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# LIFE SCIENCES PAYLOAD DEFINITION AND INTEGRATION STUDY (TASK C & D)

VOLUME III + APPENDICES

**GENERAL DYNAMICS**  
*Convair Aerospace Division*

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VOLUME I	MANAGEMENT SUMMARY
VOLUME II	PAYLOAD DEFINITION, INTEGRATION, AND PLANNING STUDIES
VOLUME III	APPENDICES
VOLUME IV	PRELIMINARY EQUIPMENT ITEM SPECIFICATION CATALOG

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AND INTEGRATION STUDY  
(TASK C & D)**

VOLUME III + APPENDICES

August 1973

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## LIST OF ACRONYMS

AAP	Apollo Applications Program
BEST	Bioexperiment Support & Transfer
BRSM	Bioresearch Support Module
cm	Cage Module
CORE	Common Operational Reserach Equipment
CVT	Concept Verification Test
DMS	Data Management System
EGG	Electrocardiogram
EC/LSS	Environmental Control/Life Support System
ECS	Environmental Control System
EI	Equipment Item
EPS	Electrical Power System
EU	Equipment Unit
FPE	Functional Program Element
HUM	Holding Unit Module
IMBLMS	Integrated Medical & Behavioral Laboratory Measurement System
LFB	Laminar Flow Bench
LSPD	Life Sciences Payload Definition
LS/PS	Life Support/Protective Systems
MSFN	Manned Space Flight Network
MSI	Man-Systems Integration
PCM	Pulse Code Modulated
PI	Principal Investigator
RAM	Research Applications Module
SRT	Supporting Research Technology
TCS	Thermal Control System

## APPENDIX I

### RESEARCH EQUIPMENT DEFINITION DATA

#### I.1 INTRODUCTION

Research equipment requirements were based on the Mini-7 and Mini-30 laboratory concepts defined in Tasks A & B of the initial LSPD contract. Modified versions of these laboratories and the research equipment within them were to be used in three missions of Shuttle/Sortie Module. These were designated (1) the Shared 7-Day Laboratory (a mission with the life sciences laboratory sharing the Sortie Module with another scientific laboratory), (2) the Dedicated 7-Day Laboratory (full use of the Sortie Module), and (3) the Dedicated 30-Day Laboratory (full Sortie Module use with a 30-day mission duration). In defining the research equipment requirements of these laboratories, the equipment was grouped according to its function, and equipment unit data packages were prepared. These data packages follow a common format and are contained in this appendix in Sections I.2 through I.15. This section (I.1) is devoted to describing the general content of each of these data packages.

Table I.1-1 shows the groups of equipment units for which equipment unit data packages have been prepared. An equipment unit (E.U.) is a group of equipment items (E.I.s) which pertain to the performance of common functions such as preparation and preservation of organisms and specimens. The equipment units which pertain to general laboratory operations required by all the FPEs are designated common operation research equipment (CORE), and the others are designated F.P.E. specific. These designations were derived in earlier studies and their use was continued in this study. In all, there are 14 equipment unit groups. These groups contain from about 5 to 30 equipment items.

As shown in the table, in several cases several equipment units have been combined and the related data placed in one E.U. data package. This was done because the individual equipment units contained very small numbers of items, and/or the items were very similar in nature and it was convenient to group them together. An example of this is E.U. 40, the Small Vertebrate Holding Unit, E.U. 41, the Primate Holding Unit, and E.U. 42, the Vertebrate Research Unit.

TABLE I.1-1

LABORATORY EQUIPMENT UNIT GROUPS

EU No.	Name	
1	Visual Records & Microscopy Unit	} Core Units
2	Data Management Unit	
3	Life Sciences Experiment Support Unit	
4	Preparation & Preservation Unit	
5	Biochemical & Biophysics Analysis Unit	
6/7	Maintenance Repair & Fabrication Unit/Ancillary Storage Unit	
11	Airlock/EVA Capability	} FPE Specific Units
12/31	Biomedical/Behavioral Research Support Unit/ Biomedical Research Support Unit	
26	Radiobiology Support Unit	
40/41/42	Vertebrate Holding Unit/Primate Holding Unit/ Vertebrate Research Support Unit	
50/51/70	Plant Holding Unit/Plant Research Support Unit & Invertebrate Holding Unit	
60/61	Cells & Tissue Holding Unit/Cells & Tissues Research Support Unit	
80	Life Support Subsystem Test Unit	
91/93	Behavioral Measurements Unit/Mobility Unit	

Shown below is an outline of the kind of information to be found in Sections I.2 through I.15 on each equipment unit group.

- Functional Capability & Summary Data
  - Summary of Weight, Power, Volume & Cost
- Equipment Items
  - Equipment List
  - Equipment Volume & Placement Figures
- Operations & Interfaces
  - Equipment Operations Analysis
  - Data Requirements
  - Consumables
  - Launch & Re-entry Operations
  - Electrical Power
  - Heat Rejection
  - Typical Equipment Unit Functional Interfaces
- Equipment Item Cost Summary

First is summary information containing a statement of the functional capability of the equipment unit and a table of total weight, power, volume and cost. Next there is detailed information about each equipment item within the equipment unit. This includes a listing of all the equipment items along with their pertinent properties, and figures showing the volume and placement of these equipment items within standardized racks and consoles.

In the area of operations and interfaces, an operations analysis model is presented and the sampled data requirements of the equipment items are tabulated. Also included is information on the consumables required within the equipment unit, and general information on any equipment requiring special consideration during launch or re-entry. Electrical power and heat rejection requirements of the equipment are presented. Typical research functional interrelationships between the equipment units are also described for most of the E. U. s. These are intended as an aid to the engineer in understanding how each equipment unit may be used by the payload specialists, and what other equipment units interact with the subject equipment unit. This information is intended to aid in the proper placement of the equipment units within the overall laboratory.

The last item listed is the equipment item cost summary. The cost summary table indicates the type of development required as well as the time required for the development of a flight article. Each of the three Sortie Module Laboratories are listed with unit and development costs for each individual EI and a summation for the total EU cost. Commercial costs for certain EI are listed for comparison. When appropriate, remarks pertaining to the cost factors of an EI are included in the table.

Table I. 1-2 is a sample of the equipment unit summary table for E. U. 5, the Biochemistry/Biophysics Analysis Unit. As shown, properties are given for each of the three laboratories studied. The properties summarized include the number of standard racks and/or consoles required to contain the equipment, and the volume of these racks and consoles.

The average electrical power is presented for the 12-hour period when the crew is on-duty, as well as the off-duty period. The estimated a. c. and d. c. components are also indicated, along with an estimated peak power requirement for the on-duty period. It was assumed throughout this study that the use of 28 v d. c. electrical power was preferred to any of the types of a. c. In the Sortie Module, hydrogen fuel cells are the primary power source and these units generate d. c. power. Thus, d. c. power will be the most efficient to use and will require the least equipment. Alternating current power will be available but will require various types of conditioning equipment.

**TABLE I.1-2. SUMMARY OF PROPERTIES  
E.U. 5 Biochemistry/Biophysics Analysis Unit**

PROPERTY	SHARED 7-DAY LAB.	DEDICATED 7-DAY LAB.	DEDICATED 30-DAY LAB.
<u>NUMBER OF RACKS &amp; CONSOLES</u>	1	2	2.5
<u>VOLUME, dm<sup>3</sup>, TOTAL</u>	<u>881</u>	<u>1671</u>	<u>2099</u>
RACKS & CONSOLES	744	1488	1860
DISTRIBUTED & EXTRA ITEMS	137	183	239
SMALL STORAGE ITEMS (MISC.)	0	0	0
<u>FIXED WEIGHT, kg (LB)</u>	230 (506)	453 (997)	582 (1,230)
<u>ELECTRICAL POWER, W</u>			
<u>ON DUTY* AVERAGE POWER, TOTAL</u>	<u>88</u>	<u>315</u>	<u>320</u>
ESTIMATED D-C	80	100	105
ESTIMATED A-C	8	215	215
<u>OFF-DUTY* AVERAGE POWER, TOTAL</u>	<u>80</u>	<u>225</u>	<u>225</u>
ESTIMATED D-C	80	100	100
ESTIMATED A-C	0	125	125
<u>ESTIMATED ON-DUTY PEAK POWER</u>	500	1,000	1,000
<u>HEAT REJECTION, w<sub>t</sub></u>			
<u>ON DUTY LOAD, TOTAL</u>	<u>88</u>	<u>315</u>	<u>320</u>
ESTIMATED AIR COOLED LOAD	44	158	160
ESTIMATED COLD PLATED LOAD	44	158	160
<u>OFF DUTY LOAD, TOTAL</u>	<u>80</u>	<u>225</u>	<u>225</u>
ESTIMATED AIR COOLED LOAD	40	113	113
ESTIMATED COLD PLATED LOAD	40	113	113
<u>DEVELOPMENT COST, \$K</u>	1,706	5,109	6,494
<u>UNIT COST, \$K</u>	347	823	928
*12 HOURS			

Most of the equipment items aboard the laboratories are in the conceptual design phase as far as a flight qualified item is concerned. Thus, either design and fabrication are yet to be done or modification of existing equipment is required. In this process, it was therefore assumed that d.c. power would be utilized unless it conflicted with the basic power using process, or with existing designs not amenable to the change.

