOR COST					0	151.70	199.94	358.02
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	212.34	279.27	500.12

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 EXPERIMENT APPLICATION SOFTWARE MAINTENANCE								
1) EXPERIMENT UNIQUE SOFTWARE	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31
2) EXPERIMENT COMMON SOFTWARE	0	0	0	0	0	0	0	0
3) HOST COMPUTER TIME	66.80	92.41	49.61	71.88	70.23	73.65	80.02	90.36
4) SIMULATION COMPUTER	9.93	14.48	7.38	10.69	10.44	10.95	14.64	13.43
5) HOST COMPUTER TIME DEP SOFTWARE	0	0	0	0	0	0	0	0
6) SIMULATION COMPUTER TIME DEP SOFTWARE	0	0	0	0	0	0	0	0
7) TRAVEL	18.67	27.31	13.89	20.13	19.67	20.63	27.60	25.32
LABOR COST	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
TOTAL COST	335.88	489.87	249.49	361.45	353.15	370.37	476.73	454.42

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS SOFTWARE INTEGRATED VERIFICATION								
1) INTEGRATED VERIFICATION					0	0	0	0
2) HOST COMPUTER TIME					0	0	0	0
3) SIMULATION COMPUTER TIME					0	0	0	0
4) INTEGRATED VERIFICATION SIMULATION SOFTWARE					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

EF-One Time Form 3 (March 25, 1976)

OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS SOFTWARE INTEGRATED VERIFICATION								
1) INTEGRATED VERIFICATION	0	0	0	0	0	0	0	0
2) HOST COMPUTER TIME	0	0	0	0	0	0	0	0
3) SIMULATION COMPUTER TIME	0	0	0	0	0	0	0	0
4) INTEGRATED VERIFICATION SIMULATION SOFTWARE	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 PREFLIGHT CHECKOUT SOFTWARE								
D DEVELOPMENT								
1) SOFTWARE DEVELOPMENT					390.60	139.50	418.50	111.60
2) COMMON SOFTWARE					0	0	0	0
3) HOST COMPUTER TIME					162.75	58.13	174.38	46.50
4) SIMULATION COMPUTER TIME					24.20	8.64	25.92	6.91
5) TRAVEL					45.60	16.29	48.86	13.03
LABOR COST					390.60	139.50	418.50	111.60
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					623.15	222.56	667.66	178.04

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 PREFLIGHT CHECKOUT SOFTWARE DEVELOPMENT								
1) SOFTWARE DEV.	55.80	0	83.70	83.70	27.90	27.90	0	0
2) COMMON SOFTWARE	0	0	0	0	0	0	0	0
3) HOST COMPUTER TIME	23.25	0	34.88	34.88	11.63	11.63	0	0
4) SIMULATION COMPUTER TIME	3.46	0	5.18	5.18	1.73	1.73	0	0
5) TRAVEL	6.51	0	9.77	9.77	3.26	3.26	0	0
LABOR COST	55.80	0	83.70	83.70	27.90	27.90	0	0
MANPOWER	1.1	0	1.7	1.7	.6	.6	0	0
TOTAL COST	89.02	0	133.53	133.53	44.52	44.52	0	0

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 PREFLIGHT CHECKOUT SOFTWARE MAINTENANCE								
1) EXPERIMENT UNIQUE SOFTWARE					0	39.06	16.74	66.96
2) EXPERIMENT COMMON SOFTWARE					0	0	0	0
3) HOST COMPUTER TIME					0	16.28	6.98	27.90
4) SIMULATION COMPUTER TIME					0	2.42	1.04	4.15
5) TRAVEL					0	4.56	2.06	7.82
LABOR COST					0	39.06	16.74	66.96
MANPOWER					0	.8	.3	1.3
TOTAL COST					0	62.32	26.82	106.83

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 PREFLIGHT CHECKOUT SOFTWARE MAINTENANCE								
1) EXPERIMENT UNIQUE SOFTWARE	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
2) EXPERIMENT COMMON SOFTWARE	0	0	0	0	0	0	0	0
3) HOST COMPUTER TIME	31.39	51.15	34.88	58.13	45.34	61.61	62.78	74.40
4) SIMULATION COMPUTER TIME	4.67	7.60	5.18	8.64	6.74	9.16	9.33	11.06
5) TRAVEL	8.80	14.33	9.77	16.29	12.70	17.26	17.59	20.75
LABOR COST	75.33	122.76	83.70	139.50	103.81	147.87	150.66	178.56
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	120.19	190.84	133.54	222.56	173.59	232.90	240.36	248.77

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS DEPENDENT STIL HARDWARE SUPPLEMENT								
1) HOST MAIN MEMORY					0	0	0	0
2) REMOTE JOB ENTRY					0	0	0	0
3) DISPLAY TERMINALS					7.91	0	0	0
4) MAINTENANCE					0	.53	.53	.53
5) TELECOMMUNI-CATIONS					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					7.91	.53	.53	.53

EF-One Time Form 3 (March 25, 1976)

OPTION IIB3A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS DEPENDENT STIL HARDWARE SUPPLEMENT								
1) HOST MAIN MEMORY	0	0	0	0	0	0	0	0
2) REMOTE JOB ENTRY	0	0	0	0	0	0	0	0
3) DISPLAY TERMINALS	0	0	0	0	0	0	0	0
4) MAINTENANCE	.53	.53	.53	.53	.53	.53	.53	.53
5) TELECOMMUNI-CATIONS	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	.53	.53	.53	.53	.53	.53	.53	.53

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 EXPERIMENT REAL-TIME SIMULATION SOFTWARE DEVELOPMENT								
1) SOFTWARE DEVELOPMENT					882.00	315.00	945.00	252.00
2) HOST COMPUTER TIME					88.63	31.65	94.96	25.32
3) SIMULATION COMPUTER TIME					63.74	22.77	68.30	18.21
4) TRAVEL					68.65	24.52	73.55	19.61
LABOR COST					882.00	315.00	945.00	252.00
MANPOWER					17.6	6.3	18.9	5.0
TOTAL COST					1103.02	393.94	1181.81	315.14

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 EXPERIMENT REAL-TIME SIMULATION SOFTWARE DEVELOPMENT								
1) SOFTWARE DEVELOPMENT	126.00	0	189.00	189.00	63.00	63.00	0	0
2) HOST COMPUTER TIME	12.66	0	18.99	18.99	6.33	6.33	0	0
3) SIMULATION COMPUTER TIME	9.11	0	13.66	13.66	4.55	4.55	0	0
4) TRAVEL	9.81	0	14.71	14.71	4.90	4.90	0	0
LABOR COST	126.00	0	189.00	189.00	63.00	63.00	0	0
MANPOWER	2.5	0	3.8	3.8	1.3	1.3	0	0
TOTAL COST	157.58	0	236.36	236.36	78.78	78.78	0	0

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 EXPERIMENT REAL-TIME SIMULATION SOFTWARE MAINTENANCE								
1) MAINTENANCE					0	88.20	37.80	151.20
2) HOST COMPUTER TIME					0	8.86	3.80	15.19
3) SIMULATION COMPUTER TIME					0	6.37	2.73	10.93
4) TRAVEL					0	6.86	2.94	11.77
LABOR COST					0	88.20	37.80	151.20
MANPOWER					0	1.8	0.8	3.0
TOTAL COST					0	110.29	47.27	189.09

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 EXPERIMENT REAL-TIME SIMULATION SOFTWARE MAINTENANCE								
1) MAINTENANCE	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
2) HOST COMPUTER TIME	17.09	27.86	19.00	31.65	24.69	33.55	34.19	38.26
3) SIMULATION COMPUTER TIME	12.30	20.03	13.66	22.77	17.76	24.13	24.59	29.14
4) TRAVEL	13.24	21.57	14.71	24.52	19.13	25.99	26.48	31.38
LABOR COST	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
MANPOWER	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
TOTAL COST	212.73	346.66	236.37	393.94	307.28	417.57	425.46	495.93

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 EXPERIMENT PROCESSOR ACQUISITION								
1) PROCESSOR HARDWARE				644.00	184.00	92.00	46.00	460.00
2) QUALIFICATION				520.30	0	0	0	0
3) SPECIAL TEST EQUIPMENT				70.00	20.00	10.00	5.00	50.00
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST				0	0	0	0	0
MANPOWER				0	0	0	0	0
TOTAL COST				1234.30	204.00	102.00	51.00	510.00

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 EXPERIMENT PROCESSOR ACQUISITION								
1) PROCESSOR HARDWARE	0	0	0	0	0	0	0	0
2) QUALIFICATION	0	0	0	0	0	0	0	0
3) SPECIAL TEST EQUIPMENT	0	0	0	0	0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB 3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 EXPERIMENT PROCESSOR MAINTENANCE								
1) MAINTENANCE					51.52	66.24	73.60	73.60
2) DISTRIBUTION					7.00	3.00	12.00	5.00
3) RE-FURBISHMENT					0	0	0	0
LABOR COST					58.52	69.24	85.60	78.60
MANPOWER					1.2	1.4	1.7	1.6
TOTAL COST					58.52	69.24	85.60	78.60

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 EXPERIMENT PROCESSOR MAINTENANCE								
1) MAINTENANCE	77.28	121.44	73.60	117.76	77.28	121.44	103.04	125.12
2) DISTRIBUTION	5.50	9.00	11.50	10.00	10.50	7.00	3.50	4.00
3) RE-FURBISHMENT	0	0	0	0	0	0	0	0
LABOR COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
MANPOWER	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
TOTAL COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.1[illegible]

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP SOFTWARE DEVELOPMENT & PROCUREMENT								
1) OPERATING SYSTEM DEVELOPMENT					400.00	0	0	0
2) SUPPORT SOFTWARE PROCUREMENT					50.00	0	0	0
LABOR COST					400.00	0	0	0
MANPOWER					8.0	0	0	0
TOTAL COST					450.00	0	0	0

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OPTION HB3A- ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP SOFTWARE DEVELOPMENT & PROCUREMENT								
1) OPERATING SYSTEM DEVELOPMENT	0	0	0	0	0	0	0	0
2) SUPPORT SOFTWARE PROCUREMENT	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3A ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5A DEP SOFTWARE MAINTENANCE & DISTRIBUTION								
1) MAINTENANCE					34.65	34.65	34.65	34.65
2) DISTRIBUTION					0.70	0.30	1.20	.50
LABOR COST					35.35	34.95	35.85	35.15
MANPOWER					.7	.7	.7	.7
TOTAL COST					35.35	34.95	35.85	35.15

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OPTION IIB3A ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5A DEP SOFTWARE MAINTENANCE & DISTRIBUTION								
1) MAINTENANCE	34.65	34.65	34.65	34.65	34.65	34.65	34.65	34.65
2) DISTRIBUTION	0.55	0.90	1.15	1.00	1.05	0.70	0.35	0.40
LABOR COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
MANPOWER	.7	.7	.7	.7	.7	.7	.7	.7
TOTAL COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05

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OPTION IIB3a ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
7.1 PI Host Computer Software								
(1) Distribution				26.94	7.70	3.85	1.92	19.24
(2) Installation				26.94	7.70	3.85	1.92	19.24
(3) Maintenance				0	70.00	90.00	100.00	100.00
LABOR COST				53.88	85.40	97.70	103.84	138.48
MANPOWER				1.1	1.7	2.0	2.1	2.8
TOTAL COST				53.88	85.40	97.70	103.84	138.48

EF-One Time Form 3 (March 25, 1976)

OPTION IIB3a ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
7.1 PI Host Computer Software								
(1) Distribution	0	0	0	0	0	0	0	0
(2) Installation	0	0	0	0	0	0	0	0
(3) Maintenance	105.00	165.00	100.00	160.00	105.00	165.00	140.00	170.00
LABOR COST	105.00	165.00	100.00	160.00	105.00	165.00	140.00	170.00
MANPOWER	2.1	3.3	2.2	3.2	2.1	3.3	2.8	3.4
TOTAL COST	105.00	165.00	100.00	160.00	105.00	165.00	140.00	170.00

EF-One Time Form 4 (March 25, 1976)

SECTION 11 Option IIB3B - Distributed Standard Mini Software Development by PI at His Facility Using RTSTS

11.1 Costing Method

ASSUMPTIONS

All experiment application dependent software will be implemented in DEP's.

PI utilizes RTSTS to develop and checkout all EAS software.

DEP is local to PI facility for all Level IV activities.

Common library is not possible due to independent PI software development.

Only one mini development/qualification is required.

No PI/PI integration is required due to independence of resource sharing. Central computer integration testing is still required.

Fewer total mini's are required due to sharing of a pool of processors.

Only one DEP operating system development is required.

Cost Element 4.1 <u>Experiment Application Software Development</u>

Cost Factor

1. Software Development

(A) = ((# of Statements) (Cost/Statement)) Per Yr.

# of Statements = (#3 + #4)

Cost/Statement = $45

(1) Total = ((#3 + #4) ($45)) Per Yr.

Cost Element 4.2 EAS Maintenance

Cost Factor

1. Maintenance

(A) = ((# of Statements) (Rate of Change) (Cost/Statement)) Per Yr.

# of Statements = #13

Cost/Statement = $45

(1) Total = ((#13) ($45)) Per Yr.

Cost Element 4.3 Integrated Verification

Total = 0 for This Option

Cost Element 4.4 <u>Preflight C/O Software Development</u>

Cost Factor

1. Software Development

(A) ((# of HOL Statements) (Cost/Statement)) Per Yr

# of Statements = #22

Cost/Statement = $30

(1) Total = ((#22) ($30)) Per Yr.

PREFLIGHT SOFTWARE SIZING RATIONALE

Saturn History

LVDC/DA interface signals	=	86
LVDC/DA # instructions	=	4,650
average # instructions/signal	=	54

ATM History

ATMDC interface signals	=	275
ATMDC # instructions	=	7,897
average # instructions/signal	=	29

Mission 8 of Spacelab

# interface signals	=	81.6
# payload elements	=	1.3
average # interface signals	=	62.77

Assume preflight job for each payload element is the same and equivalent to Saturn LVDC = 4,650 instructions.

$= \frac{4,650}{5} = 930$ HOL statements at a cost of $30/Statement.

Number of Statements = Number of HOL Statements per Payload Element X # Payload Elements = 930 X PE/Yr. (New Flight)

Cost/Statement = $30

Cost Element 4.5 Preflight C/O Software Maintenance

Cost Factors

1. Maintenance

(A) = ((# of HOL Statements) (Rate of Change) (Cost/Statement)) Per Yr.

Statements = #23

Cost/Statement = $30

(1) Total = ((#23) ($30)) Per Yr.

Cost Element 4.6 EAS Dependant STIL Hardware Modifications

Total = 0 for This Option

Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factor

1. Software Development

(A) = ((# of Statements) (Cost/Statement)) Per Yr.

# of Statements = #24

Cost/Statement = $45

(1) Total = ((#24) ($45)) Per Yr.

Rationale for Simulation Software Required for Payload Elements

Engineering Estimate - 21K Table Words Per Payload Element for Simulation Software.

Engineering Estimate that 21K Table Words Equates to Approximately 1/3 X 21K = 7K Machine Language Instructions.

7K ÷ 5 = 1.4K HOL Statements

1.4K X $45/Statement = $63K/Payload Element

Cost Element 4.9 Experiment Real-Time Software Maintenance

Cost Factors

1. Maintenance

(A) = ((# of Statements) (Rate of Change) (Cost/Statement)) Per Yr.

Statements = #25

Cost/Statement = $45

(1) Total = ((#25) ($45)) Per Yr.

Cost Element 5.1 Experiment Processor Acquisition

Cost Factors

1. Processor Hardware (I/O Included)

2. Development and Qualification

3. Special Test Equipment

(1) Processor Hardware

(A) = ((# of Processors) (Cost/Processor))

# of Processors = #34

Cost/Processor = $46K

(1) Total = ((#34) ($46K)) Per Yr.

(2) Development Qualification

(A) = ((# of Qualifications) (Cost/Qualification)) Per Yr.

# of Qualifications = 1 (One Time Cost FY79)

(2) Total = Cost/Qualification = $520.3K

(3) Special Test Equipment

(A) = ((# of Units) (Cost/Unit)) Per Yr.

Units = #34

Cost/Unit = Engineering Estimate = $5K

(3) Total = ((#34) ($5K)) Per Yr.

Cost Element 5.2 Experiment Processor Maintenance

Cost Factors

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. for Each Yr. Used

(1) Total = ((8% ($46K)) (#33)) Per Yr.

(2) Distribution

(A) = ((Cost/Distribution) (# Required)) Per Yr.

(2) Total = (($500) (#36)) Per Yr.

(3) Re-Furbishment

(A) = (Number of DEP's) (Cost/Unit for Re-Furbishment)) Per Flight Per Yr.

Number of DEP's = Determined From Mission Model Requirements

(3) Total = Cost/Unit for Re-Furbishment = 0 Assumes DEP's will meet Spacelab Lifetime Requirements.

Cost Element 5.3 DEP Software

Cost Factors

1. Operating System Development

2. Support Software Development

(1) Operating System Development

(A) = ((Number of Instructions) (Cost Per Instruction))

Number of Instructions = 4K Engineering Estimate (M&S Study)

Cost Per Instruction = $100 (Assembly Language)

(1) Total = (4K) ($100) = 1 time cost

(2) Support Software Development

(A) = (Vendor Lease) or (Number of Statements) (Cost Per Statement)

Assume Vendor Lease - $25K for Cross Assembler
25K for Cross Compiler
$50K (Engineering Estimate)

(2) Total = ($50K).1 Time Cost

Cost Element 5.4 DEP Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement))

Number of Statements = 15.4K Total

Line #2.7 = # of DEP's Used/Yr.

Rate of Change = 5% Per Yr. When Used - (Engineering Estimate)

Cost Per Statement = $45

(1) Total = ((15.4K) (5%) ($45)) Per Yr.

(2) Distribution

(A) = ((# Set Builds) (Cost/Set) (# Deliveries)

Set Builds = 1

Cost/Set = $50

Deliveries = #36

(2) Total = ((1) ($50) (#36)) Per Yr.

Cost Element 6.1 Real-Time Simulation Test Set Acquistion (RTSTS)

Cost Factors

1. Engineering Design
2. Simulation Computer
3. Dedicated Experiment Processor (DEP) Interface
4. RTSTS Integration
5. Consumable Stock

(1) (2) (3) & (4) = Engineering Estimate = $312K/RTSTS

(1) (2) (3) & (4) Total = (($312K) (#34)) Per Yr.