Table I.1-3 is an example of the equipment item list from E.U. #5. The data includes (1) the name of the equipment item, (2) the E.I. identification number from the equipment inventory, (3) the number of E.I.s required in each laboratory, (4) the unit weight of each E.I., (5) the average power required while the unit is operating, (6) the unit volume of each E.I., (7) the development and unit costs, and (8) a general description of the E.I. or its purpose. Detailed notes pertaining to the table are as follows:

\*EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\*Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\*Average power while equipment is operating.

+The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

TABLE I.1-3. SAMPLE EQUIPMENT ITEM LIST (PARTIAL)  
E.U. 5 - Biochemistry/Biophysics Analysis Unit

E. I. NAME	E.I. NO.*	NO. OF UNITS REQD., ** SHARED, DED.	UNIT WEIGHT kg (LB.)	UNIT PWR*** WATTS	UNIT VOLUME dm <sup>3</sup> (FT <sup>3</sup> )	COST DEVELOP. (UNIT) \$K	GENERAL DESCRIPTION
AUTOANALYZER, MULTIPLE	7	0 1	114 (250)	400	425 (15)	700 (100)	TO PERFORM VARIOUS ANALYSES ON BLOOD AND OTHER METABOLIC FLUIDS
ANALYZER, ATOMIC ABSORPTION SPECTROPHOTOMETER	(8A)	(1)	36 (80)	110	113 (4.0)	1200 (60) (4)*	TO ANALYZE METALLIC AND SEMI-METALLIC ELEMENTS IN SOLUTION.
ANALYZER, GENERAL SPECTROPHOTOMETER	11	1 1	136 (300)	450	283 (10)	350 (50)	FOR SPECTRAL ANALYSIS OF GASES & LIQUIDS
ANALYZER, URINE, AUTOMATIC	13	0 1	—	—	—	—	PART OF AUTOANALYZER, E.I. 7
ATMOSPHERIC SAMPLING MANIFOLD SYSTEM	15A	1 1	23 (50)	0	28 (1.0)	0 (0)	FOR PERIODIC SAMPLING OF CAGE & CAGE MODULE ATMOSPHERES. PAYLOAD SPECIFIC. ESTIMATES FOR WT. AND VOL. SHOWN.
AUDIOMETER	(16B)	(1)	5 (10)	25	4 (0.15)	35 (5)	FOR SOUND SOURCE TO EARPHONES OR BONE VIBRATORS. 125 TO 8000 HZ. FOR MEASUREMENTS ON MAN.

Standard sized racks and consoles were used to house the equipment. The outline of the rack and console are shown in Figure I.1-1. They are  $0.61 \times 0.61 \times 2.0$  meters. The equipment items were conceptually placed in the rack and console as shown in the figure. The names and volumes of each E.I. are listed in the tabulation to the left of the figure. It might be mentioned that a cubic decimeter is approximately equal to one liter ( $\approx 1$  quart) and there are  $1000 \text{ dm}^3$  per  $\text{m}^3$  and  $28.3 \text{ dm}^3$  per cubic foot. To the right of the figure is a list of E.I.s within E.U. 5 which are distributed around the laboratory because of their specific function.

An operations model was developed based upon the functions to be performed within the laboratories as listed in the functions inventory which was developed during Task A & B of the preceding contract. This permitted the calculation of certain laboratory properties, such as electrical power usage, while maintaining a facility approach to laboratory definition.

## EQUIPMENT ITEMS IN RACK &amp; CONSOLE

E.I. NUMBER & NAME	VOL. dm <sup>3</sup>
<b>IN RACK:</b>	
7 AUTOANALYZER	425
11 SPECTROPHOTOMETER	283
TOTAL	708
EXCESS VOL. ALLOWANCE	36
<b>IN TOP OF CONSOLE:</b>	
52 CELL COUNTER	57
64 COLONY COUNTER	14
70L FIBROMETER	20
85 BLOOD GAS ANALYZER	45
90 MASS SPECTROMETER	57
91 MASS SPECTROMETER (1)	6
138 pH METER	23
157 SOUND METER	28
TOTAL	250
EXCESS VOL. ALLOWANCE	40
<b>IN BOTTOM OF CONSOLE:</b>	
89 GAS CHROMATOGRAPH	207
125C REFRACTOMETER	
126B MICROPHONES (5)	1 (NEGL.)
179A THERMOCOUPLES	
TOTAL	208
EXCESS VOL. ALLOWANCE	75

DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(NOT IN RACK OR CONSOLE)

E.I. NUMBER & NAME	VOL. dm <sup>3</sup>
16A GAS MANIFOLD	28
50A MANIFOLD FLOW CONTROL	14
86 CO <sub>2</sub> ANALYZER	1
91 MASS SPECTROMETER (1)	6
93 DEW POINT SENSORS	104
125B METERS (MISC.)	1
125C AMPLIFIERS	NEGL.
180A TRACE GAS CONCENTRATOR	28
TOTAL	182

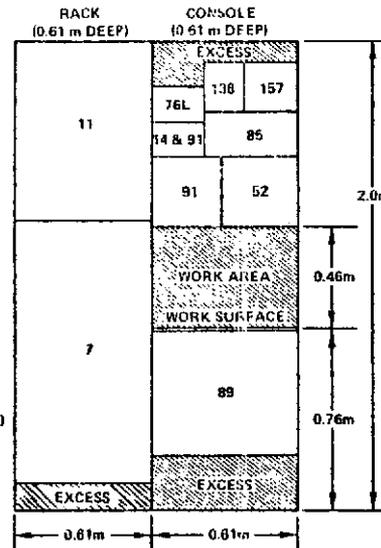


Figure I.1-1. Equipment Volume & Placement Example.  
E. U. 5 - Biochemistry/Biophysics Analysis Unit -  
Dedicated 7-Day Laboratory

For each equipment item in the laboratory, specific functions are listed in the functions inventory. Also listed is an estimated time to perform each function. The operations model is formed by using these times in addition to an assumed frequency of occurrence for each function, as indicated in Table I.1-4. Shown are two sample equipment items and the functions for which they are used. The assumed function frequency, as shown, was multiplied by the time for the crew (payload specialist) to complete the function which is contained in the functions inventory. This results in the crew times as shown in the table. More detailed discussion of the operations model and the crew time requirements are contained in Appendix II.

The time in Table I.1-4 was also used to calculate average power requirements of the laboratory, as shown. This was done by multiplying the power required for each E.I. by the time that the E.I. was on and averaging this power consumption over 24 hours. Some of the E.I.s which operate only during the time while the payload specialists are doing research in the lab were averaged over this 12-hour on-duty period. These values were used to calculate the on-duty versus the off-duty power requirements.

Table I.1-5 shows the format used in compiling the sampled data requirements of each equipment unit. The equipment items which would require data signal or control signal interconnections with the data management subsystem were listed along with the signal characteristics. These include range, resolution, signal type, number of

TABLE I.1-4. SAMPLE OF EQUIPMENT OPERATIONS MODEL (Partial List)

E. U. 4 - Preparation & Preservation Unit

EQUIP. ITEM	EQUIPMENT NAME & USING FUNCTION	DEDICATED LABS - 7 & 30 DAYS				SHARED 7-DAY LAB			
		NO. OF ITEMS REQ'D.	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVG. POWER, WATTS	NO. OF ITEMS REQ'D.	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVG. POWER, WATTS
014	ANESTHETIZER (INVERT HANDLING)	1				1			
	78A INVERTEBRATE COUNTING & SORTING		15 MIN/DY.	15.0	0		5 MIN/DY.	5.0	0
				15	0			5	0
018	BENCH, 1 AM FLO	1				1			
	6A URINE MANAGEMENT		1/WK.	4.0	0.6		1/WK.	4.0	0.6
	8B FECES MANAGEMENT		1/WK.	4.0	0.6		1/WK.	4.0	0.6
	31B BIOSAMPLING		6/DAY	30.0	4.2		3/DY.	15.0	2.1
	78A INVERTEBRATE COUNTING & SORTING		15 MIN/DY.	15.0	2.1		5 MIN/DY.	5.0	0.7
	91B PLANT RADIOCHEMISTRIES		-	-	-		2/WK.	8.0	1.1
	92B VERTEBRATE RADIOCHEMISTRIES		4/WK.	16.0	2.2		2/WK.	8.0	1.1
	93B INVERTEBRATE RADIOCHEMISTRIES		4/WK.	16.0	2.2		2/WK.	8.0	1.1
	94B CELL & TISSUE RADIOCHEMISTRIES		4/WK.	16.0	2.2		2/WK.	8.0	1.1
	124A CREW/ORGANISM ISOLATION		1/4 HR.	9.0	1.3		1/DY.	3.0	0.4
	125A CREW/CHEMICAL ISOLATION		1/4 HR.	9.0	1.3		1/DY.	3.0	0.4
	353A CULTURE/SENSITIVITY		1/WK.	1.0	0.1		-	-	-
				120	17			66	9

TABLE I.1-5. SAMPLED DATA REQUIREMENTS (Partial List)