(5) Consumable Stock

(5) Total = 0 for This Option

Cost Element 6.2 Real-Time Simulation Test Set Maintenance Second Operation

Cost Factors

1. Maintenance
2. Distribution
3. Operation
4. Special Purpose Equipment
5. Consumables
6. Re-Furbishment
7. Facility Modifications

(1) Maintenance and (4) Special Test Equipment

(Cost/Yr.) (# RTSTS's Used/Yr.)

(8%) (Purchase Cost) (# RTSTS's Used/Yr.)

(8%) ($187K) (# RTSTS's Used/Yr.)

(1) & (4) Total = ($15K) (#35)

(2) Distribution

Total = (Cost/Yr. for Distribution/Sustaining Engineering) (# RTSTS's Used/Yr.)

(2) Total = (($500) (#36)) Per Yr.

(3) Operation

Total = (Operating Cost/Yr.) (# RTSTS's Used/Yr.)
Operating Cost/Yr.) (# RTSTS's Used/Yr.)

(3) Total = 0 for This Option

Note: No Operations Cost for RTSTS - Operated by Programming Staff.

(4) Special Purpose Equipment

Included as Part of 6.2 (1)

(5) Consumables

Total = (Cost/Yr.) (# RTSTS's Used/Yr.)

Cost/Yr. = Engineering Estimate = $12,250

(5) Total = (($12,250) (#37)) Per Yr.

(6) Re-Furbishment

Assumed Covered by Maintenance in Item 6.2 (1)

(7) Facility Modifications

Assume space available and no cost associated with A/C and power service room A/C adequate and standard power service available.

Cost Element 6.3 Simulation Computer Software Development and Procurement

Cost Factors

1. Simulation Computer Software Development

2. Simulation Computer Software Procurement

(1) Simulation Computer Software Development

Engineering Estimate - Same as Rationale on 3.3 (1) for STIL Simulation Computer

Total = (# Modules) (100 Statement/Modules) (Cost/Statement)

= (58) (100) ($60)

(1) Total = ($348K) 1 Time Cost FY79

(2) Simulation Computer Software Development

Engineering Estimate = Real-Time Operating System = ($4K) (Simulation Computer)

(2) Total = ($4K) 1 Time Cost FY79

Cost Element 6.4 RTSTS Support Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

Total = (Number Instructions) (Rate of Change) (Cost/Instruction)

The above was considered by an Engineering Estimate was made instead which is - 1 Man Per Yr. of Usage. This is compatible with the level of effort charged for the STIL simulation computer software in 3.4.

(1) Total = ($50K) Per Yr. Starting in FY79

(2) Distribution

(A) = ((# Set Builds) (Cost/Set) (# Deliveries)) Per Yr.

Set Builds = 1

Cost/Set = $962 (1 Man Week)

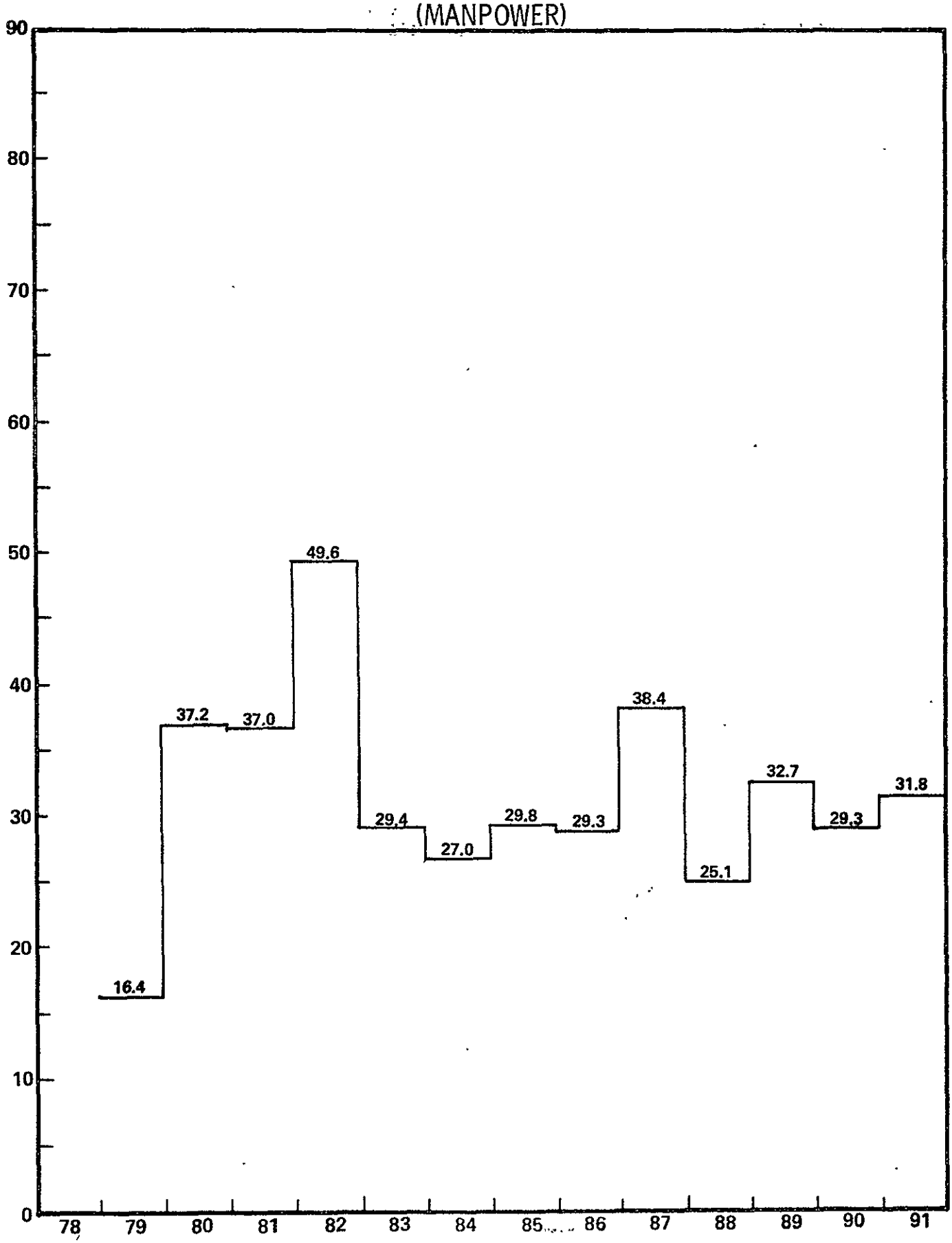
Deliveries = #36

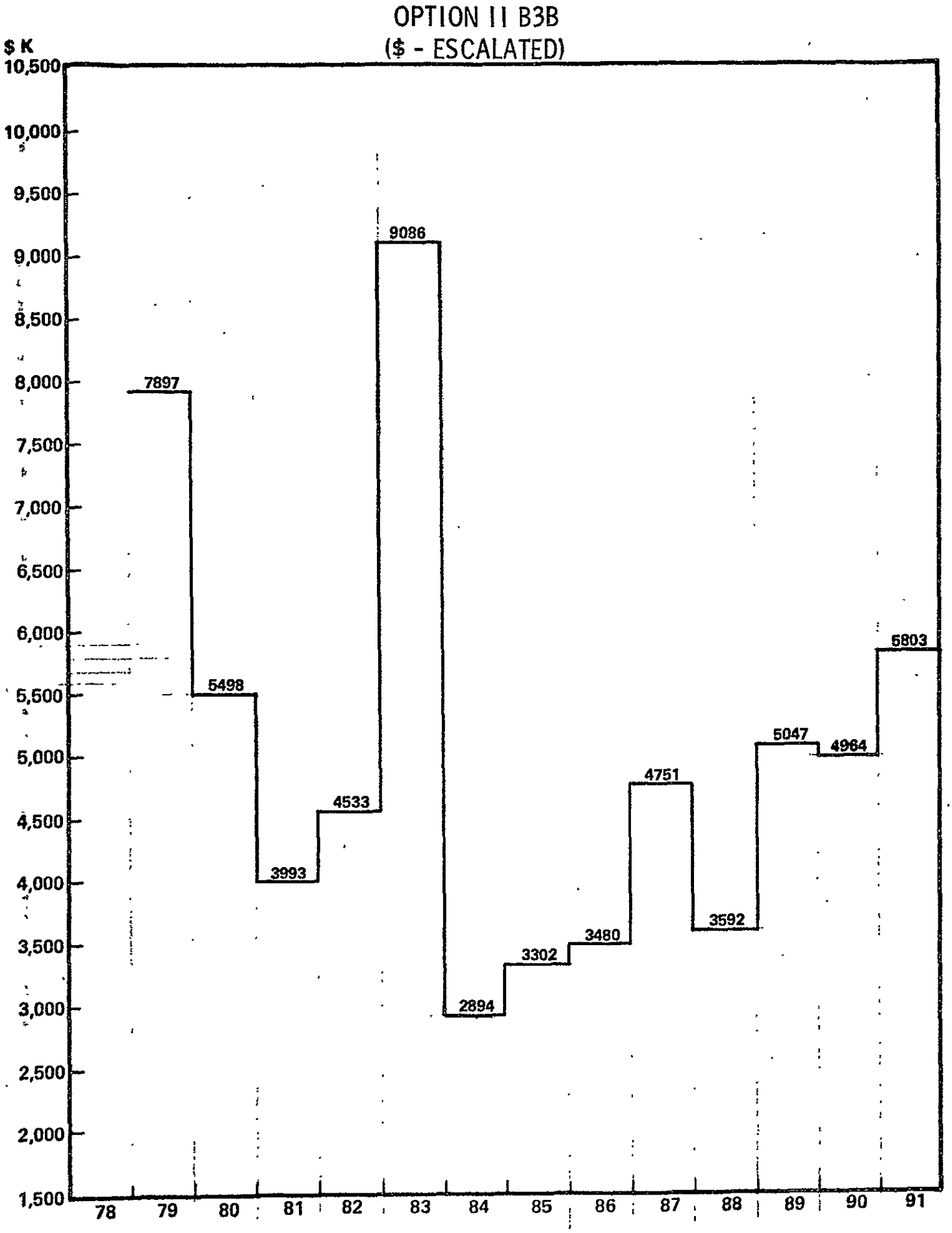
(2) Total = ((1) ($962) (#36)) Per Yr.

SECTION 11 Option IIB3B - Distributed Standard Mini Software Development by PI at His Facility Using RTSTS

11.2 Cost Data

OPTION II B3B
(MANPOWER)




OPTION II B3B
($ - ESCALATED)
$ K
10,500
10,000
9,500
9,000
8,500
8,000
7,500
7,000
6,500
6,000
5,500
5,000
4,500
4,000
3,500
3,000
2,500
2,000
1,500
7897
5498
3993
4533
9086
2894
3302
3480
4751
3592
5047
4964
5803
78
79
80
81
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83
84
85
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89
90
91

OPTION IIB3b TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				0	222.30	656.82	372.60	55.00
4.2				0	0	151.70	199.94	358.02
4.3				0	0	0	0	0
4.4				0	390.60	139.50	418.50	111.60
4.5				0	0	39.06	16.74	66.96
4.6				0	0	0	0	0
4.7				---	---	---	---	---
4.8				0	882.00	315.00	745.00	252.00
4.9				0	0	88.20	37.80	151.20
5.1				1234.30	204.00	102.00	51.00	510.00
5.2				0	58.52	69.24	85.60	78.60
5.3				0	450.00	0	0	0
5.4				0	35.35	34.95	35.85	35.15
6.1				4368.00	1248.00	624.00	312.00	3120.00
6.2				7.00	372.25	367.76	488.75	489.75
6.3				352.00	0	0	0	0
6.4				63.47	55.77	73.09	59.60	60.58
7.1				0	0	0	0	0
TOTAL				6024.77	3918.79	2661.31	2823.38	5288.36
ESCALATED TOTAL				7897.24	5498.06	3993.91	4533.73	9086.39

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OPTION IIB3b TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	177.17	0	233.24	203.67	39.06	69.75	0	0
4.2	240.48	350.67	178.61	258.79	252.81	765.14	354.47	325.31
4.3	0	0	0	0	0	0	0	0
4.4	55.00	0	83.70	83.70	27.90	27.90	0	0
4.5	75.33	122.76	83.70	139.50	108.31	147.87	150.66	178.56
4.6	0	0	0	0	0	0	0	0
4.7	---	---	---	---	---	---	---	---
4.8	126.00	0	189.00	189.00	63.00	63.00	0	0
4.9	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
5.1	0	0	0	0	0	0	0	0
5.2	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
5.3	0	0	0	0	0	0	0	0
5.4	35.20	35.55	35.00	35.65	35.70	35.35	35.00	35.05
6.1	0	0	0	0	0	0	0	0
6.2	544.50	690.25	506.00	686.50	567.00	829.25	754.75	844.75
6.3	0	0	0	0	0	0	0	0
6.4	67.32	72.13	69.24	70.20	63.47	56.73	57.70	50.00
7.1	0	0	0	0	0	0	0	0
TOTAL	1574.68	1679.00	1653.39	2109.77	1490.73	1957.33	1799.32	1965.99
ESCALATED TOTAL	2894.26	3302.59	3480.39	4751.20	3592.66	5047.95	4964.32	5803.60
TOTAL COST		34,946.82						
ESCALATED TOTAL COST		64,846.30						

AVERAGE COST PER FLIGHT 286.93

[illegible] Form 2 (March 25, 1976)

OPTION IIB3b TOTAL MANPOWER PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				---	4.5	13.1	7.5	1.1
4.2				---	0	3.	4.	7.2
4.3				---	0	0	0	0
4.4				---	7.8	2.8	8.4	2.2
4.5				---	0	.8	.3	1.3
4.6				---	---	---	---	---
4.7				---	---	---	---	---
4.8				---	17.6	6.3	18.9	5.
4.9				---	0	1.8	.8	3.
5.1				---	---	---	---	---
5.2				---	1.2	1.4	1.7	1.6
5.3				8.0	0	0	0	0
5.4				---	.7	.7	.7	.7
6.1				---	---	---	---	---
6.2				0.1	---	---	---	---
6.3				7.0	4.3	5.6	6.1	6.1
6.4				1.3	1.1	1.5	1.2	1.2
7.1				---	---	---	---	---
TOTAL MANPOWER				16.4	37.2	37.0	49.6	29.4

FF-One Time Form 6 (March 25, 1976)

OPTION IIB3b TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	3.5	0	4.7	4.1	.8	1.4	0	0
4.2	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
4.3	0	0	0	0	0	0	0	0
4.4	1.1	0	1.7	1.7	.6	.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
4.6	---	---	---	---	---	---	---	---
4.7	---	---	---	---	---	---	---	---
4.8	2.5	0	3.8	3.8	1.3	1.3	0	0
4.9	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
5.1	---	---	---	---	---	---	---	---
5.2	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
5.3	0	0	0	0	0	0	0	0
5.4	.7	.7	.7	.7	.7	.7	.7	.7
6.1	---	---	---	---	---	---	---	---
6.2	6.5	10.1	6.2	9.8	6.4	10.0	8.5	9.3
6.3	0	0	0	0	0	0	0	0
6.4	1.3	1.4	1.4	1.4	1.3	1.1	1.1	1.0
7.1	---	---	---	---	---	---	---	---
TOTAL MANPOWER	27.0	29.8	29.3	38.4	25.1	32.7	29.3	31.8

OPTION IIB3b ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1 Experiment Application Software Development								
(1) Software Development					222.30	656.82	372.60	55.00
(2) Common Software					0	0	0	0
(3) Host Computer Time					---	---	---	---
(4) Simulation Computer Time					---	---	---	---
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					---	---	---	---
(8) Training					---	---	---	---
LABOR COST					222.30	656.82	372.69	55.80
MANPOWER					4.5	13.1	7.5	1.1
TOTAL COST					222.30	656.82	372.69	55.80

FE-Cost Time Form 3 (March 25, 1976)

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1 Experiment Application Software Development								
(1) Software Development	177.17	0	233.24	203.67	39.06	79.75	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	---	---	---	---	---	---	---	---
(4) Simulation Computer Time	---	---	---	---	---	---	---	---
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	---	---	---	---	---	---	---	---
(8) Training	---	---	---	---	---	---	---	---
LABOR COST	177.17	0	233.24	203.67	39.06	69.75	0	0
MANPOWER	3.5	0	4.7	4.1	.8	1.4	0	0
TOTAL COST	177.17	0	233.24	203.67	39.06	69.75	0	0

OPTION IIB3b ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software					0	151.70	199.94	358.02
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	---	---	---
(4) Simulation Computer Time					0	---	---	---
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	---	---	---
LABOR COST					0	151.70	109.94	358.02
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	151.70	109.94	358.02

FF-One Time Form 3 (March 25, 1976)

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software	240.48	350.67	178.61	258.79	252.81	265.41	354.47	325.31
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	---	---	---	---	---	---	---	---
(4) Simulation Computer Time	---	---	---	---	---	---	---	---
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	---	---	---	---	---	---	---	---
LABOR COST	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
TOTAL COST	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31

OPTION HB36 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS Software Integrated Verification								
(1) Integrated Verification					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Integrated Verification Simulation Software					0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST					0	0	0	0

FE-Qcc Tim Form 3 (March 25, 1976)

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS Software Integrated Verification								
(1) Integrated Verification	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Integrated Verification Simulation Software	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 Preflight Checkout Software Development								
(1) Software Development					390.60	139.50	418.50	111.60
(2) Common Software					0	0	0	0
(3) Host Computer Time					---	---	---	---
(4) Simulation Computer Time					---	---	---	---
(5) Travel					---	---	---	---
LABOR COST					390.60	139.50	418.50	111.60
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					390.60	139.50	418.50	111.60

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 Preflight Checkout Software Development								
(1) Software Development	55.80	0	83.70	83.70	27.90	27.90	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	---	---	---	---	---	---	0	0
(4) Simulation Computer Time	---	0	---	---	---	---	0	0
(5) Travel	---	0	---	---	---	---	0	0
LABOR COST	55.80	0	83.70	83.70	27.90	27.90	0	0
MANPOWER	1.1	0	1.7	1.7	.6	.6	0	0
TOTAL COST	55.80	0	83.70	83.70	27.90	27.90	0	0

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software					0	39.06	16.74	66.96
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	---	---	---
(4) Simulation Computer Time					0	---	---	---
(5) Travel					0	---	---	---
LABOR COST					0	39.06	16.74	66.96
MANPOWER					0	.8	.3	1.3
TOTAL COST					0	39.06	16.74	66.96

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software	75.33	122.76	83.70	139.50	108.31	147.87	150.66	178.56
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	---	---	---	---	---	---	---	---
(4) Simulation Computer Time	---	---	---	---	---	---	---	---
(5) Travel	---	---	---	---	---	---	---	---
LABOR COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56

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OPTION IIB3b ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory					0	0	0	0
(2) Remote Job Entry					0	0	0	0
(3) Display Terminals					0	0	0	0
(4) Maintenance					0	0	0	0
(5) Telecom-munications					0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST					0	0	0	0

OPTION IIB3b ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory	0	0	0	0	0	0	0	0
(2) Remote Job Entry	0	0	0	0	0	0	0	0
(3) Display Terminals	0	0	0	0	0	0	0	0
(4) Maintenance	0	0	0	0	0	0	0	0
(5) Telecom-munications	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development					882.00	315.00	745.00	252.00
(2) Host Computer Time					---	---	---	---
(3) Simulation Computer Time					---	---	---	---
(4) Travel					---	---	---	---
LABOR COST					882.00	315.00	745.00	252.00
MANPOWER					17.6	6.3	18.9	5.0
TOTAL COST					882.00	315.00	945.00	252.00

OPTION IIB 3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development	126.00	0	189.00	189.00	63.00	63.00	0	0
(2) Host Computer Time	---	0	---	---	---	---	0	0
(3) Simulation Computer Time	---	0	---	---	---	---	0	0
(4) Travel	---	0	---	---	---	---	0	0
LABOR COST	126.00	0	189.00	189.00	63.00	63.00	0	0
MANPOWER	2.5	0	3.8	3.8	1.3	1.3	0	0
TOTAL COST	126.00	0	189.00	189.00	63.00	63.00	0	0

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance					0	88.20	37.80	151.20
(2) Host Computer Time					0	---	---	---
(3) Simulation Computer Time					0	---	---	---
(4) Travel					0	---	---	---
LABOR COST					0	88.20	37.80	151.20
MANPOWER					0	1.8	0.8	3.0
TOTAL COST					0	88.20	37.80	151.20

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OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
(2) Host Computer Time	---	---	---	---	---	---	---	---
(3) Simulation Computer Time	---	---	---	---	---	---	---	---
(4) Travel	---	---	---	---	---	---	---	---
LABOR COST	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
MANPOWER	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
TOTAL COST	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 Experiment Processor Acquisition								
(1) Processor Hardware				644.00	184.00	92.00	46.00	460.00
(2) Qualification				520.30				
(3) Special Test Equipment				70.00	20.00	10.00	5.00	50.00
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST				1234.30	204.00	102.00	51.00	510.00
MANPOWER								
TOTAL COST								

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OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 Experiment Processor Acquisition								
(1) Processor Hardware	0	0	0	0	0	0	0	0
(2) Qualification	0	0	0	0	0	0	0	0
(3) Special Test Equipment	0	0	0	0	0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 Experiment Processor Maintenance								
(1) Maintenance					51.52	66.24	73.60	73.60
(2) Distribution					7.00	3.00	12.00	5.00
(3) Re-Furbishment					0	0	0	0
LABOR COST					58.52	69.24	85.60	78.60
MANPOWER					1.2	1.4	1.7	1.6
TOTAL COST					58.52	69.24	85.60	78.60

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 Experiment Processor Maintenance								
(1) Maintenance	77.28	121.44	73.60	117.76	77.28	121.44	103.04	125.12
(2) Distribution	5.50	9.00	11.50	10.00	10.50	7.00	3.50	4.00
(3) Re-Furbishment	0	0	0	0	0	0	0	0
LABOR COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
MANPOWER	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
TOTAL COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP Software Development & Procurement								
(1) Operating System Development				400.00	0	0	0	0
(2) Support Software Procurement				50.00	0	0	0	0
LABOR COST				400.00	0	0	0	0
MANPOWER				8.00	0	0	0	0
TOTAL COST				450.00	0	0	0	0

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP Software Development & Procurement								
(1) Operating System Development	0	0	0	0	0	0	0	0
(2) Support Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance					34.65	34.65	34.65	34.65
(2) Distribution					0.70	0.30	1.20	0.50
LABOR COST					35.35	34.95	35.85	35.15
MANPOWER					.7	.7	.7	.7
TOTAL COST					35.35	34.95	35.85	35.15

OPTION _____ IIB3b _____ ELEMENT COST PAGE _____ OF _____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance	34.65	34.65	34.65	34.65	34.65	34.65	34.65	34.65
(2) Distribution	0.55	0.90	1.15	1.00	1.05	0.70	0.35	0.40
LABOR COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
MANPOWER	.7	.7	.7	.7	.7	.7	.7	.7
TOTAL COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.1 Real-Time Simulation Test Set (RTSTS) Acquisition								
(1) Engineering Design								
(2) Simulation Computer								
(3) Dedicated Experiment Processor (DEP) Interface				4368.00	1248.00	624.00	312.00	3120.00
(4) RTSTS Integration				0	0	0	0	0
(5) Consumable Stock								
LABOR COST								
MANPOWER								
TOTAL COST				4368.00	1248.00	624.00	312.00	3120.00

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.3 Real-Time Simulation Test Set (RTSTS) Acquisition								
(1) Engineering Design								
(2) Simulation Computer								
(3) Dedicated Experiment Processor (DEP) Interface	0	0	0	0	0	0	0	0
(4) RTSTS Integration	0	0	0	0	0	0	0	0
(5) Consumable Stock								
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.2 RTSTS Maintenance Operation & Distribution								
(1) Maintenance				---	210.00	270.00	300.00	300.00
(2) Distribution				7.00	3.00	12.00	5.00	5.50
(3) Operation				---	---	---	---	---
(4) Special Purpose Equipment				---	---	---	---	---
(5) Consumables				---	159.25	85.75	183.75	183.75
(6) Re-Furbishment				---	---	---	---	---
(7) Facility Modifications				0	0	0	0	0
LABOR COST				7.0	213.00	282.00	305.00	305.50
MANPOWER				0.1	4.3	5.6	6.1	6.1
TOTAL COST				7.00	372.25	367.75	483.75	489.25

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.2 RTSTS Maintenance Operation & Distribution								
(1) Maintenance	315.00	495.00	300.00	480.00	315.00	495.00	420.00	465.00
(2) Distribution	9.00	11.50	10.00	10.50	7.00	3.50	4.00	---
(3) Operation	---	---	---	---	---	---	---	---
(4) Special Purpose Equipment	---	---	---	---	---	---	---	---
(5) Consumables	220.50	183.75	196.00	196.00	245.00	330.75	330.75	379.75
(6) Re-Furbishment	---	---	---	---	---	---	---	---
(7) Facility Modifications	0	0	0	0	0	0	0	0
LABOR COST	324.00	506.50	310.00	490.50	322.00	498.50	424.00	465.00
MANPOWER	6.5	10.1	6.2	9.8	6.4	10.0	8.5	9.3
TOTAL COST	544.50	690.25	506.00	686.50	567.00	829.25	754.75	844.75

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.3 RTSTS Support Software Development & Procurement								
(1) Simulation Computer Software Development				348.00	0	0	0	0
(2) Simulation Computer Software Procurement				4.00	0	0	0	0
LABOR COST				348.00	0	0	0	0
MANPOWER				7.00	0	0	0	0
TOTAL COST				352.00	0	0	0	0

OPTION IIB3b ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.3 RTSTS Support Software Development & Procurement								
(1) Simulation Computer Software Development	0	0	0	0	0	0	0	0
(2) Simulation Computer Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.4 RTSTS Support Software Maintenance & Distribution								
(1) Maintenance				50.00	50.00	50.00	50.00	50.00
(2) Distribution				13.47	5.77	23.09	9.60	10.58
LABOR COST				63.47	55.77	73.09	59.60	60.58
MANPOWER				1.3	1.1	1.5	1.2	1.2
TOTAL COST				63.47	55.77	73.09	59.60	60.58

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OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.4 RTSTS Support Software Maintenance & Distribution								
(1) Maintenance	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
(2) Distribution	17.32	22.13	19.24	20.20	13.47	6.73	7.70	0
LABOR COST	67.32	72.13	69.24	70.20	63.47	56.73	7.70	50.00
MANPOWER	1.3	1.4	1.4	1.4	1.3	1.1	1.1	1.0
TOTAL COST	67.32	72.13	69.24	70.20	63.47	56.73	57.70	50.00

OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
7.1 PI Host Computer Software								
(1) Distribution				0	0	0	0	0
(2) Installation				0	0	0	0	0
(3) Maintenance				0	0	0	0	0
LABOR COST				0	0	0	0	0
MANPOWER				0	0	0	0	0
TOTAL COST				0	0	0	0	0

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OPTION IIB3b ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
7.1 PI Host Computer Software								
(1) Distribution	0	0	0	0	0	0	0	0
(2) Installation	0	0	0	0	0	0	0	0
(3) Maintenance	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

SECTION 12 Option IIB4 - Distributed Standard Mini Software Development by PI at His Non-Compatible Facility

12.1 Costing Method

ASSUMPTIONS

Identical to Option IIB3b because RTSTS is assumed to be used for mini software development.

Cost Element 4.1 <u>Experiment Application Software Development</u>

Cost Factor

1. Software Development

(A) = ((# of Statements) (Cost/Statement)) Per Yr.

# of Statements = (#3 + #4)

Cost/Statement = $45

(1) Total = ((#3 + #4) ($45)) Per Yr.

Cost Element 4.2 <u>EAS Maintenance</u>

Cost Factor

1. Maintenance

(A) = ((# of Statements) (Rate of Change) (Cost/Statement)) Per Yr.

# of Statements = #13

Cost/Statement = $45

(1) Total = ((#13) ($45)) Per Yr.

Cost Element 4.3 Integrated Verification

Total = 0 for This Option

Cost Element 4.4 <u>Preflight C/O Software Development</u>

Cost Factor

1. Software Development

(A) ((# of HOL Statements) (Cost/Statement)) Per Yr.

# of Statements = #22

Cost/Statement = $30

(1) Total = ((#22) ($30)) Per Yr.

PREFLIGHT SOFTWARE SIZING RATIONALE

Saturn History

LVDC/DA interface signals	=	86
LVDC/DA # instructions	=	4,650
average # instructions/signal	=	54

ATM History

ATMDC interface signals	=	275
ATMDC # instructions	=	7,897
average # instructions/signal	=	29

Mission 8 of Spacelab

# interface signals	=	81.6
# payload elements	=	1.3
average # interface signals	=	62.7$\dot{7}$

Assume preflight job for each payload element is the same and equivalent to Saturn LVDC = 4,650 instructions.

$$= \frac{4,650}{5} = 930 \text{ HOL statements at a cost of \$30/Statement.}$$

Number of Statements = Number of HOL Statements per Payload Element X # Payload Elements = 930 X PE/Yr. (New Flight)

Cost/Statement = $30

Cost Element 4.5 <u>Preflight C/O Software Maintenance</u>

Cost Factors

1. Maintenance

(A) = ((# of HOL Statements) (Rate of Change) (Cost/Statement)) Per Yr.

Statements = #23

Cost/Statement = $30

(1) Total = ((#23) ($30)) Per Yr.

Cost Element 4.6 EAS Dependant STIL Hardware Modifications

Total = 0 for This Option

Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factor

1. Software Development

(A) = ((# of Statements) (Cost/Statement)) Per Yr.

# of Statements = #24

Cost/Statement = $45

(1) Total = ((#24) ($45)) Per Yr.

Rationale for Simulation Software Required for Payload Elements

Engineering Estimate - 21K Table Words Per Payload Element for Simulation Software.

Engineering Estimate that 21K Table Words Equates to Approximately 1/3 X 21K = 7K Machine Language Instructions.

7K ÷ 5 = 1.4K HOL Statements

1.4K X $45/Statement = $63K/Payload Element

Cost Element 4.9 Experiment Real-Time Software Maintenance

Cost Factors

1. Maintenance

(A) = ((# of Statements) (Rate of Change) (Cost/Statement)) Per Yr.

Statements = #25

Cost/Statement = $45

(1) Total = ((#25) ($45)) Per Yr.

Cost Element 5.1 Experiment Processor Acquisition

Cost Factors

1. Processor Hardware (I/O Included)

2. Development and Qualification

3. Special Test Equipment

(1) Processor Hardware

(A) = ((# of Processors) (Cost/Processor))

# of Processors = #34

Cost/Processor = $46K

(1) Total = ((#34) ($46K)) Per Yr.

(2) Development Qualification

(A) = ((# of Qualifications) (Cost/Qualification)) Per Yr.

# of Qualifications = 1 (One Time Cost FY79)

(2) Total = Cost/Qualification = $520.3K

(3) Special Test Equipment

(A) = ((# of Units) (Cost/Unit)) Per Yr.

Units = #34

Cost/Unit = Engineering Estimate = $5K

(3) Total = ((#34) ($5K)) Per Yr.

Cost Element 5.2 Experiment Processor Maintenance

Cost Factors

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. for Each Yr. Used

(1) Total = ((8% ($46K)) (#33)) Per Yr.

(2) Distribution

(A) = ((Cost/Distribution) (# Required)) Per Yr.

(2) Total = (($500) (#36)) Per Yr.

(3) Re-Furbishment

(A) = (Number of DEP's) (Cost/Unit for Re-Furbishment)) Per Flight Per Yr.

Number of DEP's = Determined From Mission Model Requirements

(3) Total = Cost/Unit for Re-Furbishment = 0 Assumes DEP's will meet Spacelab Lifetime Requirements.

Cost Element 5.3 DEP Software

Cost Factors

1. Operating System Development

2. Support Software Development

(1) Operating System Development

(A) = ((Number of Instructions) (Cost Per Instruction))

Number of Instructions = 4K Engineering Estimate (M&S Study)

Cost Per Instruction = $100 (Assembly Language)

(1) Total = (4K) ($100) = 1 time cost

(2) Support Software Development

(A) = (Vendor Lease) or (Number of Statements) (Cost Per Statement)

Assume Vendor Lease - $25K for Cross Assembler
25K for Cross Compiler
$50K (Engineering Estimate)

(2) Total = ($50K) 1 Time Cost

Cost Element 5.4 DEP Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement))

Number of Statements = 15.4K Total

Line #27 = # of DEP's Used/Yr.

Rate of Change = 5% Per Yr. When Used - (Engineering Estimate)

Cost Per Statement = $45

(1) Total = ((15.4K) (5%) ($45)) Per Yr.

(2) Distribution

(A) = ((# Set Builds) (Cost/Set) (# Deliveries)

Set Builds = 1

Cost/Set = $50

Deliveries = #36

(2) Total = ((1) ($50) (#36)) Per Yr.

Cost Element 6.1 Real-Time Simulation Test Set Acquistion (RTSTS)

Cost Factors

1. Engineering Design
2. Simulation Computer
3. Dedicated Experiment Processor (DEP) Interface
4. RTSTS Integration
5. Consumable Stock

(1) (2) (3) & (4) = Engineering Estimate = $312K/RTSTS

(1) (2) (3) & (4) Total = (($312K) (#34)) Per Yr.

(5) Consumable Stock

(5) Total = 0 for This Option

Cost Element 6.2 Real-Time Simulation Test Set Maintenance Second Operation

Cost Factors

1. Maintenance
2. Distribution
3. Operation
4. Special Purpose Equipment
5. Consumables
6. Re-Furbishment
7. Facility Modifications

(1) Maintenance and (4) Special Test Equipment

(Cost/Yr.) (# RTSTS's Used/Yr.)

(8%) (Purchase Cost) (# RTSTS's Used/Yr.)

(8%) ($187K) (# RTSTS's Used/Yr.)

(1) & (4) Total = ($15K) (#35)

(2) Distribution

Total = (Cost/Yr. for Distribution/Sustaining Engineering) (# RTSTS's Used/Yr.)

(2) Total = (($500) (#36)) Per Yr.

(3) Operation

Total = (Operating Cost/Yr.) (# RTSTS's Used/Yr.) Operating Cost/Yr.) (# RTSTS's Used/Yr.)

(3) Total = 0 for This Option

Note: No Operations Cost for RTSTS - Operated by Programming Staff.

(4) Special Purpose Equipment

Included as Part of 6.2 (1)

(5) Consumables

Total = (Cost/Yr.) (# RTSTS's Used/Yr.)

Cost/Yr. = Engineering Estimate = $12,250

(5) Total = (($12,250) (#37)) Per Yr.

(6) Re-Furbishment

Assumed Covered by Maintenance in Item 6.2 (1)

(7) Facility Modifications

Assume space available and no cost associated with A/C and power service room A/C adequate and standard power service available.

Cost Element 6.3 Simulation Computer Software Development and Procurement

Cost Factors

1. Simulation Computer Software Development

2. Simulation Computer Software Procurement

(1) Simulation Computer Software Development

Engineering Estimate - Same as Rationale on 3.3 (1) for STIL Simulation Computer

Total = (# Modules) (100 Statement/Modules) (Cost/Statement)

= (58) (100) ($60)

(1) Total = ($348K) 1 Time Cost FY79

(2) Simulation Computer Software Development

Engineering Estimate = Real-Time Operating System = ($4K) (Simulation Computer)

(2) Total = ($4K) 1 Time Cost FY79

Cost Element 6.4 RTSTS Support Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

Total = (Number Instructions) (Rate of Change) (Cost/Instruction)

The above was considered by an Engineering Estimate was made instead which is - 1 Man Per Yr. of Usage. This is compatible with the level of effort charged for the STIL simulation computer software in 3.4.

(1) Total = ($50K) Per Yr. Starting in FY79

(2) Distribution

(A) = ((# Set Builds) (Cost/Set) (# Deliveries)) Per Yr.