E. U. 5 - Biochemistry/Biophysics Analysis Unit

Dedicated 7-Day Laboratory

EQUIPMENT ITEMS (E.U. NO./F.I. NO.) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	RANGE	RESOLUTION	SIGNAL TYPE	NO. OF CHAN.	BITS PER SAMPLE	SAMPLING DURATION MIN/DAY	SAMPLING RATE PER CHANNEL	TOTAL BIT RATE BPS	TOTAL BITS PER DAY	
GENERAL SPECTROPHOTO METER (S/11)										
WAVELENGTH MONITOR	0-5V	5mV	ANAL.	1	10	9	500/SEC	5000	2.7M	FOR MAXIMUM SCANNING RATE
DETECTOR SIGNAL	0-5V	15mV	ANAL.	1	9	9	5000/SEC	45K	24.3M	
ON/OFF CONTROL	2 POSITION	1 POSITION	DIG.	1	1	CONT.	1/SEC	1	86K	
OUTPUT RANGE SELECT	1-4	1	DIG.	1	2	9	1/SEC	2	1K	
SCANNED SELECT	1-6	1	DIG.	1	3	9	1/SEC	3	2K	
SPECIMEN I.D.	1-100	1	DIG.	1	7	9	0.1/SEC	1	NEGL.	
AUDIOMETER (S/168)										
tone SIGNAL OUTPUT	500-8KHz	10 Hz	ANAL.	1	-	4	-	-	-	
AMPLIFIER GAIN	5 LEVELS	1 LEVEL	DIG.	2	3	4	1/SEC	3	1K	
ON/OFF CONTROL	2 POSITIONS	2 POSITION	DIG.	1	1	CONT.	1/SEC	1	86K	
RESPONSE KEYS	1-12	1	DIG.	1	4	4	1/SEC	4	1K	
tone CONTROL	0-5 V	0.05 V	ANAL.	1	7	4	0.1/SEC	1	NEGL.	

channels, and bits per sample. The sampling duration was obtained from the operations model described on the preceding two pages, and the sampling rate was estimated based on the dynamic nature of the signal. The total bit rate is the sampling rate per channel multiplied by the product of the number of channels and the number of bits per sample. The total bits per day is the total bit rate multiplied by the sampling duration. The total bits per day summed up for all equipment within the laboratory was used to calculate an average sampled data rate for the laboratory. Only the Dedicated 7-Day Laboratory sampled data requirements were tabulated for the equipment unit groups. They were used to establish approximate sampled data requirements for the Shared 7-Day Laboratory and the Dedicated 30-Day Laboratory.

I.1.1 COMMENT. In some cases, the analysis of the various data contained in the following sections is more rigorous than the accuracy of the data would warrant. This has been done in order to establish models which can be critiqued and improved upon for future use with updated information. It was also felt that such analysis would yield better results than more approximate techniques such as the use of overall factors, and that it would also preserve a record of the basis of the data presented.

The development of more accurate data on an equipment item level was beyond the scope of the current task. Many of the equipment items aboard the payloads will require extensive and costly development programs in order to obtain better definitions of the weight, power, volume, and interfaces of these items. For this contract, the purpose of which was to generate preliminary planning information, the best available equipment item data was used within the limitations of the contract.

## I.2 EQUIPMENT UNIT 1, VISUAL RECORDS AND MICROSCOPY UNIT

I.2.1 FUNCTIONAL CAPABILITY & SUMMARY DATA. This equipment unit provides the capability for obtaining and preserving records of visual experiment phenomena and data. A summary of the pertinent properties of this equipment unit is given in Table I.2-1.

I.2.2 EQUIPMENT ITEMS. Major equipment items include movie cameras, still cameras, video cameras, a biomedical recorder and microscopes. The amount of film, recording chart paper, and log books is based on the mission duration of either 7 or 30 days, see Table I.2-2.

The placement and volume of the equipment is shown in Figures I.2-1 & I.2-2. In the Shared 7-Day Laboratory, two of the cine cameras were assumed to be in fixed positions within the Sortie Module. The other two are stored in the console and can be used at varied experiment sites on an as-needed basis. The same holds true for the two video cameras in the console, which are to be used to record a variety of Bio-medical, MSI, & LSPS experiment events. The four distributed video cameras are located in the cage modules to monitor vertebrates, plants, and/or invertebrates. The same sort of rationale applies to the cine & video cameras in the Dedicated Laboratories, Figure I.2-2. The four cameras in the Shuttle for the 30-day mission are to be used for MSI habitability studies.

### I.2.3 OPERATIONS & INTERFACES

Equipment Operations Analysis - See Table I.2-3.

Data Requirements - Sampled data requirements are estimated in Table I.2-4. For a discussion of the handling of video data from the video cameras, see Section 3.0 of Vol. II of this report.

Launch and Re-Entry Operations - Currently, none of the cameras or other equipment in E.U. 1 is anticipated to be operating during launch or re-entry phases of the mission. Any such requirements are considered to be experiment-specific and will be delineated when such experiments are to be flown.

Electrical Power - Electrical power requirements are given in Table I.2-1. Major average power consumers are the camera controller and cameras. It is estimated that the majority of this power will be 28 v. d. c. Peak loads in the dedicated labs will be on the order of 600 watts when the biomedical recorder and color video camera are on simultaneously. The peak load for the shared lab is about 450 watts when the biomedical recorder is on.

Heat Rejection - On-duty heat rejection loads are:

Shared Lab	224 w <sub>t</sub> (765 Btu/hr)
Dedicated 7-Day Lab	261 w <sub>t</sub> (891 Btu/hr)
Dedicated 30-Day Lab	271 w <sub>t</sub> (925 Btu/hr)

In the interest of minimizing the cabin air load, the camera controller (200 w<sub>t</sub>) could be cold-plated using the Sortie Module water coolant at 296°K to 310°K (73°F to 99°F). Thus, the remaining equipment would contribute approximately 24, 60, and 71 w<sub>t</sub> for the three laboratory heat loads shown above.

Typical Equipment Unit Functional Interfaces - See Table I.2-5.

I.2.4 EQUIPMENT ITEM COST SUMMARY - See Table I.2-6.

TABLE I.2-1. E.U. 1 (VISUAL RECORDS & MICROSCOPY UNIT) -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	1/2	1/2	1/2
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>446 (15.7)</u>	<u>463 (16.3)</u>	<u>463 (16.3)</u>
Racks & Consoles	372 (13.1)	372 (13.1)	372 (13.1)
Distributed & Extra Items	74 (2.6)	91 (3.2)	91 (3.2)
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	181 (398)	258 (568)	299 (658)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>224</u>	<u>261</u>	<u>271</u>
Estimated d.c.	223	248	258
Estimated a.c.	1	13	13
<u>Off-Duty* Average Power, Total</u>	<u>219</u>	<u>237</u>	<u>246</u>
Estimated d.c.	219	237	246
Estimated a.c.	0	0	0
<u>Estimated On-Duty Peak Power</u>	450	600	600
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>224</u>	<u>261</u>	<u>271</u>
Estimated Air Cooled Load	24	61	71
Estimated Cold Plated Load	200	200	200
<u>Off Duty Load, Total</u>	<u>219</u>	<u>237</u>	<u>246</u>
Estimated Air Cooled Load	19	37	46
Estimated Cold Plated Load	200	200	200
<u>Development Cost, \$K</u>	3490	3791	3791
<u>Unit Cost, \$K</u>	419	603	643
*12 Hours			

TABLE I.2-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 1

## VISUAL RECORDS AND MICROSCOPY

E.I. Name	E.I. No.*	No. of Units Req'd,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
Adapters, TV - Microscope	3C	0 1	0.2 (0.4)	0	2.8 (0.1)	1 (1)	To allow viewing the subject under the microscope with a TV camera
Camera, Cine	32	4 6	3.6 (8)	0	8.5 (.3)	150 (20) (3) <sup>+</sup>	For visual records of experiment phenomena.
Camera Controller	32A	1 1	14 (30)	200	28 (1.0)	3000 (150)	Electronic instrument to control the operation of the video cameras within the cage modules. Issues commands to cameras and identifies time and subject of image being received. Processes time lapse video data for transmission to recorders.
Camera, Still (Plate Film)	34	2 2	11 (25)	0	14 (0.5)	20 (5)	To provide still photographic documentation of various experiment phenomena such as dissections. Includes work table with lights.
Camera, Video, B/W	37	6 10 (14)	4.5 (10)	15	2.8 (0.1)	0 (10) (10) <sup>+</sup>	Black and White Camera, for recording and monitoring experiments and organisms.
Camera, Video, Color	38	0 1	36 (80)	150	74 (2.6)	300 (100) (20) <sup>+</sup>	For recording and monitoring experiment phenomena, for down-linking data
Camera, X-Y Drive	38A	1 4	2.3 (5)	20	11 (0.4)	100 (1)	Mechanical drive system for video cameras (similar to X-Y plotter mechanism) for the purpose of scanning and monitoring various experimental organisms with one camera. Part of cage module, EI 103, E.U. 40.
Film	76C	1 2 (4)	9 (20)	0	8.5 (0.3)	0 (0)	Still photography and motion picture film.
Filters, Video	76E	1 1	.5 (1)	0	2.8 (0.1)	0 (1)	Filters for color video camera.
Log Books	116	11 11	.5 (1)	0	1.4 (0.05)	0 (0)	For daily records.
Microscope, Compound	126	1 1	6.8 (15)	25	23 (0.8)	20 (12) (8) <sup>+</sup>	General purpose binocular microscope for tissue studies, etc., with camera attachments.
Monitor, Video	126G	1 1	9.1 (20)	50	57 (2.0)	0 (5)	For on-board observations of experiment phenomena by the crew. Located near the cage modules.
Paper, Recording	134B	1 1 (3)	2.3 (5)	0	8.5 (0.3)	0 (0)	For strip chart recorders.
Recorder, Multichannel Biomedical	150A	1 1	68 (150)	230	57 (2.0)	200 (100) (30) <sup>+</sup>	Recorder, 8 channel, to supplement the capability of the Data Management Subsystem.
Video ID Date-Time System	181E	1 1	-	-	-	- -	Identification and time recording system for visual records. Conceptual design item. Included in E.I. 32A, E.U. 1.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