Set Builds = 1

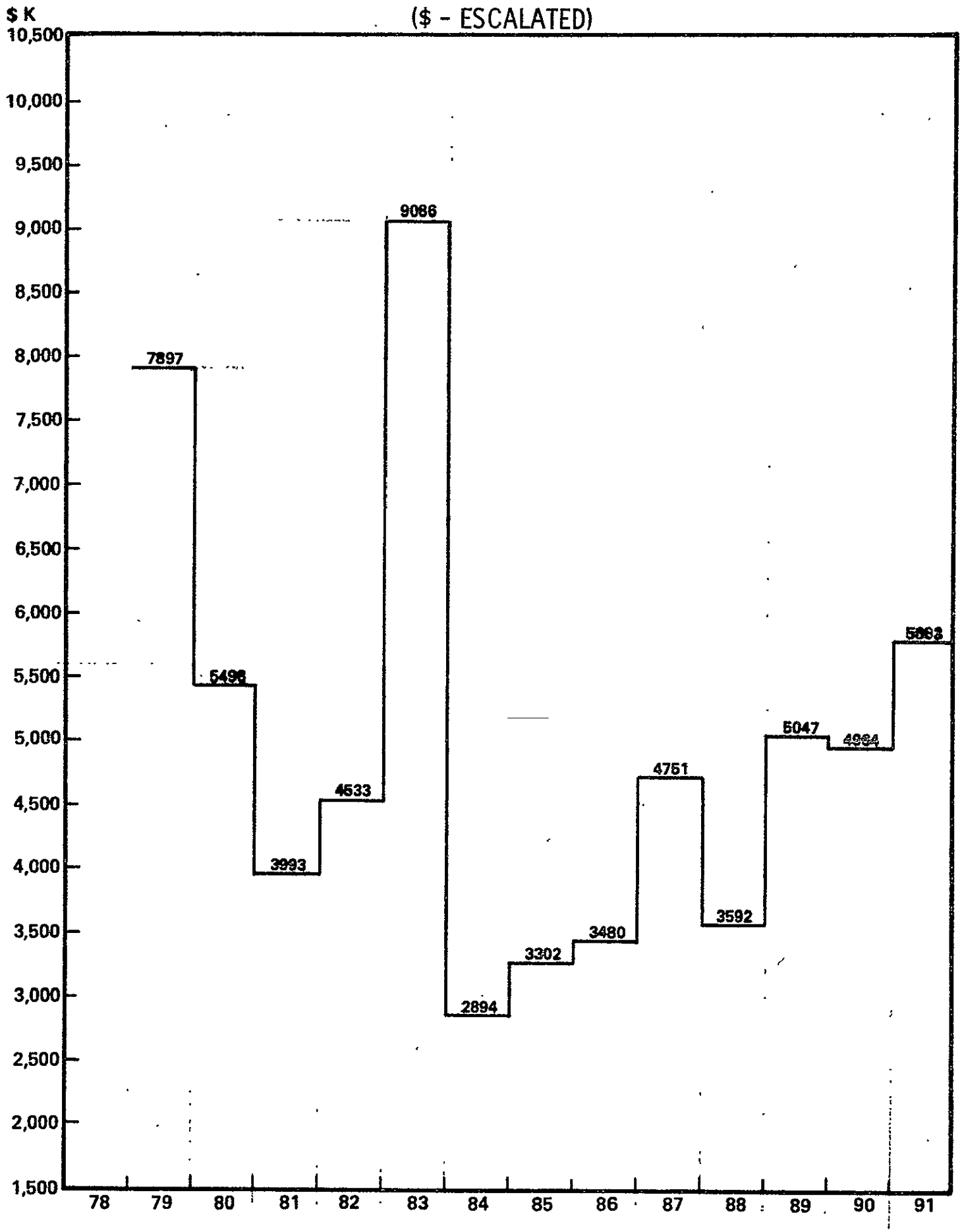
Cost/Set = $962 (1 Man Week)

Deliveries = #36

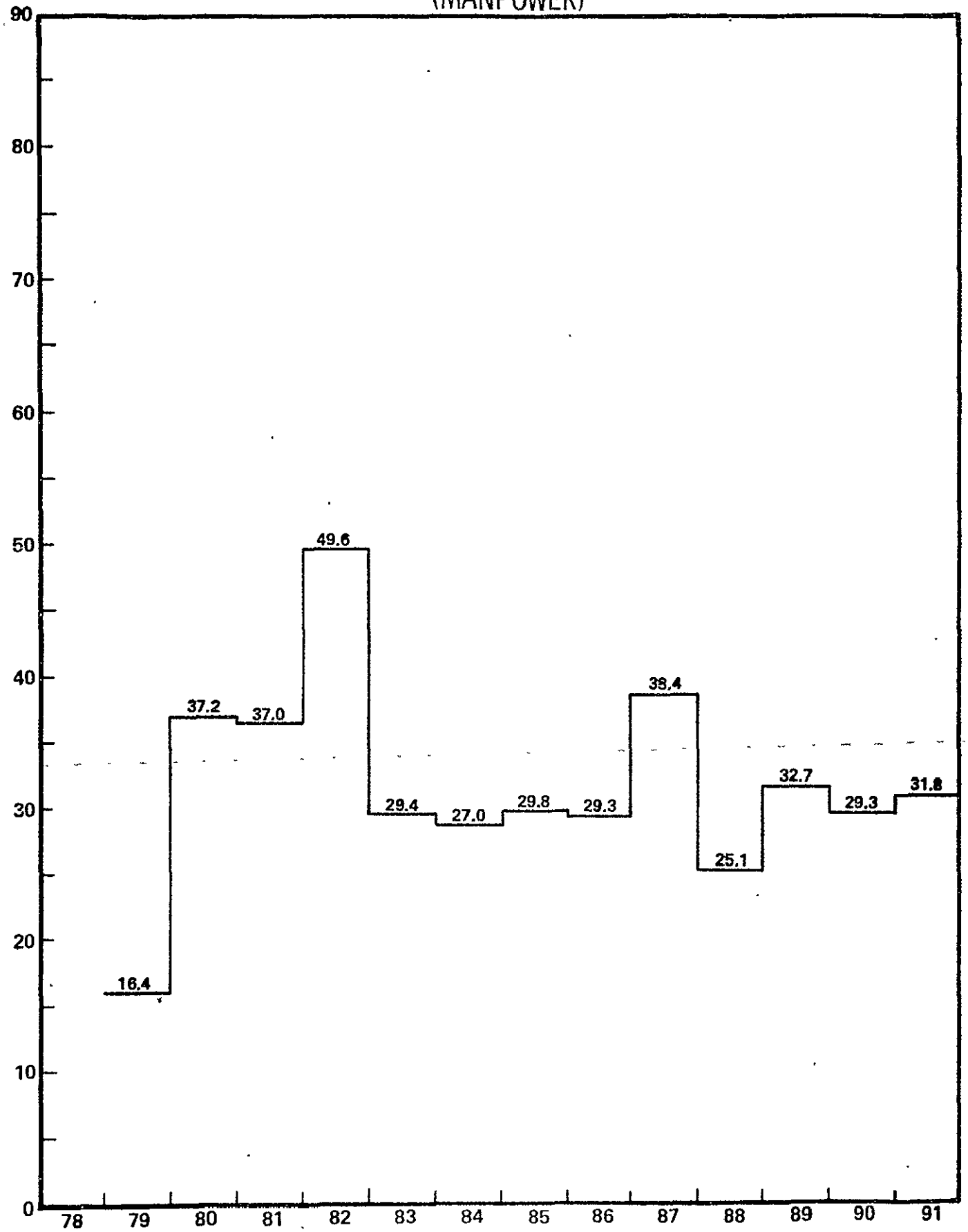
(2) Total = ((1) ($962) (#36)) Per Yr.

12.2 Cost Data

OPTION II B4
($ - ESCALATED)



OPTION II B4
(MANPOWER)



OPTION IIB4 TOTAL COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				0	222.30	656.82	372.60	55.00
4.2				0	0	151.70	199.94	358.02
4.3				0	0	0	0	0
4.4				0	390.60	139.50	418.50	111.60
4.5				0	0	39.06	16.74	66.96
4.6				0	0	0	0	0
4.7				---	---	---	---	---
4.8				0	882.00	315.00	745.00	252.00
4.9				0	0	88.20	37.80	151.20
5.1				1234.30	204.00	102.00	51.00	510.00
5.2				0	58.52	69.24	85.60	78.60
5.3				0	450.00	0	0	0
5.4				0	35.35	34.95	35.85	35.15
6.1				4368.00	1248.00	624.00	312.00	3120.00
6.2				7.00	372.25	367.76	488.75	489.75
6.3				352.00	0	0	0	0
6.4				63.47	55.77	73.09	59.60	60.58
7.1				0	0	0	0	0
TOTAL				6024.77	3918.79	2661.31	2823.38	5288.36
ESCALATED TOTAL				7897.24	5498.06	3993.91	4533.73	9086.39

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OPTION IIB4 TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	177.17	0	233.24	203.67	39.06	69.75	0	0
4.2	240.48	350.67	178.61	258.79	252.81	765.14	354.47	325.31
4.3	0	0	0	0	0	0	0	0
4.4	55.00	0	83.70	83.70	27.90	27.90	0	0
4.5	75.33	122.76	83.70	139.50	108.31	147.87	150.66	178.56
4.6	0	0	0	0	0	0	0	0
4.7	---	---	---	---	---	---	---	---
4.8	126.00	0	189.00	189.00	63.00	63.00	0	0
4.9	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
5.1	0	0	0	0	0	0	0	0
5.2	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
5.3	0	0	0	0	0	0	0	0
5.4	35.20	35.55	35.00	35.65	35.70	35.35	35.00	35.05
6.1	0	0	0	0	0	0	0	0
6.2	544.50	690.25	506.00	686.50	567.00	829.25	754.75	844.75
6.3	0	0	0	0	0	0	0	0
6.4	67.32	72.13	69.24	70.20	63.47	56.73	57.70	50.00
7.1	0	0	0	0	0	0	0	0
TOTAL	1574.68	1679.00	1653.39	2109.77	1490.73	1957.33	1799.32	1965.99
ESCALATED TOTAL	2894.26	3302.59	3480.39	4751.20	3592.66	5047.95	4964.32	5803.60
TOTAL COST		34,946.82						
ESCALATED TOTAL COST		64,846.30						

AVERAGE COST PER FLIGHT 286.93

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OPTION IIB4 TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				---	4.5	13.1	7.5	1.1
4.2				---	0	3.	4.	7.2
4.3				---	0	0	0	0
4.4				---	7.8	2.8	8.4	2.2
4.5				---	0	.8	.3	1.3
4.6				---	---	---	---	---
4.7				---	---	---	---	---
4.8				---	17.6	6.3	18.9	5.
4.9				---	0	1.8	.8	3.
5.1				---	---	---	---	---
5.2				---	1.2	1.4	1.7	1.6
5.3				8.0	0	0	0	0
5.4				---	.7	.7	.7	.7
6.1				---	---	---	---	---
6.2				0.1	---	---	---	---
6.3				7.0	4.3	5.6	6.1	6.1
6.4				1.3	1.1	1.5	1.2	1.2
7.1				---	---	---	---	---
TOTAL MANPOWER				16.4	37.2	37.0	49.6	29.4

EF-One Time Form 6 (March 25, 1976)

OPTION IIB4 TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	3.5	0	4.7	4.1	.8	1.4	0	0
4.2	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
4.3	0	0	0	0	0	0	0	0
4.4	1.1	0	1.7	1.7	.6	.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
4.6	---	---	---	---	---	---	---	---
4.7	---	---	---	---	---	---	---	---
4.8	2.5	0	3.8	3.8	1.3	1.3	0	0
4.9	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
5.1	---	---	---	---	---	---	---	---
5.2	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
5.3	0	0	0	0	0	0	0	0
5.4	.7	.7	.7	.7	.7	.7	.7	.7
6.1	---	---	---	---	---	---	---	---
6.2	6.5	10.1	6.2	9.8	6.4	10.0	8.5	9.3
6.3	0	0	0	0	0	0	0	0
6.4	1.3	1.4	1.4	1.4	1.3	1.1	1.1	1.0
7.1	---	---	---	---	---	---	---	---
TOTAL MANPOWER	27.0	29.8	29.3	38.4	25.1	32.7	29.3	31.8

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1 Experiment Application Software Development								
(1) Software Development					222.30	656.82	372.60	55.00
(2) Common Software					0	0	0	0
(3) Host Computer Time					---	---	---	---
(4) Simulation Computer Time					---	---	---	---
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					---	---	---	---
(8) Training					---	---	---	---
LABOR COST					222.30	656.82	372.69	55.80
MANPOWER					4.5	13.1	7.5	1.1
TOTAL COST					222.30	656.82	372.69	55.80

EF-One Time Form 3 (March 25, 1976)

OPTION HB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1 Experiment Application Software Development								
(1) Software Development	177.17	0	233.24	203.67	39.06	79.75	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	---	---	---	---	---	---	---	---
(4) Simulation Computer Time	---	---	---	---	---	---	---	---
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	---	---	---	---	---	---	---	---
(8) Training	---	---	---	---	---	---	---	---
LABOR COST	177.17	0	233.24	203.67	39.06	69.75	0	0
MANPOWER	3.5	0	4.7	4.1	.8	1.4	0	0
TOTAL COST	177.17	0	233.24	203.67	39.06	69.75	0	0

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software					0	151.70	199.94	358.02
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	---	---	---
(4) Simulation Computer Time					0	---	---	---
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	---	---	---
LABOR COST					0	151.70	109.94	358.02
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	151.70	109.94	358.02

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software	240.48	350.67	178.61	258.79	252.81	265.41	354.47	325.31
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	---	---	---	---	---	---	---	---
(4) Simulation Computer Time	---	---	---	---	---	---	---	---
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	---	---	---	---	---	---	---	---
LABOR COST	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
TOTAL COST	240.48	350.67	178.61	258.75	252.81	265.14	354.47	325.31

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS Software Integrated Verification								
(1) Integrated Verification					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Integrated Verification Simulation Software					0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST					0	0	0	0

EF-One Time Form 3 (March 25, 1976)

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS Software Integrated Verification								
(1) Integrated Verification	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Integrated Verification Simulation Software	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 Preflight Checkout Software Development								
(1) Software Development					390.60	139.50	418.50	111.60
(2) Common Software					0	0	0	0
(3) Host Computer Time					---	---	---	---
(4) Simulation Computer Time					---	---	---	---
(5) Travel					---	---	---	---
LABOR COST					390.60	139.50	418.50	111.60
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					390.60	139.50	418.50	111.60

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OPTION ____ IID4 ____ ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 Preflight Checkout Software Development								
(1) Software Development	55.80	0	83.70	83.70	27.90	27.90	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	---	---	---	---	---	---	0	0
(4) Simulation Computer Time	---	0	---	---	---	---	0	0
(5) Travel	---	0	---	---	---	---	0	0
LABOR COST	55.80	0	83.70	83.70	27.90	27.90	0	0
MANPOWER	1.1	0	1.7	1.7	.6	.6	0	0
TOTAL COST	55.80	0	83.70	83.70	27.90	27.90	0	0

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software					0	39.06	16.74	66.96
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	---	---	---
(4) Simulation Computer Time					0	---	---	---
(5) Travel					0	---	---	---
LABOR COST					0	39.06	16.74	66.96
MANPOWER					0	.8	.3	1.3
TOTAL COST					0	39.06	16.74	66.96

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software	75.33	122.76	83.70	139.50	108.31	147.87	150.66	178.56
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	---	---	---	---	---	---	---	---
(4) Simulation Computer Time	---	---	---	---	---	---	---	---
(5) Travel	---	---	---	---	---	---	---	---
LABOR COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory					0	0	0	0
(2) Remote Job Entry					0	0	0	0
(3) Display Terminals					0	0	0	0
(4) Maintenance					0	0	0	0
(5) Telecom-munications					0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST					0	0	0	0

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory	0	0	0	0	0	0	0	0
(2) Remote Job Entry	0	0	0	0	0	0	0	0
(3) Display Terminals	0	0	0	0	0	0	0	0
(4) Maintenance	0	0	0	0	0	0	0	0
(5) Telecom-munications	0	0	0	0	0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development					882.00	315.00	745.00	252.00
(2) Host Computer Time					---	---	---	---
(3) Simulation Computer Time					---	---	---	---
(4) Travel					---	---	---	---
LABOR COST					882.00	315.00	745.00	252.00
MANPOWER					17.6	6.3	18.9	5.0
TOTAL COST					882.00	315.00	945.00	252.00

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development	126.00	0	189.00	189.00	63.00	63.00	0	0
(2) Host Computer Time	---	0	---	---	---	---	0	0
(3) Simulation Computer Time	---	0	---	---	---	---	0	0
(4) Travel	---	0	---	---	---	---	0	0
LABOR COST	126.00	0	189.00	189.00	63.00	63.00	0	0
MANPOWER	2.5	0	3.8	3.8	1.3	1.3	0	0
TOTAL COST	126.00	0	189.00	189.00	63.00	63.00	0	0

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance					0	88.20	37.80	151.20
(2) Host Computer Time					0	---	---	---
(3) Simulation Computer Time					0	---	---	---
(4) Travel					0	---	---	---
LABOR COST					0	88.20	37.80	151.20
MANPOWER					0	1.8	0.8	3.0
TOTAL COST					0	88.20	37.80	151.20

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
(2) Host Computer Time	---	---	---	---	---	---	---	---
(3) Simulation Computer Time	---	---	---	---	---	---	---	---
(4) Travel	---	---	---	---	---	---	---	---
LABOR COST	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20
MANPOWER	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
TOTAL COST	170.10	277.20	189.00	315.00	245.70	333.90	340.20	403.20

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 Experiment Processor Acquisition								
(1) Processor Hardware				644.00	184.00	92.00	46.00	460.00
(2) Qualification				520.30				
(3) Special Test Equipment				70.00	20.00	10.00	5.00	50.00
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST				1234.30	204.00	102.00	51.00	510.00
MANPOWER								
TOTAL COST								

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 Experiment Processor Acquisition								
(1) Processor Hardware	0	0	0	0	0	0	0	0
(2) Qualification	0	0	0	0	0	0	0	0
(3) Special Test Equipment	0	0	0	0	0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 Experiment Processor Maintenance								
(1) Maintenance					51.52	66.24	73.60	73.60
(2) Distribution					7.00	3.00	12.00	5.00
(3) Re-Furbishment					0	0	0	0
LABOR COST					58.52	69.24	85.60	78.60
MANPOWER					1.2	1.4	1.7	1.6
TOTAL COST					58.52	69.24	85.60	78.60

FE Q.[illegible] Time Form 3 (March 25, 1976)

OPTION XB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 Experiment Processor Maintenance								
(1) Maintenance	77.28	121.44	73.60	117.76	77.28	121.44	103.04	125.12
(2) Distribution	5.50	9.00	11.50	10.00	10.50	7.00	3.50	4.00
(3) Re-Furbishment	0	0	0	0	0	0	0	0
LABOR COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
MANPOWER	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
TOTAL COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP Software Development & Procurement								
(1) Operating System Development				400.00	0	0	0	0
(2) Support Software Procurement				50.00	0	0	0	0
LABOR COST				400.00	0	0	0	0
MANPOWER				8.00	0	0	0	0
TOTAL COST				450.00	0	0	0	0

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP Software Development & Procurement								
(1) Operating System Development	0	0	0	0	0	0	0	0
(2) Support Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance					34.65	34.65	34.65	34.65
(2) Distribution					0.70	0.30	1.20	0.50
LABOR COST					35.35	34.95	35.85	35.15
MANPOWER					.7	.7	.7	.7
TOTAL COST					35.35	34.95	35.85	35.15

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OPTION _____ IIB4 _____ ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance	34.65	34.65	34.65	34.65	34.65	34.65	34.65	34.65
(2) Distribution	0.55	0.90	1.15	1.00	1.05	0.70	0.35	0.40
LABOR COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
MANPOWER	.7	.7	.7	.7	.7	.7	.7	.7
TOTAL COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.1 Real-Time Simulation Test Set (RTSTS) Acquisition								
(1) Engineering Design								
(2) Simulation Computer								
(3) Dedicated Experiment Processor (DEP) Interface				4368.00	1248.00	624.00	312.00	3120.00
(4) RTSTS Integration				0	0	0	0	0
(5) Consumable Stock								
LABOR COST								
MANPOWER								
TOTAL COST				4368.00	1248.00	624.00	312.00	3120.00

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.3 Real-Time Simulation Test Set (RTSTS) Acquisition								
(1) Engineering Design								
(2) Simulation Computer								
(3) Dedicated Experiment Processor (DEP) Interface	0	0	0	0	0	0	0	0
(4) RTSTS Integration	0	0	0	0	0	0	0	0
(5) Consumable Stock								
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.2 RTSTS Maintenance Operation & Distribution								
(1) Maintenance				---	210.00	270.00	300.00	300.00
(2) Distribution				7.00	3.00	12.00	5.00	5.50
(3) Operation				---	---	---	---	---
(4) Special Purpose Equipment				---	---	---	---	---
(5) Consumables				---	159.25	85.75	183.75	183.75
(6) Re-Furbishment				---	---	---	---	---
(7) Facility Modifications				0	0	0	0	0
LABOR COST				7.0	213.00	282.00	305.00	305.50
MANPOWER				0.1	4.3	5.6	6.1	6.1
TOTAL COST				7.00	372.25	367.75	488.75	489.25

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.2 RTSTS Maintenance Operation & Distribution								
(1) Maintenance	315.00	495.00	300.00	480.00	315.00	495.00	420.00	465.00
(2) Distribution	9.00	11.50	10.00	10.50	7.00	3.50	4.00	---
(3) Operation	---	---	---	---	---	---	---	---
(4) Special Purpose Equipment	---	---	---	---	---	---	---	---
(5) Consumables	220.50	183.75	196.00	196.00	245.00	330.75	330.75	379.75
(6) Re-Furbishment	---	---	---	---	---	---	---	---
(7) Facility Modifications	0	0	0	0	0	0	0	0
LABOR COST	324.00	506.50	310.00	490.50	322.00	498.50	424.00	465.00
MANPOWER	6.5	10.1	6.2	9.8	6.4	10.0	8.5	9.3
TOTAL COST	544.50	690.25	506.00	686.50	567.00	829.25	754.75	844.75

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.3 RTSTS Support Software Development & Procurement								
(1) Simulation Computer Software Development				348.00	0	0	0	0
(2) Simulation Computer Software Procurement				4.00	0	0	0	0
LABOR COST				348.00	0	0	0	0
MANPOWER				7.00	0	0	0	0
TOTAL COST				352.00	0	0	0	0

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.3 RTSTS Support Software Development & Procurement								
(1) Simulation Computer Software Development	0	0	0	0	0	0	0	0
(2) Simulation Computer Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.4 RTSTS Support Software Maintenance & Distribution								
(1) Maintenance				50.00	50.00	50.00	50.00	50.00
(2) Distribution				13.47	5.77	23.09	9.60	10.58
LABOR COST				63.47	55.77	73.09	59.60	60.58
MANPOWER				1.3	1.1	1.5	1.2	1.2
TOTAL COST				63.47	55.77	73.09	59.60	60.58

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.4 RTSTS Support Software Maintenance & Distribution								
(1) Maintenance	50.00	50.00	50.00	50.00	50.00	50.00	50.00	50.00
(2) Distribution	17.32	22.13	19.24	20.20	13.47	6.73	7.70	0
LABOR COST	67.32	72.13	69.24	70.20	63.47	56.73	7.70	50.00
MANPOWER	1.3	1.4	1.4	1.4	1.3	1.1	1.1	1.0
TOTAL COST	67.32	72.13	69.24	70.20	63.47	56.73	57.70	50.00

OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
7.1 PI Host Computer Software								
(1) Distribution				0	0	0	0	0
(2) Installation				0	0	0	0	0
(3) Maintenance				0	0	0	0	0
LABOR COST				0	0	0	0	0
MANPOWER				0	0	0	0	0
TOTAL COST				0	0	0	0	0

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OPTION IIB4 ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
7.1 PI Host Computer Software								
(1) Distribution	0	0	0	0	0	0	0	0
(2) Installation	0	0	0	0	0	0	0	0
(3) Maintenance	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

SECTION 13 Option IIB3B - CDMS Simulator, Distributed Standard Mini Software Development by PI at His Compatible Facility

13.1 Costing Method - Variation I

ASSUMPTIONS

- All experiment application software implemented in DEP's.
- PI utilizes CDMSS (CDMS Simulator) and experiment hardware to checkout all EAS.
- DEP and CDMSS is local to PI facility for all Level IV activities.
- Common library is not possible due to independent PI software development.
- Only one mini development/qualification is required.
- No PI/PI integration is required due to independence of resource sharing.
- Central computer integration testing is required.
- Fewer total mini's/CDMSS's are required due to sharing of a pool of processors.
- Only one DEP operating system is required.
- .5 man years required for hardware support during EAS development.

Cost Element 4.1 Experiment Application Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP software
6. Simulation Computer Time DEP software
7. Travel
8. Training

(1) Software Development

(A) = ((Number of Statements) (Cost/Statement)) Per Flight Per Yr.

Number of Statements = GDC Estimate = ((New Flights) = (Previous Yr. Common)) Per Yr.

Cost/Statement = $45 (Requirements, Code, and Verification) $15 Per Statement is Applied to Integrated Verification (See 4.3 (1))

(1) Total = (#3 + #4) ($45)) Per Yr.

(2) Common Software

(2) Total = 0 for this option

(3) Host Computer Time

(A) = ((Host Time) (Cost/Hr.)) Per New Flight Per Yr.

Host Time = ((# Instructions) (# Instructions/Module)) (Hrs./Module)

= (# of Modules) (Hrs./Module)

Hrs./Module = 18 Compiles/Module @ 3 Mins/Compile + 9 Functional Simulations @ 12 Mins./Run @ Data Reduction for 75% of Simulation Runs @ 10 Mins. Each.

(54 Mins.) + (108 Mins.) + (70 Mins.) = 3.87 Hrs.

Cost/Hr. = $323

(3) Total = (3.87 Hrs./Module) (# Modules) ($323)

= ((3.87) (#3 + #4) ÷ ($323)) Per Yr.

(4) Simulation Computer Time

(A) = (# of Hrs./Module) (Cost/Hr.) (# of Modules)

# of Hrs. = 4 Simulations at 60 Min./Simulation (Includes Set-up, Runs, and Run Evaluations)

Cost/Hr. = (10% (Maintenance (CDMS, CID Simulation Computer)) + Consumables) + (Operations)) ÷ 2080 Hrs.

= ($8) + (0) + ((2 X $40K) ÷ 2080)

= ($8) + ($38.46)

= $46.46/Hr.

# of Modules = GDC Estimate

(4) Total = 0 for this option

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr.)) Per Flight/Yr.

Host Time = (# Modules) (Time/Module)

Time/Module = 18 Compiles/Module @ 3 Mins./Compile + 3 Data Reductions Runs/Module @ 10 Mins./Run

= 84 Mins./Module

Cost/Hr. = $323

(5) Total = 0 for this option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs.) (Cost/Hr.)) (# of Modules)) Per Flight/Yr.

# of Hrs. = 7 Simulations at 60 Mins./Simulation (Includes Set-Up, etc.)

9 Functional Simulations = 3 Real-Time Simulations. Assume no Functional Simulations for DEP

Cost/Hr. = $46.46 (Same as 4.1 (4))

(6) Total = 0 for this option

(7) Travel

(7) Total = 0 for this option

(8) Training

(8) Total = 0 for this option

Cost Element <u>Experiment Application Software Maintenance</u>

Cost Factors

1. Experiment Unique Software

2. Experiment Common Software

3. Host Computer Time

4. Simulation Computer Time

5. Host Computer Time DEP Software

6. Simulation Computer Time DEP Software

7. Travel

(1) <u>Experiment Unique Software</u>

(A) = (# of Statements) (Rate of Change) = #13

Rate of Change = Engineering Estimate Based on past Programs = 40% for 1st Re-Fly, 30% for 2nd Re-Fly, 20% for 3rd Re-Fly, 10% for all Subsequent Re-Flys.

Cost/Statement = $45 (See 4.1 for Rationale)

(1) Total = ((#13) ($45)) Per Yr.

(2) <u>Experiment Common Software</u>

(A) = (# Statements) (Change Rate) (Cost/Statement)/Yr.

Statements = #6

Change Rate = Engineering Estimate = 1%

Cost/Statement = $60 (Verification - Multiuse)

(2) Total = 0 for this option

(3) Host Computer Time

(A) = (# Modules) (# Hrs./Module) (Cost/Hr.)

Modules = #13 ÷ 100

Hrs./Module = 3.87 (See 4.1 for Rationale)

Cost/Hr. = $323 (See 4.1 for Rationale)

(3) Total = ((#13 ÷ 100) (3.87) ($323)) Per Yr.

(4) Simulation Computer Time

(A) = ((# Modules) (# of Hrs./Module) (Cost/Hr.)) Per Yr.

Modules = #14

Hrs./Module = 4 Hrs. (See 4.1 for Rationale)

Cost/Hr. = $46.46 (See 4.1 for Rationale)

(4) Total = 0 for this option

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr.)) Per Yr.

Host Time/Module = 1.4 Hrs. (See 4.1 for Rationale)

Modules = #15

Cost/Hr. = $323

(5) Total = 0 for this option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs.) (Cost/Hr.) (# Modules)) Per Yr.

# of Hrs. = 7 (See 4.1 for Rationale)

Cost/Hr. = $46.46 (See 4.1 for Rationale)

(6) Total = 0 for this option

(7) Travel

(7) Total = 0 for this option

Cost Element 4.3 EAS Software Integrated Verification

Cost Factors

1. Integrated Verification

2. Host Computer Time

3. Simulation Computer Time

4. Integrated Verification Simulation Software

(1) Integrated Verification

(A) = ((# of Modules) (Cost/Module)) Per Flight/Yr.

# of Modules = #21

Cost/Module = (# of Statements) (Cost/Statement)
# of Statements = 100/Module

Cost/Statement = $15 ($60 Estimated Total Cost Per Statement for Central Development Less $45 for Development)

(1) Total = 0 for this option

(2) Host Computer Time

(A) = (# Hrs.) (Cost/Hr.)

(2) Total = 0 (This Function has been Included in Spacelab Costs)

(3) Simulation Computer Hardware Time

(A) = (# of Hrs./Module) (Cost/Hr.) (# Module)

Hrs./Module = 2 Simulations/Module at 60 Min. Per Simulation (Includes Set-up, etc.)

Cost/Hr. = $46.46 (See 4.1 (4))

Modules = Line #21

(3) Total = 0 for this option

(4) Integrated Verification Simulation Software

(A) = ((# of Modules) (Cost/Module)) Per Yr.

# of Modules = (#24 + #25) ÷100

Cost/Module = 1,500 (See 4.3 (1) for Rationale)

(4) Total = 0 for this option

Cost Element 4.4 Preflight Checkout Software Development

Cost Factors

1. Software Development

2. Common Software

3. Host Computer Time

4. Simulation Computer Time

5. Travel

(1) Software Development

(A) = ((Number of HOL Statements) (Cost/Statement))

Number of Statements = Number of HOL Statements Per Payload X # of Payload Elements
= 930 X Payload Elements/Yr. (New Flights)

Cost/Statement = $30

(1) Total = ((#22) ($30))/Yr.

(2) Common Software

(2) Total = 0 for this option

(3) Host Computer Time

(Host Time) (Cost/Hr.) Ref. 4.1 (3)

(3.87) (# Modules) ($323) Per Flight/Yr.

(3) Total = ((3.87) (#22 ÷ 100) ($323)) Per Yr.

(4) Simulation Computer Time

(A) = (# Hrs./Module) (Cost/Hr.) (# Modules)
Ref. 4.1 (4)

(4) Total = 0 for this option

(5) Travel = 0 for this option

Cost Element 4.5 Pre-Flight Checkout Software Maintenance

Cost Factors

1. Experiment Unique Software

2. Experiment Common Software

3. Host Computer Time

4. Simulation Computer Time

5. Travel

(1) Experiment Unique Software

(A) = ((# of Statements) (Change Rate) (Cost Statement)

Number of Statements = (930) (# Payload Elements/Yr.) (Maintenance Flights)

Change Rate = 10% for Each Flight

Cost Statement = $30 (Ref. 4.4 (1))

(1) Total = ((#23) ($30)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 No Common Software This Element

(3) Host Computer Time

(A) = (Host Time) (Cost/Hr.)

(3) Total = ((#23 ÷ 100) (3.87) ($323)) Ref. 4.2 (3)

(4) Simulation Computer Time

(4) Total = 0 for this option

(5) Travel

(5) Total = 0 for this option

Cost Element 4.6 <u>EAS Dependent STIL Hardware Modifications</u>

Cost Factors

1. Host Main Memory

2. Remote Job Entry

3. Display Terminals

4. Maintenance Added Hardware

5. Telecommunications

(1) <u>Host Main Memory</u>

= (GSA Price) (Memory Size)

(1) Total = 0 for this option

(2) <u>Remote Job Entry</u>

= (GSA Price) (#Remote Job Entry)

(2) Total = 0 for this option

(3) <u>Display Terminals</u>

= (GSA Price) (# Terminals)

GSA Price = $989

Terminals = Engineering Estimate = 8

(3) Total = 0 for this option

(4) <u>Maintenance Added Hardware</u>

= GSA

(4) Total = 0 for this option

(5) <u>Telecommunications</u>

(A) = (Line Cost) (# Lines)

(5) Total = 0 for this option

Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factors

1. Software Development

2. Host Computer Time

3. Simulation Computer Time

4. Travel

(1) Software Development

(A) = (# of Statements) (Cost/Statement)

# of Statements = (1.4K) (Payload Elements/Yr.) (New Flights)

Cost/Statement = $45 Due to Less Documentation and No Integration

(1) Total = 0 for this option

(2) Host Computer Time

(A) = Same Formula as 4.1 (5)

(2) Total = 0 for this option

(3) Simulation Computer Time

(A) = Same Formula as 4.1 (6)

Modules = #24 ÷ 100

(3) Total = ((7) (#24 ÷ 100) ($46.46)) Per Yr.

(3) <u>Simulation Computer Time</u>

Same Formula as 4.1 (6)

Modules = #24 ÷ 100

(3) Total = 0 for this option

(4) Travel = 0 for this option

Cost Element 4.9 Experiment Real-Time Simulation Software Maintenance

Cost Factors

1. Maintenance

2. Host Computer Time

3. Simulation Computer Time

4. Travel

(1) Maintenance

(# of Statements) (Change Rate) (Cost/Statement)

# of Statements = 1.4K X Payload Elem ents/Yr. Maintenance Flights

Change Rate = Engineering Estimate = 10%/Flight

Cost/Statement =$45 Same as 4.8 (1) (3)

(1) Total = 0 for this option

(2) Host Computer Time

(2) Total = 0 for this option

(3) Simulation Computer Time

(3) Total = 0 for this option

(4) Travel

(4) Total = 0 for this option

Cost Element 5.1 Experiment Processor Acquisition

Cost Factors

1. Processor Hardware (I/O) Included
2. Development and Qualification
3. Special Test Equipment

(1) Processor Hardware (I/O) Included

((# of Processors) (Cost/Processor))

# of Processors = #34

Cost/Processor = $46K

(1) Total = ((#34) ($46K)) Per Yr.

(2) Development and Qualification

(A) = ((# Qualifications) (Cost Qualification) Per Yr.

(2) Total = ($520.3K) in FY79

(3) Special Test Equipment

Engineering Estimate = $5K/Unit

(# Units) ($5K) Per Yr.

(3) Total = (#34) ($5K) Per Yr.

Cost Element 5.2 Experiment Processor Maintenance

Cost Factors

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. for Each Yr. Used

(1) Total = ((8% ($46K)) (#35)) Per Yr.

(2) Distribution

(A) = ((Cost/Distribution) (# Required)) Per Yr.

(2) Total = (($500) (#36)) Per Yr.

(3) Re-Furbishment

(A) = (Number of DEP's) (Cost/Unit for Re-Furbishment)) Per Flight Per Yr.

Number of DEP's = Determined from Mission Model Requirements

(3) Total = Cost/Unit for Re-Furbishment = 0
Assumes DEP's will meet Spacelab Lifetime Requirements

Cost Element 5.3 DEP Software

Cost Factors

1. Operating System Development

2. Support Software Development

(1) Operating System Development

(A) = (Number of Instructions) (Cost Per Instruction)

Number of Instructions = 4K Engineering Estimate (M&S Study)

Cost Per Instruction = $100 (Assembly Language)

(1) Total = (4K) ($100) (1 Time Cost for Standard Mini Option) In FY79

(2) Support Software Development

(A) = (Vendor Lease) or ((Number of Statements) (Cost Per Statement)

Assume Vendor Lease - $25K for Cross Assembler
25K for Cross Compiler
$50K (Engineering Estimate)

(2) Total = $50K (1 Time Cost This Option) in FY79

Cost Element 5.4 DEP Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement)

Number of Statements = 4.0K Operating System
2.4K Cross Assembler
9.0K Cross Compiler
15.4K (Engineering Estimate)

Rate of Change = 5% Per Yr. (Engineering Estimate)

Cost Per Statement = $45

(1) Total = ((15.4K) (5%) ($45))/Yr. Starting in FY80

(2) Distribution

(A) = (Set Builds) (Cost/Set) (# Deliveries)

(# Set Builds) + (Cost/Set) = $50

Deliveries = $35

(2) Total = (($50) (#35)) Per Yr.

Cost Element 6.1 <u>CDMS Simulator Acquisition</u>

Cost Factors

1. Engineering Design
2. Simulation Computer
3. Dedicated Experiment Processor (DEP) Interface
4. RTSTS Integration
5. Consumable Stock

(1) (2) (3) & (4) = Engineering Estimate = $127K/RTSTS

(1) (2) (3) & (4) Total = (($127K) (#34)) Per Yr.

(5) <u>Consumable Stock</u>

(5) Total = 0 for this option

Cost Element 6.2 CDMS Simulator

Cost Factors

1. Maintenance
2. Distribution
3. Operation
4. Special Purpose Equipment
5. Consumables
6. Re-Furbishment
7. Facility Modifications

(1) Maintenance and (4) Special Purpose Equipment

(A) = (Cost/Yr.) (# RTSTS's Used/Yr.)