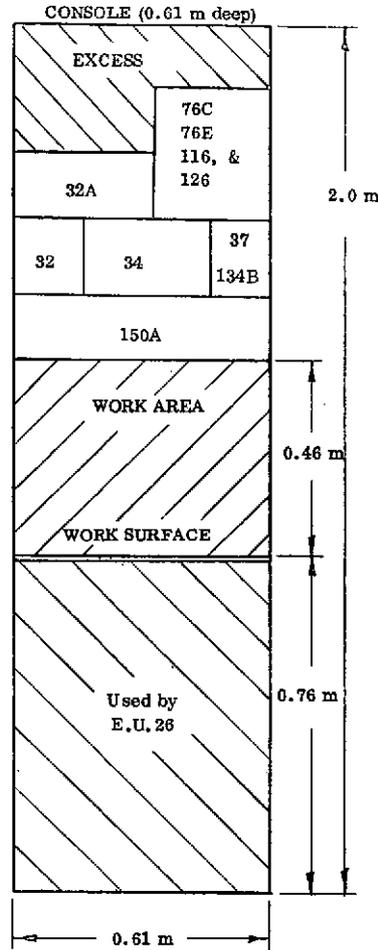
FIGURE I. 2-1 EQUIPMENT VOLUME AND PLACEMENT

Shared 7-Day Laboratory

E.U. 1 Visual Records and Microscopy

EQUIPMENT ITEMS IN CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
<u>In Top of Console:</u>	
32 Cine Cameras (2)	17
32A Camera Controller	28
34 Plate Film Cameras	28
37 Video Cameras (2)	5.6
76C Film	9
76E Filters	2.8
116 Log Books	15.4
126 Binocular Microscope	23
134B Recorder Paper	8.5
150A Biomedical Recorder	57
Total	194.3
Excess Volume Allowance	96



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
32 Cine Cameras (2)	17
37 Video Cameras (4, in Cage Modules)	-
38A Camera Drive (in Cage Module)	-
126G Video Monitor	57
Total	74

FIGURE I.2-2 EQUIPMENT VOLUME AND PLACEMENT

Dedicated 7-Day and 30-Day Laboratories

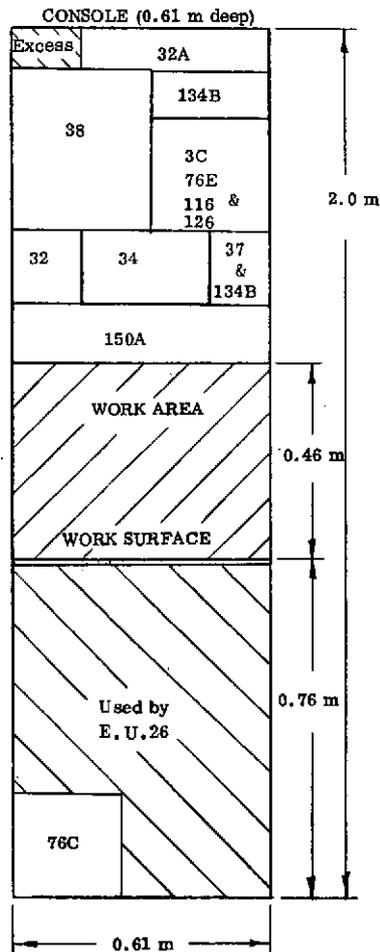
E.U. 1 Visual Records and Microscopy

EQUIPMENT ITEMS IN CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
<u>In Top of Console:</u>	
3C Microscope TV Adapter	2.8
32 Cine Cameras (2)	17.0
32A Camera Controller	28
34 Plate Film Cameras	28
37 Video Cameras (2)	5.6
38 Color Video Camera	74
76E Filters	2.8
116 Log Books	15.4
126 Binocular Microscope	23
134B Recording Paper	26*
150A Biomedical Recorder	56.6
<b>Total</b>	<b>279.2</b>
Excess Volume Allowance	11
<u>In Bottom of Console:</u>	
76C Film	36
<b>Total</b>	<b>36</b>

Excess in Bottom of Console  
to be used by E.U. 26

\*30-Day Laboratory volume requirement used



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
32 Cine Cameras (4)	34
37 Video Cameras (in Cage Modules)	-
37 Video Cameras (4, in Shuttle, needed only for 30-Day mission)	-
38A Camera Drive (in Cage Module)	-
126G Video Monitor	57
<b>Total</b>	<b>91</b>

(both 7 & 30-Day Labs)

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.2-3. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 1. VISUAL RECORDS AND MICROSCOPY UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
3C	ADAPTERS, TV - MICROSCOPE 170A TV monitoring ad hoc - color	1	30 min/dy	30.0 30	0 0	0			
32	CAMERA, CINE 15A Camera setup - space 822B Crew body position measurements 823B Crew body motion measurements	6	1/dy 30 min/dy 30 min/dy	20.0 30.0 30.0	0 0 0	4	- 15 min/dy 15 min/dy	- 15.0 15.0	- 0 0
32A	CAMERA CONTROLLER 32A Specimen status observation 65A Plant activity 66A Animal activity 169A Television monitoring, routine & for data 170A TV monitoring ad hoc - color	1	20/dy 1 min/dy 1 min/dy 1/5 C 30 min/dy	20.0 1.0 A A 30.0		1	10/dy 1 min/dy 1 min/dy 1/5 C -	10.0 1.0 A A -	- - - - -
				51	200			11	200
34	CAMERA, STILL 15A Camera setup - space 15B " " - ground	2	1/dy -	20.0 -	0 -	2	- -	(Prelaunch) 0	- 0
37	CAMERA, VIDEO, B&W 15A Camera setup - space 15B " " - ground 32A Specimen status observation 65A Plant activity 66A Animal activity 169A TV monitoring, routine & for data 780A Gross psychomtr. measmts. - body coord. 820C Task completion times 830A Frequency of equipment utilization 831A Length of use of equipment/facility 832A Sequence of use of equipment/facility 834A Facility traffic patterns	10 (14)	1/dy - 20/dy 1 min/dy 1 min/dy 1/5 C 2/3 dy 60 min/dy (1/10 C) (1/10 C) (1/10 C) (1/10 C)	20.0 - 20.0 1.0 A A 3.7 60.0 (A) (A) (A) (A)	2.9 - 2.5 ↑ ↑ 21.0 + + (9) - - ↑ -	6	- - 10/dy 1 min/dy 1 min/dy 1/5 C - - 30 min/dy - - - -	- - 10.0 1.0 A A - - 30.0 - - - -	- - 0.8 ↑ ↑ 15.0 - - - - - - -
				105	26 (35)			41	18

TABLE I.2-3. EU 1 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
38	CAMERA, VIDEO, COLOR 15A Camera setup - space 15B Camera setup - ground 170A TV monitoring ad hoc - color	1	1/dy - 30 min/dy	20.0 - 30.0 50	4.2 - 6.2 10	0			
38A	CAMERA, X-Y DRIVE 16C Setup camera optical commutator. 16D Setup camera optical com. -grnd.	4	1/5C - -	.A - 0	16.0 - 16	1	1/5 C - -	A - 0	4.0 - 4
76C	FILM	2 (4)*				1*			
76E	FILTERS, VIDEO 169A TV monitoring, routine & for data	1	1/5 C	A 0	0 0	1	1/5 C	A 0	0 0
116	LOG BOOKS FOR DAILY RECORDS 350A Crew metabolic records - food consumpt., etc. 411A Mineral balance 419A Nitrogen balance 420A Caloric intake 833B Crew subjective comments	11	5 min/dy 4/dy 4/dy 2/dy 5 min/dy	5.0 5.0 5.0 3.0 5.0 23	0 0 0 0 0 0	11	5 min/dy 2/dy - - 5 min/dy	5.0 3.0 - - 5.0 13	0 0 - - 0 0
126	MICROSCOPE, COMPOUND 77A Microscopy general 141A Air particulate sampling & analysis 427A Platelet adhesiveness 452A Membrane assay and cytogenic anal.	1	4/2 dy (1/dy) (2/wk) (4/wk)	20.0 (15.0) (6.0) (15.0) 20 (56)	0.7 (0.5) (0.2) (0.5) 1 (2)	1	2/2 dy - - -	10.0 - - - 10	0.4 - - - 0
126G	MONITOR, VIDEO 15A Camera setup - space 32A Specimen status observation	1	1/dy 20/dy	20.0 20.0 40	1.4 1.4 3	1	- 10/dy	- 10.0 10	- 0.7 1
134B	PAPER, RECORDING 43B Digital records 44B Analog records	1 (3)	1/dy 1/dy	5.0 5.0 10	0 0 0	1	1/dy 1/dy	5.0 5.0 10	0 0 0

\*Use is payload and/or experiment specific.