(8%) (Purchase Cost) (# RTSTS's Used/Yr.)

(8%) ($127K) (# RTSTS's Used/Yr.)

(1) and (4) Total = ($6.1K) (#35)

(2) Distribution

(A) = (Cost/Yr. for Distribution/Sustaining Engineering) (# RTSTS's Used/Yr.)

(2) Total = (($500) (#36)) Per Yr.

(3) Operation of Experiment Hardware

(A) = (Operating Cost/Yr.) (# RTSTS's Used/Yr.)

Operational Cost/Yr. = .5 Man

RTSTS's Used/Yr. = #37

(3) Total = (($25K) (#37)) Per Yr.

(4) Special Purpose Equipment

Included as Part of 6.2 (1)

(5) Consumables

(A) = (Cost/Yr.) (# RTSTS's Used/Yr.)

Cost/Yr. = Engineering Estimate = 0

(5) Total = 0 for this option

(6) Re-Furbishment

Assumed Covered by Maintenance in Item 6.2 (1)

(7) Facility Modifications

Assume space available and no cost associated with A/C and power service room A/C adequate and standard power service available.

Cost Element 6.3 <u>Simulation Computer Software Development and Procurement</u>

Cost Factors

1. Simulation Computer Software Development

2. Simulation Computer Software Procurement

(1) <u>Simulation Computer Software Development</u>

Engineering Estimate = Same as Rationale on 3.3 (1) for STIL Simulation Computer

Rationale: CDMS Simulator to be Converted

4,000 Statements
X $60/Statement
$240,000

(1) Total = $240K in FY79

(2) <u>Simulation Computer Software Procurement</u>

Engineering Estimate = Real-Time Operating System = ($4K) (Simulation Computer)

(2) Total = ($4K) in FY79

Cost Element 6.4 RTSTS Support Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(A) = (Number of Instructions) (Rate of Change) (Cost/Instruction)

The above was considered by an engineering estimate made instead which is 0.5 man per yr. of usage. This is compatible with the level of effort charged for the STIL simulation computer software in 3.4

(1) Total = ($25K) Per Yr. Starting in FY79

(2) Distribution

(A) = ((# Set Builds) (Cost/Set) (# Deliveries)) Per Yr.

Set Builds = 1

Cost/Set = $962 (1 Man Week)

Deliveries = #36

(2) Total = ((1) ($962) (#36)) Per Yr.

Cost Element 7.1 PI Host Computer Software

Cost Factors

1. Distribution

2. Installation

3. Maintenance

(1) Distribution

(A) = ((# Set Builds) (Cost/Set) (# Deliveries) Per Yr.

Set Builds = 2 (Support Software + Simulation Software)

Cost/Set = Engineering Estimate = 1 Man Week = $962

Deliveries = #31

(1) Total = ((2) ($962) (#31)) Per Yr.

(2) Installation

(A) = Engineering Estimate = 2 Man Weeks

= ($962) (2)

= $1924 Per Installation

(2) Total = ($1924) (#31)

(3) Maintenance

(A) = Level of Effort

Maintenance is Feed Back of Problems Encountered in Use of Distributed Software

Level of Effort = Engineering Estimate

= (.1 Man Yr.) Per Yr. Used

(3) Total = (($5K) (#35)) Per Yr.

SECTION 13 Option II B3B - CDMS Simulator, Distributed Standard Mini Software Development by PI at His Compatible Facility

13.2 Cost Data - Variation I

OPTION IIB3b (CDMS Simulator) TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				0	284.05	839.27	476.13	70.50
4.2				0	0	93.84	255.48	457.47
4.3				0	0	0	0	0
4.4				0	553.35	197.63	592.88	158.10
4.5				0	0	55.34	23.72	94.86
4.6				0	0	0	0	0
4.7				0	0	0	0	0
4.8				0	0	0	0	0
4.9				0	0	0	0	0
5.1				1234.30	204.00	102.00	51.00	510.00
5.2				0	58.52	69.24	85.60	78.60
5.3				0	450.00	0	0	0
5.4				0	35.35	34.95	35.85	35.15
6.1				1778.00	508.00	254.00	127.00	1270.00
6.2				7.00	413.40	296.80	502.00	502.00
6.3				244.00	0	0	0	0
6.4				38.47	30.77	48.09	34.60	35.58
7.1				0	123.88	109.20	146.18	115.40
TOTAL				3301.77	2661.32	2200.36	2330.44	3327.66
ESCALATED TOTAL				4327.95	3733.83	3302.74	3740.74	5716.92

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OPTION IIB3b (CDMS Simulator) TOTAL COST PAGE -- OF --

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	226.38	0	298.03	260.25	49.91	99.13	0	0
4.2	307.28	448.08	228.22	330.67	323.04	338.79	452.93	415.67
4.3	0	0	0	0	0	0	0	0
4.4	79.05	0	118.58	118.58	39.53	39.53	0	0
4.5	106.72	173.91	118.58	197.63	153.65	209.48	213.44	252.96
4.6	0	0	0	0	0	0	0	0
4.7	0	0	0	0	0	0	0	0
4.8	0	0	0	0	0	0	0	0
4.9	0	0	0	0	0	0	0	0
5.1	0	0	0	0	0	0	0	0
5.2	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
5.3	0	0	0	0	0	0	0	0
5.4	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
6.1	0	0	0	0	0	0	0	0
6.2	587.10	587.80	532.00	605.70	635.10	879.80	849.80	964.10
6.3	0	0	0	0	0	0	0	0
6.4	42.32	47.13	44.24	45.20	38.47	31.73	32.70	25.00
7.1	112.70	165.00	111.54	171.54	108.84	168.84	140.00	155.00
TOTAL	1579.53	1587.91	1572.09	1892.98	1472.02	1931.09	1830.41	1976.90
ESCALATED TOTAL	2903.18	3123.42	3309.25	4262.99	3547.57	4980.28	5050.10	5835.81
TOTAL COST		27,664.48						
ESCALATED TOTAL COST		53,834.40						

AVERAGE COST PER FLIGHT $238.21

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OPTION IIB3b (CDMS Simulator) TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				0	4.5	13.1	7.5	1.1
4.2				0	0	3.0	4.0	7.2
4.3				0	0	0	0	0
4.4				0	7.8	2.8	8.4	2.2
4.5				0	0	0.8	0.3	1.3
4.6				0	0	0	0	0
4.7				0	0	0	0	0
4.8				0	17.6	6.3	18.9	5.0
4.9				0	0	1.8	0.8	3.0
5.1				0	0	0	0	0
5.2				0	1.2	1.4	1.7	1.6
5.3				8.0	0	0	0	0
5.4				0	0.7	0.7	0.7	0.7
6.1				0	0	0	0	0
6.2				0.1	8.3	5.9	10.0	10.0
6.3				4.8	0	0	0	0
6.4				0.8	0.6	1.0	0.7	0.7
7.1				0	2.5	2.2	2.9	2.3
TOTAL MANPOWER				13.7	43.2	39.0	55.9	35.1

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OPTION IIB3b (CDMS Simulator) TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	3.5	0	4.7	4.1	0.8	1.4	0	0
4.2	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
4.3	0	0	0	0	0	0	0	0
4.4	1.1	0	1.7	1.7	0.6	0.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
4.6	0	0	0	0	0	0	0	0
4.7	0	0	0	0	0	0	0	0
4.8	2.5	0	3.8	3.8	1.3	1.3	0	0
4.9	3.4	5.5	3.8	6.3	4.9	6.7	6.8	8.1
5.1	0	0	0	0	0	0	0	0
5.2	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
5.3	0	0	0	0	0	0	0	0
5.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6.1	0	0	0	0	0	0	0	0
6.2	11.7	11.8	10.6	12.1	12.7	17.6	17.0	19.3
6.3	0	0	0	0	0	0	0	0
6.4	0.8	0.9	0.9	0.9	0.8	0.6	0.6	0.5
7.1	2.3	3.3	2.2	3.4	2.2	3.4	2.8	3.1
TOTAL MANPOWER	34.0	34.3	35.4	43.6	33.1	43.2	40.1	44.4

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1 Experiment Application Software Development								
(1) Software Development					222.30	656.82	372.60	55.00
(2) Common Software					0	0	0	0
(3) Host Computer Time					61.75	182.45	103.53	15.50
(4) Simulation Computer Time					0	0	0	0
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	0	0	0
(8) Training					0	0	0	0
LABOR COST					222.30	656.82	372.69	55.80
MANPOWER					4.5	13.1	7.5	1.1
TOTAL COST					284.05	839.27	476.13	70.50

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1 Experiment Application Software Development								
(1) Software Development	177.17	0	233.24	203.67	39.06	69.75	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	49.21	0	64.79	56.58	10.85	19.38	0	0
(4) Simulation Computer Time	0	0	0	0	0	0	0	0
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	0	0	0	0	0	0	0	0
(8) Training	0	0	0	0	0	0	0	0
LABOR COST	177.17	0	233.24	203.67	39.06	69.75	0	0
MANPOWER	3.5	0	4.7	4.1	.8	1.4	0	0
TOTAL COST	226.38	0	298.03	260.25	49.91	99.13	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software					0	151.70	199.94	358.02
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	42.14	55.54	99.45
(4) Simulation Computer Time					0	0	0	0
(5) Host Computer Time DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	0	0	0
LABOR COST					0	151.70	109.94	358.02
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	193.84	255.48	457.47

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software	240.48	350.67	178.61	258.79	252.81	265.14	354.47	325.31
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	66.80	97.41	49.61	71.88	70.23	73.65	98.46	90.36
(4) Simulation Computer Time	0	0	0	0	0	0	0	0
(5) Host Computer Time DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	0	0	0	0	0	0	0	0
LABOR COST	240.48	350.67]	178.61	258.75	252.81	265.14	354.47	325.31
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.3	7.1	6.5
TOTAL COST	307.28	448.08	228.22	330.67	323.04	338.79	452.93	415.67

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS Software Integrated Verification								
(1) Integrated Verification					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Integrated Verification Simulation Software					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS Software Integrated Verification								
(1) Integrated Verification	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Integrated Verification Simulation Software	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 Preflight Checkout Software Development								
(1) Software Development					390.60	138.50	418.50	111.60
(2) Common Software					0	0	0	0
(3) Host Computer Time					162.75	58.13	174.38	46.50
(4) Simulation Computer Time					0	0	0	0
(5) Travel					0	0	0	0
LABOR COST					390.60	139.50	418.50	111.60
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					553.35	197.63	592.88	158.10

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 Preflight Checkout Software Development								
(1) Software Development	55.80	0	83.70	83.70	27.90	27.90	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	23.25	0	34.88	34.88	11.63	11.63	0	0
(4) Simulation Computer Time	0	0	0	0	0	0	0	0
(5) Travel	0	0	0	0	0	0	0	0
LABOR COST	55.80	0	83.70	83.70	27.90	27.90	0	0
MANPOWER	1.1	0	1.7	1.7	.6	.6	0	0
TOTAL COST	79.05	0	118.58	118.58	39.53	39.53	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software					0	39.06	16.74	66.96
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	16.28	6.98	27.90
(4) Simulation Computer Time					0	0	0	0
(5) Travel					0	0	0	0
LABOR COST					0	39.06	16.74	66.96
MANPOWER					0	.8	.3	1.3
TOTAL COST					0	55.34	23.72	94.86

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software	75.33	122.76	83.70	139.50	108.31	147.87	150.66	178.56
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	31.39	51.15	34.88	58.13	45.34	61.61	62.78	74.40
(4) Simulation Computer Time	0	0	0	0	0	0	0	0
(5) Travel	0	0	0	0	0	0	0	0
LABOR COST	75.33	122.76	83.70	139.50	108.81	147.87	150.66	178.56
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	106.72	173.91	118.58	197.63	153.65	209.48	213.44	252.96

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory					0	0	0	0
(2) Remote Job Entry					0	0	0	0
(3) Display Terminals					0	0	0	0
(4) Maintenance					0	0	0	0
(5) Telecom-munications								
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory	0	0	0	0	0	0	0	0
(2) Remote Job Entry	0	0	0	0	0	0	0	0
(3) Display Terminals	0	0	0	0	0	0	0	0
(4) Maintenance	0	0	0	0	0	0	0	0
(5) Telecom-munications	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Travel					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Travel	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Travel					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 Experiment Real-Time Simulation Software Maintenance								
(1) Maintenance	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Travel	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 Experiment Processor Acquisition								
(1) Processor Hardware				644.00	184.00	92.00	46.00	460.00
(2) Qualification				520.30	0	0	0	0
(3) Special Test Equipment				70.00	20.00	10.00	5.00	50.00
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST				1234.30	204.00	102.00	51.00	510.00

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 Experiment Processor Acquisition								
(1) Processor Hardware	0	0	0	0	0	0	0	0
(2) Qualification	0	0	0	0	0	0	0	0
(3) Special Test Equipment	0	0	0	0	0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 Experiment Processor Maintenance								
(1) Maintenance					51.52	66.24	73.60	73.60
(2) Distribution					7.00	3.00	12.00	5.00
(3) Re-furbishment					0	0	0	0
LABOR COST					58.52	69.24	85.60	78.60
MANPOWER					1.2	1.4	1.7	1.6
TOTAL COST					58.52	69.24	85.60	78.60

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 Experiment Processor Maintenance								
(1) Maintenance	77.28	121.44	73.60	117.76	77.28	121.44	103.04	125.12
(2) Distribution	5.50	9.00	11.50	10.00	10.50	7.00	3.50	4.00
(3) Re-furbishment	0	0	0	0	0	0	0	0
LABOR COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
MANPOWER	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
TOTAL COST	82.78	130.44	85.10	127.76	87.78	138.44	106.54	129.12

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP Software Development & Procurement								
(1) Operating System Development				400.00	0	0	0	0
(2) Support Software Procurement				50.00	0	0	0	0
LABOR COST				400.00	0	0	0	0
MANPOWER				8.0	0	0	0	0
TOTAL COST				450.00	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP Software Development & Procurement								
(1) Operating System Development	0	0	0	0	0	0	0	0
(2) Support Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance					34.65	34.65	34.65	34.65
(2) Distribution					0.70	0.30	1.20	0.50
LABOR COST					35.35	34.95	35.85	35.15
MANPOWER					.7	.7	.7	.7
TOTAL COST					35.35	34.95	35.85	35.15

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance	34.65	34.65	34.65	34.65	34.65	34.65	34.65	34.65
(2) Distribution	0.55	0.90	1.15	1.00	1.05	0.70	0.35	0.40
LABOR COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
MANPOWER	.7	.7	.7	.7	.7	.7	.7	.7
TOTAL COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.1 Real-Time Simulation Test Set (RTSTS) Acquisition								
(1) Engineering Design				0	0	0	0	0
(2) Simulation Computer				0	0	0	0	0
(3) Dedicated Experiment Processor (DEP) Interface				1778.00	508.00	254.00	127.00	1270.00
(4) RTSTS Integration				0	0	0	0	0
(5) Consumable Stock				0	0	0	0	0
LABOR COST								
MANPOWER								
TOTAL COST				1778.00	508.00	254.00	127.00	1270.00

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OPTION HB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.1 Real-Time Simulation Test Set (RTSTS) Acquisition								
(1) Engineering Design	0	0	0	0	0	0	0	0
(2) Simulation Computer	0	0	0	0	0	0	0	0
(3) Dedicated Experiment Processor (DEP) Interface	0	0	0	0	0	0	0	0
(4) RTSTS Integration	0	0	0	0	0	0	0	0
(5) Consumable Stock								
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.2 RTSTS Maintenance Operation & Distribution								
(1) Maintenance				0	85.40	109.80	122.00	122.00
(2) Distribution				7.00	3.00	12.00	5.00	5.50
(3) Operation				0	325.00	175.00	375.00	375.00
(4) Special Purpose Equipment				0	0	0	0	0
(5) Consumables				0	0	0	0	0
(6) Re-furbishment				0	0	0	0	0
(7) Facility Modifications				0	0	0	0	0
LABOR COST				7.00	413.40	296.80	502.00	502.00
MANPOWER				0.1	8.3	5.9	10.0	10.0
TOTAL COST				7.00	413.40	296.80	502.00	502.00

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.2 RTSTS Maintenance Operation & Distribution								
(1) Maintenance	128.10	201.30	122.00	195.20	128.10	201.30	170.80	189.10
(2) Distribution	9.00	11.50	10.00	10.50	7.00	3.50	4.00	0
(3) Operation	450.00	375.00	400.00	400.00	500.00	675.00	675.00	775.00
(4) Special Purpose Equipment	0	0	0	0	0	0	0	0
(5) Consumables	0	0	0	0	0	0	0	0
(6) Re-furbishment	0	0	0	0	0	0	0	0
(7) Facility Modifications	0	0	0	0	0	0	0	0
LABOR COST	587.10	587.80	532.00	605.70	635.10	879.80	849.80	964.10
MANPOWER	11.7	11.8	10.6	12.1	12.7	17.6	17.0	19.3
TOTAL COST	587.10	587.80	532.00	605.70	635.10	879.80	849.80	964.10

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.3 RTSTS Support Software Development & Procurement								
(1) Simulation Computer Software Development				240.00	0	0	0	0
(2) Simulation Computer Software Procurement				4.00	0	0	0	0
LABOR COST				240.00	0	0	0	0
MANPOWER				4.8	0	0	0	0
TOTAL COST				244.00	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.3 RTSTS Support Software Development & Procurement								
(1) Simulation Computer Software Development	0	0	0	0	0	0	0	0
(2) Simulation Computer Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE 6 OF

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.4 RTSTS Support Software Maintenance & Distribution								
(1) Maintenance				25.00	25.00	25.00	25.00	25.00
(2) Distribution				13.47	5.77	23.09	9.60	10.58
LABOR COST				38.47	30.77	48.09	34.60	35.58
MANPOWER				0.8	0.6	1.0	0.7	0.7
TOTAL COST				38.47	30.77	48.09	34.60	35.58

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.4 RTSTS Support Software Maintenance & Distribution								
(1) Maintenance	25.00	25.00	25.00	25.00	25.00	25.00	25.00	25.00
(2) Distribution	17.32	22.13	19.24	20.20	13.47	6.73	7.70	0
LABOR COST	42.32	47.13	44.24	45.20	38.47	31.73	32.70	25.00
MANPOWER	0.8	0.9	0.9	0;9	0.8	0.6	0.6	0.5
TOTAL COST	42.32	47.13	44.24	45.20	38.47	31.73	32.70	25.00

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
7.1 PI Host Computer Software								
(1) Distribution				0	26.94	9.60	23.09	7.70
(2) Installation				0	26.94	9.60	23.09	7.70
(3) Maintenance				0	70.00	90.00	100.00	100.00
LABOR COST				0	123.88	109.20	146.18	115.40
MANPOWER				0	2.5	2.2	2.9	2.3
TOTAL COST				0	123.88	109.20	146.18	115.40

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OPTION IIB3b (CDMS Simulator) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
7.1 PI Host Computer Software								
(1) Distribution	3.85	0	5.77	5.77	1.92	1.92	0	0
(2) Installation	3.85	0	5.77	5.77	1.92	1.92	0	0
(3) Maintenance	105.00	165.00	100.00	160.00	105.00	165.00	140.00	155.00
LABOR COST	112.70	165.00	111.54	171.54	108.84	168.84	140.00	155.00
MANPOWER	2.3	3.3	2.2	3.4	2.2	3.4	2.8	3.1
TOTAL COST	112.70	165.00	111.54	171.54	108.84	168.84	140.00	155.00

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SECTION 14 Option IIB3B - Distributed Standard Mini, Software Development by PI at His Facility Using S360 Host

14.1 Costing Method - Variation II

ASSUMPTIONS

All experiment application dependent software will be implemented in DEP's.