TABLE I.2-3. EU 1 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
150A	RECORDER, MULTICHANNEL, BIOMEDICAL	1				1			
	43B Digital records		1/dy	5.0	1.6		1/dy	5.0	1.6
	44B Analog records		1/dy	5.0	1.6		1/dy	5.0	1.6
	776B Grass psychomtr. measmts. - muscle strength		2/3 dy	6.7	2.1		-	-	-
				17	5			10	3
181E	VIDEO ID DATE-TIME SYS	1 <sup>1</sup>				1 <sup>1</sup>			
	65A Plant activity								
	68A Organism identification film								
	EU TOTAL				261/237 (271/246)				224/219
	<sup>1</sup> Included in E.I. 32A.								

TABLE I.2-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E. U. 1 - VISUAL RECORDS & MICROSCOPY UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Biomedical Recorder ( 1/150A)</u>										
Recorded signal	0.5 v	50 mV	Anal.	8	7	17.	750/sec	42.0 K	42.8 M	
On-off control	2 level	1 level	Dis.	1	1	cont.	1/sec	1	86 K	
<u>Camera Controller (1/32A)</u>										
On-off indicator	2 level	1 level	Dis.	1	1	cont.	1/sec	1	86 K	
Camera select	1 - 10	1	Dig.	1	4	cont.	1/sec	4	346 K	
Organism ID signal monitor	1 - 80	1	Dig.	1	7	21	10/sec	70	88 K	
Scan interrupt control	2 level	1	Dis.	1	1	21	10/sec	10	1 K	
Camera real time monitoring on-off switch	2 level	1	Dis.	1	1	21	10/sec	10	1 K	
Camera signal	-	-	-	-	-	-	-	-	-	Hardwire to DMS TV monitor
									43.4 M	TOTAL

TABLE I.2-5. TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES

## EU 1 - VISUAL RECORDS AND MICROSCOPY UNIT

EU #	DESCRIPTION OF TYPICAL FUNCTIONAL INTERFACES WITH EU 1	CRITI- CALITY*
2	Commutation of video signals from bioexperiment modules with subsequent conditioning, storage and downlinking preparation.	3
4	Video and photographic documentation of biological fluid and tissue acquisition and preparation from cage modules via the LFB. Photomicrographic documentation of cell morphology studies.	2
5	Video and photographic documentation of experiment specific laboratory operations. Conducting blood counts, and urine sediment analysis.	2
6/7	Storage of photographic film within shielded compartments (lead lined).	1
11	Video monitoring and photographic documentation of EVA maintenance tasks and recording activity of astronauts with the Maintenance Task Simulator.	2
12	Video recording of electrophysiology display. Video/photographic record of experiments using the Rotating Litter Chair, Body Mass Measurement device, and psycho-physiological test equipment.	3
31	Eye movement studies with the use of the iris camera. Video records of cardiopulmonary analyses and correlation of zero-g activities on the bicycle ergometer with the metabolic analyzer display on split-image video monitor.	3
40	Video recording and photographic documentation of animal activity within cage modules. Video monitoring of zero-g adaptation and perturbation of normal, baseline (1 g) physiological and reproductive responses.	3
41	Observation of adaptive responses to zero-g environment of sub-human primates as well as adjunctive documentation of psychological testing activities.	2
42	Photographic study of rat dissection and the preparation of slides for blood morphology and bone marrow studies, and tissue sectioning for histologic evaluation.	3
50	Video records of plant mass measurement study. Evaluation of zero-g adaptation by means of time-lapse photography. Editing of time-lapse studies and preparation for downlinking for diurnal rhythm perturbation analysis in P.I. ground lab.	1
51	Video/photo studies of olivostat experiments. Close-up photographic studies and photomicrography of parasitic affinity for plant tissues in zero-g.	3
60	Photographic documentation of subculturing and tissue embedment operations within the Laminar Flow Bench (LFB).	2
61	Photographic recording of colonial morphology of bacterial cultures. Density photographs of impingement air sampler agar plates.	3
70	Video documentation within the invertebrate cage module of insect activity, reproduction and zero-g adaptation.	3
80	Visual documentation of various test phenomena.	3
91	Video and photographic analytical studies of psychomotor performance levels, sensory acuity and zero-g performance decrement.	3
93	Documentation of activity patterns of rats and mice and making size measurements.	3

\* 1 = Minimal, 2 = Nominal, 3 = Maximal

The majority of the heat comes from the portable display and the signal conditioners (see Table I.3-4). It is estimated that these devices, as well as the other smaller loads, will be air cooled.

Typical Equipment Unit Functional Interfaces - See Table I.3-6.

I.3.4 EQUIPMENT ITEM COST SUMMARY - See Table I.3-7.

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TABLE I.3-1. E.U. 2, DATA MANAGEMENT UNIT -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	0	0	0
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>86 (3.0)</u>	<u>188 (6.6)</u>	<u>188 (6.6)</u>
Racks & Consoles	0	0	0
Distributed & Extra Items	86	188	188
Small Storage Items (Misc.)	negl.	negl.	negl.
<u>Fixed Weight, kg (lb)</u>	34 (75)	84 (185)	84 (185)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>103</u>	<u>155</u>	<u>155</u>
Estimated d.c.	103	146	146
Estimated a.c.	0	9	9
<u>Off-Duty* Average Power, Total</u>	<u>100</u>	<u>146</u>	<u>146</u>
Estimated d.c.	100	141	141
Estimated a.c.	0	5	5
<u>Estimated On-Duty Peak Power</u>	120	450	450
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>103</u>	<u>155</u>	<u>155</u>
Estimated Air Cooled Load	103	155	155
Estimated Cold Plated Load	0	0	0
<u>Off Duty Load, Total</u>	<u>100</u>	<u>146</u>	<u>146</u>
Estimated Air Cooled Load	100	146	146
Estimated Cold Plated Load	0	0	0
<u>Development Cost, \$K</u>	87	372	372
<u>Unit Cost, \$K</u>	167	285	285
*12 Hours			

TABLE 1.3-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 2

## DATA MANAGEMENT UNIT

E.I. Name	E.I. No.*	No. of Units Reqd.,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
Antennas, Assorted	14B	0 1	0.05 (0.1)	0	0.03 (0.001)	20 (1)	For acquisition of radio transmitted biological data, EMI monitoring, etc.
Computer, Digital	51	1 1	-	-	-	-	Considered to be part of support vehicle Data Management Subsystem (DMS).
Data Management System, Buses	56A	- -	-	-	-	-	Data Buses and Lines. Considered to be part of the Data Management Subsystem.
Data Management System, Plotter/Printer	58	0 1	32 (70)	360	74 (2.6)	100 (38) (3.8) <sup>+</sup>	Digital Plotter/Printer. This unit takes a picture of CRT display.
Data Management System, Remote Control Station	58A	1 1	-	-	-	-	Control & Display Station Module, for crew/data management subsystem interaction. Considered to be part of DMS.
Data Management System, Remote Instrumentation Module	58B	- -	-	-	-	- -	Provides interface between DMS and bioinstrumentation. Includes bus terminals, multiplexers, switching units, etc.
Display - Keyboard	63B	2 2	14 (30)	60	43 (1.5)	50 (30) (3)**	Portable Interrogative Display and Keyboard. Oscilloscope/keyboard device for crew guidance at the experiment site.
ECG Coupler	64	12 12	0.05 (0.1)	1	1.1 (0.04)	5 (1)	Coupler (signal conditioner), for use on man and other vertebrates, see E.I. 156 for definition sheet.
EEG Coupler	65	0 4	0.05 (.1)	1	1.1 (0.04)	5 (1)	Signal conditioner, see E.I. 156 for definition sheet.
EMG Coupler	66	0 6	0.05 (.1)	1	1.1 (0.04)	5 (1)	Signal Conditioner, see E.I. 156 for definition sheet.
Oscilloscope	132	0 1	14 (30)	50	28 (1.)	150 (20) (1.5) <sup>+</sup>	For data display and voltage measurements. Includes persistent image capability.
Photocells	138A	6 12	0.05 (0.1)	0	0.03 (0.001)	7 (1)	For monitoring light levels.
Phototransistor (Coupler)	138B	6 12	0.05 (0.1)	1	1.1 (0.04)	7 (1)	Photocell couplers, for E.I. 138A
Coupler - Pressure	143G	0 4	0.05 (0.1)	1	0.3 (0.01)	5 (1)	Coupler (signal conditioner), for pressure transducer - solid state plug-in card. See E.I. 156 for definition sheet.
Signal Conditioner (Coupler)	156	24 35	0.05 (0.1)	2	1.4 (0.05)	15 (3) (3) <sup>+</sup>	Signal Conditioner (coupler), to transform signals from various sensors into a form compatible with DMS.
Tape, Video	176	-	-	-	-	-	Part of DMS
Timer, Event	180	2 2	0.2 (0.5)	1	0.3 (0.01)	2 (1)	General purpose elapsed time device, portable, used for various psychomotor performance tests, biochemical analysis procedures, etc.
Transducer, Pressure	181D	9 9	0.05 (0.1)	1	1.1 (0.04)	1 (1)	For various pressure measurements.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

TABLE I.3-3. EQUIPMENT VOLUME AND PLACEMENT -  
SHARED & DEDICATED LABORATORIES

E.U. 2 - Data Management Unit  
(No Rack or Console Required)

DISTRIBUTED OR EXTRA EQUIPMENT ITEMS

E.I. Number & Name		Volume, dm <sup>3</sup>	
		Shared 7-Day Lab	Dedicated Labs
58	Digital Plotter/Printer	0	74
63B	Portable Display	86	86
64	ECG Couplers (in cage modules)	--	--
65	EEG Couplers (in cage modules)	--	--
66	EMG Couplers (in cage modules)	--	--
132	Oscilloscope	0	28
138A	Photocells (in cage modules)	--	--
138B	Photocell Couplers (in cage modules)	--	--
143G	Press. Couplers (in cage modules)	--	--
156	Signal Conditioners (in cage modules)	--	--
181D	Pressure Transducers (in cage modules)	--	--
TOTAL		86	188

SMALL STORAGE EQUIPMENT ITEMS

(Can be stored in miscellaneous small  
storage areas)

E.I. Number & Name		Volume, dm <sup>3</sup>	
		Shared 7-Day Lab	Dedicated Labs
14B	Antennas	0	negl.
180	Event Timer	negl.	negl.
TOTAL		negl.	negl.

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.3-4. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 2. DATA MANAGEMENT UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
14B	ANTENNAS, ASSORTED 468A Electromagnetic field monitrg.	1	C	$\frac{A}{0}$	$\frac{0}{0}$	0			
51	COMPUTER, DIGITAL (see note) 14B Bioelectric transducer instaltn. & setup 17B Monitor ECG 18B Monitor EEG 19B Monitor EMG 20A Respiratory rate monitoring 51B Trace gas analysis hydrocarbons 52A Trace gas analysis inorganics 72A Organism identification video records 73A Data storage 73B Data storage 75A Crew guidance 76A Experiment management system 86A Bacterial colony counting 165A Event monitoring 312A Electronic equipment calibration 343A Body mass measurement device 346A Subject histories 350B Crew metabolic records 359A Heart rate 364B Visual task with head rotation 366A Arteriolar reactivity 403A Average skin temperature 404A Red blood cell mass 416A Tracking measurements 468A Electromagnetic field monitoring 525A Data management 700A Visual measmts. - acuity 702A " " - stereopsis 704A " " - brightness threshold 706A " " - color perception 707A " " - critical flicker fusion freq. 708A " " - phorias, lateral & vert. 709A " " - glare recovery	1 <sup>2</sup>				1 <sup>2</sup>			

Note:  
The "Equipment Operations Analysis" table is used to determine two things: (1) average EI power requirements, and (2) EI placement and accessibility for crew use. Certain EIs have a very high use factor and it is not necessary to perform the detail analysis of function frequency and crew times to establish this fact.

<sup>2</sup> Considered to be part of Sortie Module Data Management Subsystem.

TABLE I.3-4. EU 2 (Cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
	710A Visual measmts. - dark adaptation								
	713A " " - peripheral field								
	715A Auditory measmts. - absolute threshold								
	716A " " - pitch discrimination								
	717A " " - temporal acuity								
	734A Cognitive/complex perceptual - perceptual spd.								
	740A Cognitive/conceptual & thinking ability								
	752A Cognitive/memory - memory span								
	760A Fine psychomtr. - manipulative ability								
	766A " " - gross positioning								
	768A " " - multi-limb coord.								
	770A " " - reaction time, simple								
	771A " " - reaction time, complex								
56A	DATA MANAGEMENT SYSTEM, BUSES & LINES	1 <sup>a</sup>				1 <sup>a</sup>			
	525A Data management								
58	DATA MS, PLOT/PRINTER	1				0			
	43B Digital records		1/dy	5.0	1.9				
	44B Analog records		1/dy	5.0	1.9				
	73B Data storage		C	$\frac{A}{10}$	$\frac{3.8}{8}$				
58A	DATA MS, REMOTE CONTROL MODULE	1 <sup>a</sup>				1 <sup>a</sup>			
	43A Digital records								
	75A Crew guidance								
	525A Data management								
58B	DATA MS, REMOTE INSTRUMENTATION MODULE	4 <sup>a</sup>				3 <sup>2</sup>			
	525A Data management								

TABLE I.3-4. EU 2 (Cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
63B	DISPLAY-KEYBOARD, PORTABLE 44A Analog records 75A Crew guidance	2	C 30 min/dy	A <u>30.0</u> 30	— 60	2	C 15 min/dy	A <u>15.0</u> 15	— 60
64	ECG COUPLER 17B Monitor ECG - hardwire 17F " " - backpack 422A Coriolis sickness susceptibility 424A Carotid body stimulation response	12	C 30 min/wk 2/wk 2/wk	1.8 6.0 30.0 <u>11.0</u> 49	12.0 0.1 0.1 <u>0.1</u> 12	12	- 15 min/wk 1/wk -	- 3.0 18.0 — 21	- 0.1 0.1 — 0
65	EEG COUPLER 18B Monitor EEG - hardwire 18F " " - backpack	4	C 5 min/3dy	7.0 <u>1.7</u> 9	4.0 <u>0.1</u> 4	0			
66	EMG COUPLER 19B Monitor EMG - hardwire 19F " " - backpack	6	C 5 min/wk	1.4 <u>1.0</u> 2	6.0 <u>0.1</u> 6	0			
132	OSCILLOSCOPE 14B Bioelectric transducer installtn.	1	2/2 dy	<u>10.0</u> 10	<u>0.7</u> 1	0			
138A	PHOTOCELLS 71A Light monitoring	12*				6*			
138B	PHOTOTRANSISTOR 71B Light monitoring	12*				6*			
143G	COUPLER-PRESSURE TRANSDUCER 161A Arterial blood pressure 322A Venous blood pressure	4	2/dy 2/wk	10.0 <u>7.0</u> 17	0.1 <u>0.1</u> 0	0			

\*Use is payload and/or experiment specific.

TABLE I.3-4. EU 2 (Cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
156	SIGNAL CONDITIONERS (COUPLERS)	35				24			
	21A Cardiac output - catheterized		2/wk	4.0			-	-	-
	21B Cardiac output - ultrasonic flowmeter		1/wk	6.0			-	-	-
	22A Temperature measmts. - thermocouples		10 min/wk	2.0			5 min/wk	1.0	-
	22B Temperature measmts. - thermistors		10 min/wk	2.0			5 min/wk	1.0	-
	24A Water consumption - manifold flowmeter		30 min/wk	A			-	-	-
	24C " " - water dispenser		30 min/wk	A			-	-	-
	64A Noise monitoring		C	A			C	A	
	65D Plant activity		1 min/dy	1.0			1 min/dy	1.0	
	70A Air movement		C	A			C	A	
	71A Light monitoring - photocells		C	A			C	A	
	71B " " - phototransistors		C	A			C	A	
	164A Peripheral venous blood pressure		2/wk	6.0			-	-	-
	165B Event monitoring		C	A			-	-	-
	218B Deep body temperature		C	A			-	-	-
				21				3	
					63				42
					w/60 C				w/40 C
176	TAPE, VIDEO	10				5			
	32A Specimen status observation		20/dy	20.0	0		10/dy	10.0	0
	65A Plant activity		1 min/dy	1.0	0		1 min/dy	1.0	0
	66A Animal activity		1 min/dy	A	0		1 min/dy	A	0
	169A TV monitoring routine & for data		1/5 C	A	0		1/5 C	A	0
	170A TV monitoring ad hoc - color		30 min/dy	30.0	0		-	-	-
				50	0			11	0
180	TIMER, EVENT	2				2			
	310A Bicycle ergometer - fixed console		2/3 dy	57.7	0.1		-	-	-
	310B " " - backpack		-	-	-		2/wk	34.6	0.1
	342A Plasma coagulation		3/wk	4.0	0.1		-	-	-
	820A Task completion times		10 min/dy	10.0	0.1		5 min/dy	5.0	0.1
				72	0			40	0
181D	TRANSDUCER, PRESSURE	9				9			
	66A Animal activity		1 min/dy	A	0.1		1 min/dy	A	0.1
				0	1				1
	E.U. TOTAL				155/146 (155/146)				103/100