PI utilizes 360 Host to develop and checkout all EAS software.

DEP is local to PI facility for all Level IV activities.

Common library is not possible due to independent PI software development.

Only one mini development/qualification is required.

No PI/PI integration is required due to independence of resource sharing. Central computer integration testing is still required.

Fewer total mini's are required due to sharing of a pool of processors.

Only one DEP operating system development is required.

S360 Host is used for assembly/compile and for real time experiment simulation.

Assume PI has an S360 Host computer available for EAS development.

Cost Element 4.1 Experiment Application Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel
8. Training

(1) Software Development

(A) = ((Number of Statements) (Cost/Statement)) Per Flight Per Yr.

Number of Statements = GDC Estimate = ((New Flights) = (Previous Yr. Common)) Per Yr.

Cost/Statement = $45 (Requirements, Code and Verification) $15 Per Statement is Applied to Integrated Verification (See 4.3 (1))

(1) Total =((#3 + #4) ($45)) Per Yr.

(2) Common Software

(2) Total = 0 for this Option

(3) Host Computer Time

(A) = ((Host Time) (Cost/Hr.)) Per New Flight Per Yr.

Host Time = ((# Instructions) (# Instructions/Module)) (Hrs./Module)

= (# of Modules) (Hrs./Module)

Hrs./Module = 18 Compiles/Module @ 3 Mins./Compile + 9 Functional Simulations @ 12 Mins./Run @ Data Reduction for 75% of Simulation Runs @ 10 Mins. Each.

(54 Mins.) + (108 Mins.) + (70 Mins.) = 3.87 Hrs.

Cost/Hr. = $323 Reference 4.1 (2) Option IA1

= (3.87 Hrs./Module) (# Modules) ($323/Hr.)

(3) Total = (3.87) (#3 + #4) ÷ 100 ($323) Per Yr.

(4) Simulation Computer Time

(A) = (# of Hrs./Module) (Cost/Hr.) (# of Modules)

# of Hrs. = 4 Simulations at 60 Min./Simulation (Includes Set Up, Runs, and Run Evaluations)

Cost/Hr. Host for CDMS Simulation = $323 (Host Cost)

Modules = GDC Estimate

(4) Total = (($323) (#3 + #4) ÷ 100 (4 Hrs.)) Per Yr.

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr.)) Per Flight/Yr.

Host Time = (# Modules) (Time/Module)

Time/Module = 18 Compiles/Module @ 3 Mins./Compile + 3 Data Reductions Runs/Module @ 10 Mins./Run

= 84 Mins./Module

Cost/Hr. = $123.22 (Same as 4.1 (3))

(5) Total = 0 for this Option (Use Exp. Hardware)

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs.) (Cost/Hr.)) (# of Modules))
Per Flight/Yr.

# of Hrs. = 7 Simulations at 60 Mins./Simulation
(Includes Set Up, etc.)

9 Functional Simulations = 3 Real-Time Simulations.
Assume No Functional Simulations for DEP

Cost/Hr. = $46.46 (Same as 4.1 (4))

(6) Total = 0 for this Option

(7) Travel

(7) Total = 0 for this option

(8) Training

(8) Total = 0 for This Option

Cost Element 4.2 Experiment Application Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Host Computer Time DEP Software
6. Simulation Computer Time DEP Software
7. Travel

(1) Experiment Unique Software

(A) = (# of Statements) (Rate of Change) (Cost/ Statement)

(Number of Statements) (Rate of Change) = #13

Rate of Change = Engineering Estimate Based on Past Programs = 40% for 1st Re-Fly, 30% for 2n Re-Fly, 20% for 3rd Re-Fly, 10% for All Subsequent Re-Flys.

Cost/Statement = $45 (See 4.1 for Rationale)

(1) Total = ((#13) ($45)) Per Yr.

(2) Experiment Commons Software

(A) = (# Statements) (Change Rate) (Cost/Statement)/Yr.

Statements = #6

Change Rate = Engineering Estimate = 1%

Cost/Statement = $60 (Verification -- Multi Use)

(2) Total = 0 for this Option

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(3) Host Computer Time

(A) = (# Modules) (# Hrs./Module) (Cost/Hr.)

Modules = #13 ÷ 100

Hrs./Module = 3.87 (See 4.1 for Rationale)

Cost/Hr. = $323 (See 4.1 for Rationale)

(3) Total = (#13 ÷ 100) (3.87) ($323)) Per Yr.

(4) Simulation Computer Time

(A) = ((# Modules) (# of Hrs./Module) (Cost/Hr.)) Per Yr.

Modules = (#11 + #12) ÷ 100

Hrs./Module = 4 Hrs. (See 4.1 for Rationale)

Cost/Hr. = $323 (See 4.1 for Rationale)

(4) Total = (#11 + #12) ÷ 100 (4) ($323) Per Yr.

(5) Host Computer Time DEP Software

(A) = ((Host Time/Module) (# Modules) (Cost/Hr.)) Per Yr.

Host Time/Module = 1.4 Hrs. (See 4.1 for Rationale)

Modules = #15

Cost/Hr. = $123.22 (See 4.1 for Rationale)

(5) Total = 0 for this Option

(6) Simulation Computer Time DEP Software

(A) = ((# of Hrs.) (Cost/Hr.) (# Modules)) Per Yr.

# of Hrs. = 7 (See 4.1 for Rationale)

Cost/Hr. = $46.46 (See 4.1 for Rationale)

(6) Total = 0 for this Option

(7) <u>Travel</u>

(7) Total = 0 for this Option

Cost Element 4.3 <u>EAS Software Integrated Verification</u>

Cost Factors

1. Integrated Verification

2. Host Computer Time

3. Simulation Computer Time

4. Integrated Verification Simulation Software

(1) (2) (3) (4) Total = 0 for this Option

Cost Element 4.4 Preflight Checkout Software Development

Cost Factors

1. Software Development
2. Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Software Development

(A) = ((Number of HOL Statements) (Cost/Statement))

Number of Statements = (Number of HOL Statements Per Payload) (# of Payload Elements)/Yr. (New Elements)

Cost/Statements = $30

(1) Total = ((#22) ($30))/Yr.

(2) Common Software

(2) Total = 0 No Common Software for this Element

(3) Host Computer Time

(A) = (Host Time) (Cost/Hr.) Ref. 4.1 (3)

(3) Total = ((3.87) (#22 ÷ 100) ($323)) Per Yr.

(4) Simulation Computer Time

(A) = (# of Hrs. /Module) (Cost/Hr.) (# Modules) Ref. 4.1 (4)

(4) Total = ($323) (#22 ÷ 100) (4)) Per Yr.

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(5) Travel

(5) Total = 0 for This Option

PREFLIGHT SOFTWARE SIZING RATIONALE

Saturn History

LVDC/DA interface signals	=	86
LVDC/DA # instructions	=	4,650
average # instructions/signal	=	54

ATM History

ATMDC interface signals	=	275
ATMDC # instructions	=	7,897
average # instructions/signal	=	29

Mission 8 of Spacelab

# interface signals	=	81.6
# payload elements	=	1.3
average # interface signals	=	62.77

Assume preflight job for each payload element is the same and equivalent to Saturn LVDC = 4,650 instructions.

$= \frac{4,650}{5}$ = 930 HOL statements at a cost of $30/Statement.

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Cost Element 4.5 Pre-Flight Checkout Software Maintenance

Cost Factors

1. Experiment Unique Software
2. Experiment Common Software
3. Host Computer Time
4. Simulation Computer Time
5. Travel

(1) Experiment Unique Software

(A) = ((# of Statements) (Change Rate) (Cost Statement)

Number of Statements = (930) (# Payload Elements/Yr) (Maintenance Flights)

Change Rate = 10% for Each Flight

Cost Statement = $30 Ref. 4.4 (1)

(1) Total = ((#23) ($30)) Per Yr.

(2) Experiment Common Software

(2) Total = 0 no Common Software This Element

(3) Host Computer Time

(A) = (Host Time) (Cost/Hr)

(3) Total = ((#23 ÷ 100) (3.87) ($323)) Reference 4.2 (3)

(4) Simulation Computer Time

(4) Total = ((#23 ÷ 100) (4) ($323) Reference 4.2 (4)

(5) Travel

(5) Total = 0 for This Option

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Cost Element 4.6 <u>EAS Dependent STIL Hardware Modifications</u>

Cost Factors

1. Host Main Memory
2. Remote Job Entry
3. Display Terminals
4. Maintenance Added Hardware
5. Telecommunications

(1) (2) (3) (4) (5) Total = 0 for This Option

Cost Element 4.8 Experiment Real-Time Simulation Software Development

Cost Factors

1. Software Development

2. Host Computer Time

3. Simulation Computer Time

4. Travel

(1) (2) (3) (4) Total = 0 for this Option

Rationale for Simulation Software Required for Payload Elements

Engineering Estimate - 21K Table Words Per Payload Element for Simulation Software.

Engineering Estimate that 21K Table Words Equates to Approximately 1/3 X 21K = 7K Machine Language Instructions.

7K ÷ 5 = 1.4K HOL Statements

1.4K X $45/Statement = $63K/Payload Element

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Cost Element 4.9 Experiment Real-Time Simulation Software Maintenance

Cost Factors

1. Maintenance

2. Host Computer Time

3. Simulation Computer Time

4. Travel

(1) (2) (3) (4) Total = 0 for This Option

Cost Element 5.1 <u>Experiment Processor Acquisition</u>

Cost Factors

1. Processor Hardware (I/O Included)

2. Development and Qualification

3. Special Test Equipment

(1) <u>Processor Hardware</u>

(A) = ((# of Processors) (Cost/Processor))

# of Processors = #34

Cost/Processor = $46K

(1) Total = ((#34) ($46K)) Per Yr.

(2) <u>Development and Qualification</u>

(A) = ((# of Qualifications) (Cost/Qualification) Per Yr.

(2) Total = ($520.3K) 1 Time Cost FY79

(3) <u>Special Test Equipment</u>

Engineering Estimate = $5K/Unit

(# Units) ($5K) Per Yr.

(3) Total = ((#34) ($5K)) Per Yr.

GROUND RULES FOR DEDICATED EXPERIMENT PROCESSOR

I. Central Experiment Computer Capacity = (Speed) and (Memory)

Speed = (500K Adds per Second) X 65%

(A) = 325 KADS

500 KADS = CII Specifications

65% = 100% - (15% Overhead) - (20% Contingency)

Memory = (Total Capacity) - (Contingency) - (Operating System)

Total Capacity = 64K CII Specification

Contingency = 30% Engineering Estimate

Note: Low compared to industry (50 - 100%)
Operating System = 20K ESA Estimate

(A) = 64K - 19.2K - 20K
= 24.8K

II. When a new payload exceeds central computer capacity, a DEP will be selected for that element that has the greatest capacity requirement. Each element having this requirement will be assigned a different DEP, except the case where one DEP is used on multiple missions.

III. Assume all Spacelab's Review Item Disposition (RID's) for CDMS modifications are incorporated for mass memory, data bus, etc.

IV. *Two classes of DEP's were considered:

1) Micro Processor

2) Mini Processor

* Only 1 DEP will be specified

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V. Assume any non-standard DEP's selected will have support software that is executable on STIL simulation computer.

VI. For any mission, assume that the required number of data bus RAU's can be provided.

VII. Number of processors = determined by applying "Ground Rules for DEP" to GDC provided software.

Cost/processor = determined by: processor class, configuration.

((Processor hardware) + (Qualification) + (Special I/O (RAU equivalent) + (Special Test Equipment) + (Peripherals*) + (Peripherals Qualification).

Each element will be determined according to selected processor class and configuration.

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Cost Element 5.2 Experiment Processor Maintenance

Cost Factors

1. Maintenance

2. Distribution

3. Re-Furbishment

(1) Maintenance

(A) = 8% of DEP Purchase Price/Yr. for Each Yr. Used

(1) Total = ((8% ($46K)) (#35)) Per Yr.

(2) Distribution

(2) Total = (($500) (#36)) Per Yr.

(3) Re-Furbishment

(A) = ((Number of DEP's) (Cost/Unit for Re-Furbishment)) Per Flight Per Yr.

Number of DEP's = Determined From Mission Model Requirements

(3) Total = Cost/Unit for Re-Furbishment = 0
Assumes DEP's will Meet Spacelab Lifetime Requirements

Cost Element 5.3 DEP Software

Cost Factors

1. Operating System Development

2. Support Software Development

(1) Operating System Development

(A) = ((Number of Instructions) (Cost Per Instruction)

Number of Instructions = 4K Engineering Estimate (M&S Study)

Cost Per Instruction = $100 (Assembly Language)

(1) Total = (4K) ($100) (1 Time Cost for Standard Mini Option) in FY79

(2) Support Software Development

(A) = (Vendor Lease) or ((Number of Statements)) (Cost Per Statement)

Assume Vendor Lease - $25K for Cross Assembler
25K for Cross Compiler
$50K (Engineering Estimate)

(2) Total = $50K (1 Time Cost This Option) FY79

Cost Element 5.4 <u>DEP Software Maintenance and Distribution</u>

Cost Factors

1. Maintenance

2. Distribution

(1) <u>Maintenance</u>

(A) = ((Number of Statements) (Rate of Change) (Cost Per Statement))

Number of Statements = 4.0K Operating System
2.4K Cross Assembler
9.0K Cross Compiler
15.4K (Engineering Estimate)

Rate of Change = 5% Per Yr. (Engineering Estimate)

Cost Per Statement = $45

(1) Total = ((15.4K) (5%) ($45))/Yr. Start FY80

(2) <u>Distribution</u>

(A) = (Set Builds) (Cost/Set) (# Deliveries)

(# Set Builds) + (Cost/Set) = $50

Deliveries = #35

(2) Total = (($50) (#35)) Per Yr.

Cost Element 6.1 <u>Interface Device Development - Host to DEP</u>

Cost Factors

1. Engineering Design

2. DEP Interface

3. Integration

4. Consumable Stock

(1) (2) (3) & (4) = ((Engineering Estimate) (#34)) Per Yr.

(1) (2) (3) & (4) Total = (($104.5K) (#34)) Per Yr.

Cost Element 6.2 <u>Interface Device Maintenance - Host to DEP</u>

Cost Factors

1. Maintenance

2. Operation of Exp. Hardware System

3. Distribution

(1) <u>Maintenance</u>

(A) = ((# HID Used/Yr.) (8% (Purchase))/Yr.

(1) Total = (($1758) (#35)) Per Yr.

(2) <u>Operation of Exp. Hardware System</u>

(A) = ((.5 Man Yr.) (# HID Used/Yr.))

(2) Total = (($25K) (#37)) Per Yr.

(3) <u>Distribution</u>

(A) = ((Cost/Yr.) (# Used/Yr.)) Per Yr.

(3) Total = (($500) (#36)) Per Yr.

Cost Element 6.3 . Simulation Computer Software Development and Procurement

Cost Factors

1. Simulation Computer Software Development

2. Simulation Computer Software Procurement

(1) Simulation Computer Software Development (S360)

(A) = Modification of Operating System Drivers

Engineering Estimate = 4.5 mm

$\frac{4.5 \text{ mm}}{12 \text{ mm}}$ X \$50K = \$18,750 in FY79

(2) Simulation Computer Software Procurement (PDP 1104)

(A) = Generation of Driver Software to Read/Write to the Interface Box

Engineering Estimate = 4.5 mm

(2) Total = $\frac{4.5 \text{ mm}}{12 \text{ mm}}$ X \$50K

(2) Total = \$18,750 in FY79

Cost Element 6.4 HID Support Software Maintenance and Distribution

Cost Factors

1. Maintenance

2. Distribution

(1) Maintenance

(1) Total = 0 for this Option

(2) Distribution

(A) = (# Set Builds) (Cost/Set) (# Deliveries)/Per Yr.

Set Builds = 1

Cost/Set = $962 (1 Man Week)

Deliveries = #36

(2) Total = ((1) ($962) (#36) Per Yr.