TABLE 1.3-5. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E. U. 2 - DATA MANAGEMENT UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Digital Plotter/Printer (2/58)</u>										
CRT Signal Voltage	0-5 V	0.05 V	Anal.	1	N.A. (not applicable)	10	N.A.	N.A.	N.A.	Hardwire to wide band recorder
<u>Portable Display/Keyboard (2/63B)</u>										
On-Off Control	2 positions	1 position	Disc.	1	1	cont.	1/sec	1	86K	
Alpha-numeric Display Commands	1-16 figures	1	Dig.	2	10	30	1/sec	20	36K	
Oscilloscope Signals	N.A.	N.A.	Anal.	2	N.A.	30	NA	NA	NA	Hardwire to wide band recorder.
Keyboard Monitor	0-40	1	Dig.	1	6	30	10/sec	60	2K	
<u>ECG Couplers (2/64)</u>										
Voltage Output of 4 Couplers	0-5 V	0.05 V	Anal.	4	7	cont.	500/sec	14K	1210M	
Voltage Output of 8 Couplers	0-5 V	0.05 V	Anal.	8	7	15	500/sec	28K	25.2M	
<u>EEG Couplers (2/65)</u>										
Voltage Signal (4 Couplers)	0-5 V	0.05 V	Anal.	4	7	5	500/sec	14K	4.2M	
<u>EMG Couplers (2/66)</u>										
Voltage Signal (6 couplers)	0-5 V	0.05 V	Anal.	6	7	5	500/sec	21K	6.3M	
<u>Oscilloscope (2/132)</u>										
On-Off Control	2 positions	1 position	Disc.	1	1	cont.	1/sec	1	86K	This oscilloscope is at the cage module location.
Data Entry Control Switch	2 level	1 level	Disc.	1	1	10	1/sec	1	1K	
Sweep Speed Monitor	1-8	1	Dig.	1	3	10	1/sec	3	2K	
Gain Control	1-8	1	Dig.	1	3	10	1/sec	3	2K	
Voltage Signal	0-5 V	0.05 V	Anal.	1	7	10	500/sec	3500	302K	
<u>Couplers for Photocells (2/138B)</u>										
Signal Voltage (12 Couplers)	0-5 V	0.05 V	Anal.	12	7	cont.	1/sec	84	7.26M	
<u>Couplers for Pressure Transducers (2/143G)</u>										
Signal Voltage (4)	0-5 V	0.05 V	Anal.	4	7	17	100/sec	28K	28.6M	
<u>Couplers (miscellaneous) (2/156)</u>										
Signal Voltage	0-5 V	0.05 V	Anal.	35	7	21	100/sec	24.5K	30.87M	Typical values are shown.
									1,313M	TOTAL

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TABLE I.3-6. TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES

EU 2 - DATA MANAGEMENT UNIT

EU #	DESCRIPTION OF FUNCTIONAL INTERFACE WITH EU 2	CRITI-CALITY *
3	(Life Sciences Expt. Unit) Monitoring gas flow from gas storage vessels.	1
5	(Biochemical/Biophysics Analysis Unit) Processing, signal conditioning and analog-digital data handling of signals from automated clinical analyzers. Analysis of data received from gas chromatograph and mass spectrograph for trace gas contaminant profiling.	3
12	Analog-to-Digital conversion and handling of input signals to EEG, EMG, and EKG couplers to pulse code modulated (PCM) form and transmission to ground. Processing biotransducer signals (accelerometer, plythesmograph) acquired from the electrophysiology signal receiver and (1) display results on CRT, (2) add notation (time, subject, date) to CRT display, and (3) store CRT display on tape.	3
31	Processing of signals from metabolic analyzer by (1) extracting data only from a representative time interval, (2) perform a programmed waveform analysis on the representative data, (3) specify experiment parameters on CRT, and (4) provide experiment design changes via light pen or alpha-numeric keyboard inputs. (Interfaces of 2 with EU 12 & 31 will be very similar.)	3
40/41/ 42	Display of electrophysiology signals from vertebrate cage module couplers with subsequent tape storage.	3
50/51	Handling and storage of incrementally acquired data from the clinostat and make-break motor assembly for assessment of plant adaptation to rotation environment and zero-g.	2
70	Plotting of diurnal activity (with subsequent A/D conversion and transmission to ground) of invertebrates such as <u>Drosophila</u> .	1
91	Determination of crew performance decrement utilizing the maintenance/gross coordination test taskboard. Test conditions are programmed by an interactive graphic display and alpha-numeric keyboard. This keyboard also serves as the input source for crew responses.	3

\* 1 = Minimal, 2 = Nominal, 3 = Maximal

TABLE I.3-7. COST SUMMARY -  
EQUIPMENT UNIT - 2 DATA MANAGEMENT UNIT

EU-2

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
14B	ANTENNAS, ASSORTED	REDESIGN	1			0	0	20	1	1	21	20	1	1	21		
51	COMPUTER, DIGITAL	-	-	-	-	1	-	-	-	1	-	-	-	1	-	-	SORTIE SYSTEM
56A	DATA MGT SYS BUSES	-	-	-	-	1	-	-	-	1	-	-	-	1	-	-	SORTIE SYSTEM
58	DATA MGT PLOT/PRINT	REMFG	1	-	-	0	0	100	38	1	138	100	38	1	138	3,800	
58A	DATA MGT SYSTEM	-	-	-	-	1	-	-	-	1	-	-	-	1	-	-	SORTIE SYSTEM
58B	DATA MGT SYSTEM	-	-	-	-	3	-	-	-	4	-	-	-	4	-	-	SORTIE SYSTEM
63B	DISPLAY-KEYERD	REMFG	2	50	30	2	110	50	30	2	110	50	30	2	110	3,000	
64	ECG COUPLR	REPACK	1	5	1	12	17	5	1	12	17	5	1	12	17		
65	BEG COUPLR	REPACK	1			0	0	5	1	4	9	5	1	4	9		
66	EMG COUPLR	REPACK	1			0	0	5	1	6	11	5	1	6	11		
132	OSCILSCOPE	REMFG	2			0	0	150	20	1	170	150	20	1	170	1,500	
138A	PHOTOCELLS	REPACK	1	7	1	6	13	7	1	12	19	7	1	12	19		
138B	PHOTOTRANSISTOR (CPLR)	REPAIR	1	7	1	6	13	7	1	12	19	7	1	12	19		
143G	COUPLR-PRESS TRANSDUCR	MINIMAL	1			0	0	5	1	4	9	5	1	4	9		
156	SIGNL COND COUPLR	REMFG	2	15	3	24	87	15	3	35	120	15	3	35	120	3,000	
176	TAPE, VIDEO	MINIMAL	0	0	0	5	1	0	0.2	10	2	0	0.2	10	2		
180	TIMER, EVENT	MINIMAL	1	2	1	-	4	2	1	2	4	2	1	2	4		
181D	TRANSDUCER, PRESSURE	MINIMAL	0	1	1	9	10	1	1	9	10	1	1	9	10		
	TOTAL COST ESTIMATE			87	167		254	372	285		657	372	285		657		

#### I.4 EQUIPMENT UNIT 3 - LIFE SCIENCES EXPERIMENT SUPPORT UNIT

I.4.1 FUNCTIONAL CAPABILITY AND SUMMARY DATA. This unit is intended to provide centralized supporting and vehicle interface equipment for the life sciences payloads. The summary of E. U. properties is given in Table I.4-1.

I.4.2 EQUIPMENT ITEMS. Major equipment includes crew mobility aids, crew restraints, gas storage vessels, and waste storage. The equipment is listed in Table I.4-2 and its volume and placement is indicated in Table I.4-3.

#### I.4.3. OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.4-4.

Data Requirements - See Table I.4-5.

Consumables - The various gas storage vessels must be replaced between flights. These vessels are all anticipated to be small, high pressure gas storage bottles.

Electrical Power - Electrical power demands for this E. U. are small and are expected to be totally 28 v. d. c. Peak power demands were estimated and are shown in Table I.4-1.

Heat Rejection - Heat rejection loads corresponding to on-duty power requirements are:

Shared Lab	20 w <sub>t</sub>	(68 Btu/hr)
Dedicated 7-Day Lab	65 w <sub>t</sub>	(222 Btu/hr)
Dedicated 30-Day Lab	65 w <sub>t</sub>	(222 Btu/hr)

No low temperature cooling is required, and the loads will probably be dissipated to the cabin air.

Typical Equipment Unit Functional Interfaces - See Table I.4-6.

#### I.4.4. EQUIPMENT ITEM COST SUMMARY - See Table I.4-7.

TABLE I.4-1. E.U. 3, LIFE SCIENCES EXPERIMENT UNIT -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	0	0	0
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>237 (8.4)</u>	<u>324 (11.4)</u>	<u>472 (16.7)</u>
Racks & Consoles	0	0	0
Distributed & Extra Items	237	324	472
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	157 (345)	195 (430)	255 (561)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>20</u>	<u>65</u>	<u>65</u>
Estimated d.c.	20	65	65
Estimated a.c.	0	0	0
<u>Off-Duty* Average Power, Total</u>	<u>20</u>	<u>64</u>	<u>64</u>
Estimated d.c.	20	64	64
Estimated a.c.	0	0	0
<u>Estimated On-Duty Peak Power</u>	50	90	90
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>20</u>	<u>65</u>	<u>65</u>
Estimated Air Cooled Load	20	65	65
Estimated Cold Plated Load	0	0	0
<u>Off Duty Load, Total</u>	<u>20</u>	<u>64</u>	<u>64</u>
Estimated Air Cooled Load	20	64	64
Estimated Cold Plated Load	0	0	0
<u>Development Cost, \$K</u>	431	652	652
<u>Unit Cost, \$K</u>	101	155	207
*12 Hours			