Cost Element 7.1 PI Host Computer Software

Cost Factors

1. Distribution

2. Installation

3. Maintenance

(1) Distribution

(A) = ((# Set Builds) (Cost/Set) (# Deliveries))

Set Builds = 2 (Support Software + Simulation Software)

Cost/Set = Engineering Estimate = 1 Man Week = $962

Deliveries = #31

(1) Total = ((2) ($962) (#31))

(2) Installation

(A) = Engineering Estimate = 2 Man Weeks

= ($962) (2)

= $1924 Per Installation

(2) Total = ($1924) (#31)

(3) Maintenance

(A) = Level of Effort = Engineering Estimate

Maintenance is = Feedback of Problems Encountered in use of Distributed Software

Level of Effort = (.1 Man Yr.) Per Yr. Used

(3) Total = ((5K) (#35))

SECTION 14 Option IIB3B - Distributed Standard Mini, Software Development by PI at His Facility Using S360 Host

14.2 Cost Data - Variation II

OPTION IIB3b (HID) TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				0	347.91	1027.89	583.21	87.28
4.2				0	0	237.39	312.88	560.26
4.3				0	0	0	0	0
4.4				0	721.57	257.71	773.11	206.16
4.5				0	0	72.16	30.93	123.70
4.6				0	0	0	0	0
4.7				0	0	0	0	0
4.8				0	0	0	0	0
4.9				0	0	0	0	0
5.1				1234.30	204.00	102.00	57.00	510.00
5.2				0	58.52	69.24	85.60	78.60
5.3				450.00	0	0	0	0
5.4				0	35.35	34.95	35.85	35.15
6.1				1463.00	418.00	209.00	104.50	35.15
6.2				7.00	352.61	218.64	415.16	415.66
6.3				37.50	0	0	0	0
6.4				13.47	5.77	23.09	9.62	10.58
7.1				0	123.88	109.24	146.18	115.40
TOTAL				3205.27	2267.61	2361.31	2548.04	3187.79
ESCALATED TOTAL				4201.46	3180.44	3543.69	4091.60	5477.22

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OPTION IIB3b (HID) TOTAL COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	277.28	0	364.98	318.73	61.10	109.18	0	0
4.2	376.40	548.77	279.50	404.96	395.62	414.91	554.70	509.07
4.3	0	0	0	0	0	0	0	0
4.4	103.08	0	154.63	154.63	51.55	51.55	0	0
4.5	139.16	226.78	154.63	257.71	200.51	273.16	278.32	329.86
4.6	0	0	0	0	0	0	0	0
4.7	0	0	0	0	0	0	0	0
4.8	0	0	0	0	0	0	0	0
4.9	0	0	0	0	0	0	0	0
5.1	0	0	0	0	0	0	0	0
5.2	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
5.3	0	0	0	0	0	0	0	0
5.4	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
6.1	0	0	0	0	0	0	0	0
6.2	494.92	444.51	445.16	466.76	543.92	736.51	727.72	829.50
6.3	0	0	0	0	0	0	0	0
6.4	17.32	22.13	19.24	20.20	13.47	6.73	7.70	0
7.1	112.90	165.00	111.40	171.40	108.84	168.84	140.00	155.00
TOTAL	1639.04	1573.18	1650.44	1957.80	1498.49	1924.67	1849.98	1987.60
ESCALATED TOTAL	3013.31	3094.68	3473.93	4409.34	3611.13	4962.83	5104.15	5867.72
TOTAL COST		27,651.22						
ESCALATED TOTAL COST		54,031.50						

AVERAGE COST PER FLIGHT ____

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OPTION IIB3b (HID) TOTAL MANPOWER PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1				0	4.5	13.1	7.5	1.1
4.2				0	0	3.0	4.0	7.2
4.3				0	0	0	0	0
4.4				0	7.8	2.8	8.4	2.2
4.5				0	0	0.8	0.3	1.3
4.6				0	0	0	0	0
4.7				0	0	0	0	0
4.8				0	0	0	0	0
4.9				0	0	0	0	0
5.1				0	0	0	0	0
5.2				0	1.2	1.4	1.7	1.6
5.3				8.0	0	0	0	0
5.4				0	0.7	0.7	0.7	0.7
6.1				0	0	0	0	0
6.2				0.1	7.1	4.4	8.3	8.3
6.3				0.4	0	0	0	0
6.4				0.3	0.1	0.5	0.2	0.2
7.1				0	2.5	2.2	2.9	2.3
TOTAL MANPOWER				8.8	23.0	28.9	34.0	24.9

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OPTION IIB3b (HID) TOTAL MANPOWER PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1	3.5	0	4.7	4.1	0.8	1.4	0	0
4.2	4.8	7.0	3.6	5.2	5.1	5.1	7.1	6.5
4.3	0	0	0	0	0	0	0	0
4.4	1.1	0	1.7	1.7	0.6	0.6	0	0
4.5	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
4.6	0	0	0	0	0	0	0	0
4.7	0	0	0	0	0	0	0	0
4.8	0	0	0	0	0	0	0	0
4.9	0	0	0	0	0	0	0	0
5.1	0	0	0	0	0	0	0	0
5.2	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
5.3	0	0	0	0	0	0	0	0
5.4	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
6.1	0	0	0	0	0	0	0	0
6.2	9.9	8.9	8.9	9.3	10.9	14.7	14.6	16.6
6.3	0	0	0	0	0	0	0	0
6.4	0.4	0.4	0.4	0.4	0.4	0.1	0.2	0
7.1	2.3	3.3	2.3	3.4	2.2	3.4	2.8	3.1
TOTAL MANPOWER	25.9	25.4	25.7	30.2	24.6	31.6	30.5	33.1

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.1 Experiment Application Software Development								
(1) Software Development					222.30	656.82	372.69	55.80
(2) Common Software					0	0	0	0
(3) Host Computer Time					61.77	182.47	103.52	15.48
(4) Simulation Computer Time					63.84	188.60	107.00	16.00
(5) Host Computer Time - DEP Software					0	0	0	0
(6) Simulation Computer Time DEP Software					0	0	0	0
(7) Travel					0	0	0	0
(8) Training					0	0	0	0
LABOR COST					222.30	656.82	372.69	55.80
MANPOWER					4.5	13.1	7.5	1.1
TOTAL COST					347.91	1027.89	583.21	87.28

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.1 Experiment Application Software Development								
(1) Software Development	177.17	0	233.24	203.67	39.06	69.75	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	49.23	0	64.78	56.58	10.84	19.39	0	0
(4) Simulation Computer Time	50.88	0	66.96	58.48	11.20	20.04	0	0
(5) Host Computer Time - DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time DEP Software	0	0	0	0	0	0	0	0
(7) Travel	0	0	0	0	0	0	0	0
(8) Training	0	0	0	0	0	0	0	0
LABOR COST	177.17	0	233.24	203.67	39.06	69.75	0	0
MANPOWER	3.5	0	4.7	4.1	0.8	1.4	0	0
TOTAL COST	277.28	0	364.98	318.73	61.10	109.18	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software					0	151.70	199.94	358.02
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	42.14	55.54	99.45
(4) Simulation Computer Time					0	43.55	57.40	102.79
(5) Host Computer Time - DEP Software					0	0	0	0
(6) Simulation Computer Time - DEP Software					0	0	0	0
(7) Travel					0	0	0	0
LABOR COST					0	151.70	199.94	358.02
MANPOWER					0	3.0	4.0	7.2
TOTAL COST					0	237.39	312.88	560.26

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.2 Experiment Application Software Maintenance								
(1) Experiment Unique Software	240.48	350.67	178.61	258.79	252.81	265.14	354.47	325.31
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	66.80	97.41	49.61	71.88	70.23	73.65	98.46	90.36
(4) Simulation Computer Time	69.12	100.69	51.28	74.29	72.58	76.12	101.77	93.40
(5) Host Computer Time - DEP Software	0	0	0	0	0	0	0	0
(6) Simulation Computer Time - DEP Software	0	0	0	0	0	0	0	0
(7) Travel	0	0	0	0	0	0	0	0
LABOR COST	240.48	350.67	178.61	258.79	252.81	265.14	354.47	325.31
MANPOWER	4.8	7.0	3.6	5.2	5.1	5.1	7.1	6.5
TOTAL COST	376.40	548.77	279.50	404.96	395.62	414.91	554.70	509.07

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OPTION IIB3b (HID) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.3 EAS Software Integrated Verification								
(1) Integrated Verification					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Integrated Verification Simulation Software					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.3 EAS Software Integrated Verification								
(1) Integrated Verification	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Integrated Verification Simulation Software	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3B (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.4 Preflight Checkout Software Development								
(1) Software Development					390.60	139.50	418.50	111.60
(2) Common Software					0	0	0	0
(3) Host Computer Time					162.75	58.13	174.38	46.50
(4) Simulation Computer Time					168.22	60.08	180.23	48.06
(5) Travel					0	0	0	0
LABOR COST					390.60	139.50	418.50	111.60
MANPOWER					7.8	2.8	8.4	2.2
TOTAL COST					721.57	257.71	773.11	206.16

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.4 Preflight Checkout Software Development								
(1) Software Development	55.80	0	83.70	83.70	27.90	27.90	0	0
(2) Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	23.25	0	34.88	34.88	11.63	11.63	0	0
(4) Simulation Computer Time	24.03	0	36.05	36.05	12.02	12.02	0	0
(5) Travel	0	0	0	0	0	0	0	0
LABOR COST	55.80	0	83.70	83.70	27.90	27.90	0	0
MANPOWER	1.1	0	1.7	1.7	0.6	0.6	0	0
TOTAL COST	103.08	0	154.63	154.63	51.55	51.55	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software					0	39.06	16.74	66.96
(2) Experiment Common Software					0	0	0	0
(3) Host Computer Time					0	16.28	6.98	27.90
(4) Simulation Computer Time					0	16.82	7.21	28.84
(5) Travel					0	0	0	0
LABOR COST					0	39.06	16.74	66.96
MANPOWER					0	0.8	0.3	1.3
TOTAL COST					0	72.16	30.93	123.70

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.5 Preflight Checkout Software Maintenance								
(1) Experiment Unique Software	75.33	122.76	83.70	139.50	108.31	147.87	150.66	178.56
(2) Experiment Common Software	0	0	0	0	0	0	0	0
(3) Host Computer Time	31.39	51.15	34.88	58.13	45.34	61.61	62.78	74.40
(4) Simulation Computer Time	32.44	52.87	36.05	60.08	46.86	63.68	64.88	76.90
(5) Travel	0	0	0	0	0	0	0	0
LABOR COST	75.33	122.76	83.70	139.50	108.31	147.87	150.66	178.56
MANPOWER	1.5	2.5	1.7	2.8	2.2	3.0	3.0	3.6
TOTAL COST	139.16	226.78	154.63	257.71	200.51	273.16	278.32	329.86

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory					0	0	0	0
(2) Remote Job Entry					0	0	0	0
(3) Display Terminals					0	0	0	0
(4) Maintenance					0	0	0	0
(5) Telecom-munications					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.6 EAS Dependent STIL Hardware Supplement								
(1) Host Main Memory	0	0	0	0	0	0	0	0
(2) Remote Job Entry	0	0	0	0	0	0	0	0
(3) Display Terminals	0	0	0	0	0	0	0	0
(4) Maintenance	0	0	0	0	0	0	0	0
(5) Telecom-munications	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development					0	0	0	0
(2) Host Computer Time					0	0	0	0
(3) Simulation Computer Time					0	0	0	0
(4) Travel					0	0	0	0
LABOR COST					0	0	0	0
MANPOWER					0	0	0	0
TOTAL COST					0	0	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.8 Experiment Real-Time Simulation Software Development								
(1) Software Development	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Travel	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
4.9 Experiment Real-Time Simulation Software								
(1) Maintenance				0	0	0	0	0
(2) Host Computer Time				0	0	0	0	0
(3) Simulation Computer Time				0	0	0	0	0
(4) Travel				0	0	0	0	0
LABOR COST				0	0	0	0	0
MANPOWER				0	0	0	0	0
TOTAL COST				0	0	0	0	0

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OPTION HB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
4.9 Experiment Real-Time Simulation Software								
(1) Maintenance	0	0	0	0	0	0	0	0
(2) Host Computer Time	0	0	0	0	0	0	0	0
(3) Simulation Computer Time	0	0	0	0	0	0	0	0
(4) Travel	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.1 Experiment Processor Acquisition								
(1) Processor Hardware				644.00	184.00	92.00	46.00	460.00
(2) Qualification				520.30				
(3) Special Test Equipment*				70.00	20.00	10.00	5.00	50.00
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST				1234.30	204.00	102.00	51.00	510.00

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.1 Experiment Processor Acquisition								
(1) Processor Hardware	0	0	0	0	0	0	0	0
(2) Qualification	0	0	0	0	0	0	0	0
(3) Special Test Equipment*	0	0	0	0	0	0	0	0
NO MANPOWER ASSOCIATED WITH THIS COST ELEMENT								
LABOR COST								
MANPOWER								
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.2 Experiment Processor Maintenance								
(1) Maintenance					51.52	66.24	73.60	73.60
(2) Distribution					7.00	3.00	12.00	5.00
(3) Re-Furbishment					0	0	0	0
LABOR COST					58.52	69.24	85.60	78.60
MANPOWER					1.2	1.4	1.7	1.6
TOTAL COST					58.52	69.24	85.60	78.60

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.2 Experiment Processor Maintenance								
(1) Maintenance	77.28	121.44	73.60	117.76	77.28	121.44	103.04	125.12
(2) Distribution	5.50	9.00	11.50	10.00	10.50	7.00	3.50	4.00
(3) Re-Furbishment	0	0	0	0	0	0	0	0
LABOR COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12
MANPOWER	1.7	2.6	1.7	2.6	1.8	2.6	2.1	2.6
TOTAL COST	82.78	130.44	85.10	127.76	87.78	128.44	106.54	129.12

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OPTION IIB3b (HID) ELEMENT COST PAGE ___ OF ___

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.3 DEP Software Development & Procurement								
(1) Operating System Development				400.00	0	0	0	0
(2) Support Software Procurement				50.00	0	0	0	0
LABOR COST				400.00	0	0	0	0
MANPOWER				8.0	0	0	0	0
TOTAL COST				450.00	0	0	0	0

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OPTION HB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.3 DEP Software Development & Procurement								
(1) Operating System Development	0	0	0	0	0	0	0	0
(2) Support Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance					34.65	34.65	34.65	34.65
(2) Distribution					0.70	0.30	1.20	0.50
LABOR COST					35.35	34.95	35.85	35.15
MANPOWER					0.7	0.7	0.7	0.7
TOTAL COST					35.35	34.95	35.85	35.15

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COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
5.4 DEP Software Maintenance & Distribution								
(1) Maintenance	34.65	34.65	34.65	34.65	34.65	34.65	34.65	34.65
(2) Distribution	0.55	0.90	1.15	1.00	1.05	0.70	0.35	0.40
LABOR COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05
MANPOWER	0.7	0.7	0.7	0.7	0.7	0.7	0.7	0.7
TOTAL COST	35.20	35.55	35.80	35.65	35.70	35.35	35.00	35.05

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COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.1 Interface Device Development Host to DEP								
(1) Engineering Design								
(2) DEP Interface				1463.00	418.00	209.00	104.50	1045.00
(3) Integration								
(4) Consumable Stock								
LABOR COST								
MANPOWER								
TOTAL COST				1463.00	418.00	209.00	104.50	1045.00

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.1 Interface Device Development Host to DEP								
(1) Engineering Design								
(2) DEP Interface	0	0	0	0	0	0	0	0
(3) Integration								
(4) Consumable Stock								
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.2 Interface Device Maintenance - Host to DEP								
(1) Maintenance				0	24.61	31.64	35.16	35.16
(2) Operation of Experiment Hardware System				0	325.00	175.00	375.00	375.00
(3) Distribution				7.00	3.00	12.00	5.00	5.50
LABOR COST				7.00	352.61	218.64	415.16	415.66
MANPOWER				0.1	7.1	4.4	8.3	8.3
TOTAL COST				7.00	352.61	218.64	415.16	415.66

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.2 Interface Device Maintenance - Host to DEP								
(1) Maintenance	36.92	58.01	35.16	56.26	36.92	58.01	49.22	54.50
(2) Operation of Experiment Hardware System	450.00	375.00	400.00	400.00	500.00	675.00	675.00	775.00
(3) Distribution	9.00	11.50	10.00	10.50	7.00	3.50	4.00	0
LABOR COST	494.92	444.51	445.16	466.76	543.92	736.51	727.72	829.50
MANPOWER	9.9	8.9	8.9	9.3	10.9	14.7	14.6	16.6
TOTAL COST	494.92	444.51	445.16	466.76	543.92	736.51	727.72	829.50

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.3 Simulation Computer Software Development & Procurement								
(1) Simulation Computer Software Development				18.75	0	0	0	0
(2) Simulation Computer Software Procurement				18.75	0	0	0	0
LABOR COST				18.75	0	0	0	0
MANPOWER				0.4	0	0	0	0
TOTAL COST				37.50	0	0	0	0

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COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.3 Simulation Computer Software Development & Procurement								
(1) Simulation Computer Software Development	0	0	0	0	0	0	0	0
(2) Simulation Computer Software Procurement	0	0	0	0	0	0	0	0
LABOR COST	0	0	0	0	0	0	0	0
MANPOWER	0	0	0	0	0	0	0	0
TOTAL COST	0	0	0	0	0	0	0	0

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COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
6.4 HID Support Software Maintenance & Distribution								
(1) Maintenance				0	0	0	0	0
(2) Distribution				13.47	5.77	23.09	9.62	10.58
LABOR COST				13.47	5.77	23.09	9.62	10.58
MANPOWER				0.3	0.1	0.5	0.2	0.2
TOTAL COST				13.47	5.77	23.09	9.62	10.58

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
6.4 HID Support Software Maintenance & Distribution								
(1) Maintenance	0	0	0	0	0	0	0	0
(2) Distribution	17.32	22.13	19.24	20.20	13.47	6.73	7.70	0
LABOR COST	17.32	22.13	19.24	20.20	13.47	6.73	7.70	0
MANPOWER	0.4	0.4	0.4	0.4	0.3	0.1	0.2	0
TOTAL COST	17.32	22.13	19.24	20.20	13.47	6.73	7.70	0

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COST ELEMENT	FY76	FY77	FY78	FY79	FY80	FY81	FY82	FY83
7.1 PI Host Computer Software								
(1) Distribution					26.94	9.62	23.09	7.70
(2) Installation					26.94	9.62	23.09	7.70
(3) Maintenance					70.00	90.00	100.00	100.00
LABOR COST					123.88	109.24	146.18	115.40
MANPOWER					2.5	2.2	2.9	2.3
TOTAL COST					123.88	109.24	146.18	115.40

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OPTION IIB3b (HID) ELEMENT COST PAGE ____ OF ____

COST ELEMENT	FY84	FY85	FY86	FY87	FY88	FY89	FY90	FY91
7.1 PI Host Computer Software								
(1) Distribution	3.85	0	5.77	5.77	1.92	1.92	0	0
(2) Installation	3.85	0	5.77	5.77	1.92	1.92	0	0
(3) Maintenance	105.00	165.00	100.00	160.00	105.00	165.00	140.00	155.00
LABOR COST	112.90	165.00	111.40	171.40	108.84	168.84	140.00	155.00
MANPOWER	2.3	3.3	2.3	3.4	2.2	3.4	2.8	3.1
TOTAL COST	112.90	165.00	111.40	171.40	108.84	168.84	140.00	155.00

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APPROVAL

SPACELAB EXPERIMENT COMPUTER STUDY

Volume V: Spacelab User Cost Data (Distributed Computer)

By James L. Lewis, Bobby C. Hodges, and James O. Christy

The information in this report has been reviewed for security classification. Review of any information concerning Department of Defense or Atomic Energy Commission programs has been made by the MSFC Security Classification Officer. This report, in its entirety, has been determined to be unclassified.

This document has also been reviewed and approved for technical accuracy.

J. T. POWELL
Director, Data Systems Laboratory

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