TABLE I.4-2 EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT #3

## LIFE SCIENCES EXPERIMENT SUPPORT UNIT

E.I. Name	E.I. No.*	No. of Units Reqd.,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
Accelerometer	1	5 7	0.1 (0.2)	0	0.03 (0.001)	1 (1) (0.7) <sup>+</sup>	Attached to organism holding units to indicate activity level, and also used for general acceleration measurements.
Accelerometer Coupler	1A	5 7	0.9 (2.0)	10	0.03 (0.001)	20 (2)	Coupler for EI #1. See E. I. 156, E.U. 2 for definition sheet.
Crew Mobility Aids	55A	24 27	2.3 (5.0)	0	2.8 (0.1)	50 (1)	Aids such as handrails, tethers and special shoe devices. Laboratory specific. Values shown are average estimates.
Crew Restraints	55B	24 27	2.3 (5.0)	0	2.8 (0.1)	50 (1)	Restraints such as leg rails, mid-torso belts and special shoe devices. Laboratory specific. Values shown are average estimates.
Flowmeter, water manifold	76F	0 4	0.2 (0.4)	0	1.4 (0.05)	1 (1)	For in-line measurement of water flow, generally of low rate associated with water consumption by organisms, FPE specific.
Flowmeter Coupler	76H	0 4	0.05 (0.1)	1	1.0 (0.036)	20 (2)	Signal conditioner for E.I. 76 F. See E. I. 156, E.U. 2, for definition sheet.
Flowmeter, Gas	76J	2 6	0.2 (0.4)	2	0.06 (0.002)	10 (1)	Generally for air flow measurement, FPE specific.
Gas Supplies	93A	8 16 (32)	2.3 (5)	0	5.7 (0.2)	200 (2) (0.5) <sup>+</sup>	Various gas storage vessels, for chromatograph operation, biochemical analyses, anesthesia, & sterilization. He, H <sub>2</sub> , Air, CO <sub>2</sub> , O <sub>2</sub> , ETO. Payload specific. Values shown are estimated average items.
Receiver	150D	0 1	2.3 (5)	20	14 (0.5)	200 (10) (1) <sup>+</sup>	Radio Receiver, for monitoring transmitted biological measurements, electromagnetic background noise, etc.
Waste Storage Device	187A	1 1 (2)	22.7 (50)	0	57 (2.0)	100 (20)	For experiment waste materials, chemicals, etc.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

TABLE I.4-3. EQUIPMENT VOLUME AND PLACEMENT -  
SHARED AND DEDICATED LABORATORIES

E.U. 3 - Life Sciences Experiment Unit  
(No Rack or Console Required)

DISTRIBUTED OR EXTRA EQUIPMENT ITEMS

E.I. Number & Name	Volume, dm <sup>3</sup>		
	Shared 7-Day Lab	Dedicated Labs	
		7-Day	30-Day
1 Accelerometers	negl.	negl.	negl.
1A Accelerometer Couplers	negl.	negl.	negl.
55A Crew Mobility Aids	67	76	76
76F Water Flowmeters	67	76	76
76H Flowmeter Couplers	0	4	4
76J Gas Flowmeters	negl.	negl.	negl.
93A Gas Storage Vessels	46	91	182
150D Radio Receivers	0	14	14
187A Waste Storage	57	57	114
<b>TOTALS</b>	<b>237</b>	<b>324</b>	<b>472</b>

SMALL STORAGE EQUIPMENT ITEMS

(Can be stored in miscellaneous small  
storage areas)

E.I. Number & Name Vol.  
dm<sup>3</sup>

None

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.4-4. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 3. LIFE SCIENCES EXPERIMENT SUPPORT UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
1	ACCELEROMETER (ACTIVITY) 61A Vibration monitoring 62A Acceleration monitoring 823C Crew body motion measurements	7	C C 60 min/dy	A A <u>60.0</u> 60	0 0 <u>9</u> 0	5	C C 30 min/dy	A A <u>30.0</u> 30	0 0 <u>0</u> 0
1A	ACCELEROMETER COUPLER 61A Vibration monitoring 62A Acceleration monitoring 823C Crew body motion measurements	7	C C 60 min/dy	A A <u>60.0</u> 60	20 20 <u>0.8</u> 41	5	C C 30 min/dy	A A <u>30.0</u> 30	10 10 <u>0.4</u> 20
55A	CREW MOBILITY AIDS 81B Biosampling 127H Crew mobility/transfer 128H Materials transfer 222B Vertebrate experiment initiation 223B Plant " " 224B Invertebrate " " 225B Cells and tissue " " 840A Max mass transportable - SS 840B " " " - PS 841A " volume " - SS 841B " " " - PS 842A " MOI " - SS 842B " " " - PS	27*				24*			
55B	CREW RESTRAINTS 201L Crew restraint 520A Pressure suit donning & doffing 843A Max mass alignable - SS 843B " " " - PS 844A " volume " - SS 844B " " " - PS 845A " MOI " - SS 845B " " " - PS	27*				24*			

\*Payload and/or experiment specific.

TABLE I.4-4. EU 3 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
76F	FLOWMETER - WATER MANIFOLD 24A Water consumption	4	30 min/wk	$\frac{A}{0}$	$\frac{0}{0}$	0			
76H	FLOWMETER COUPLER - WATER MANIFOLD 24A Water consumption 421A Water consumption for man	4	30 min/wk 4/dy	$\frac{A}{5.0}$ $\frac{5}{5}$	$\frac{4-C}{4}$	0			
76J	FLOWMETER - GAS 401A Alveolar ventilation	6	4/wk	$\frac{0.8}{1}$	$\frac{0.1}{0}$	2	2/wk	$\frac{0.4}{0}$	$\frac{0.1}{0}$
93A	GAS SUPPLY, ASSORTED 51A Trace gas analysis - hydrocarbons 52B Trace gas analysis - inorganics 59A Atmospheric ethylene monitoring 94A Organism subculturing - cell & tis. 97A Experiment waste management 163A Anesthesiology - invertebrates 313B Atmospheric monitor calibration 501A Analysis of gas mixtures	16 (32)	15 min/dy 10 min/wk 1/4 C 8/dy 10 min/dy 5 bottles/dy 10 min/wk 5 min/dy	$\frac{A}{19.0}$ $\frac{A}{15.0}$ $\frac{A}{2.0}$ $\frac{A}{46}$	$\frac{0}{0}$ $\frac{0}{0}$ $\frac{0}{0}$ $\frac{0}{0}$ $\frac{0}{0}$ $\frac{0}{0}$ $\frac{0}{0}$	8	- - 1/4 C - 10 min/dy 2 bottles/dy 10 min/wk 3 min/dy	- - A - 10.0 6.0 2.0 $\frac{A}{18}$	- - 0 - 0 0 0 $\frac{0}{0}$
150D	RECEIVERS DC-5MHZ 468A Electromagnetic field monitoring	1	C	$\frac{A}{0}$	$\frac{20}{20}$	0			
187	WASTE MANAGEMENT SYSTEM 82A Work bench cleanup 84A Organism subculturing - cells & tis. 96A Radiochem. waste mgmt.	1* (2)				1*			
	EU TOTAL				$\frac{65}{64}$ (65/64)				$\frac{20}{20}$

TABLE I.4-5. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

## E. U. 3 - LIFE SCIENCES EXPERIMENT UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Accelerometer Coupler (3/1A)</u>										
Voltage Output of 4 Couplers	0-5 V	0.05 V	Anal.	4	7	60	500	14K	50.4M	
Voltage Output of 3 Couplers	0-5 V	0.05 V	Anal.	3	7	cont.	500/sec	10.5K	907.2M	
<u>Flowmeter Coupler (3/76H)</u>										
Voltage Output	0-5 V	0.05 V	Anal.	4	7	cont.	1/min	negl.	40K	
<u>Gas Storage Vessels (3/93A)</u>										
Gas Pressure Sensors	0-5 V	0.05 V	Anal.	16	7	cont.	1/min.	2	161K	
									957.80M	TOTAL

TABLE I.4-6. TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES

E.U. 3 - LIFE SCIENCES EXPERIMENT UNIT

EU #	DESCRIPTION OF FUNCTIONAL INTERFACES WITH EU 3	CRITI- CALITY*
2	Monitoring gas flow from gas storage vessels.	1
4	Crew mobility and restraint aids for use during preparation and preservation tasks.	3
5	Gas chromatograph calibration for quantitative measurement of gases within cage modules.	2
6	Transfer of waste and clean-up materials to the waste storage device.	3
7	Storage of gas cylinders and crew restraints.	1
11	Use of crew restraints and mobility aids in conducting EVA and Maintenance Task Simulator operations.	2
12	Accelerometer measurements during Rotating Litter Chair Operations.	2
40/41	Determination of water consumption in vertebrate cage module.	2
50	Air flow rate measurements into plant holding module. Acceleration measurements during clinostat operation.	2
70	Flow metering of airflow into and out of the invertebrate cage module.	1

\* 1 = Minimal, 2 = Nominal, 3 = Maximal

TABLE I.4-7. COST SUMMARY -  
EQUIPMENT UNIT - 3 LIFE SCIENCE EXP. SUPPORT UNIT  
EU-3

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER-	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	CIAL COSTS	
1	ACCELEROMTR ACTIVITY	MINIMAL	0	1	1	5	6	1	1	7	8	1	1	7	8	700.00	
1A	ACCELEROMTR COUPLR	REMFG	3	20	2	5	30	20	2	7	34	50	2	7	34		
55A	CREW MOBILITY AIDS	MINIMAL	1	50	1	24	74	50	1	27	77	50	1	27	77		
55B	CREW RESTRAINTS	MINIMAL	1	50	1	24	74	50	1	27	77	50	1	27	77		
76F	FLOWMETER, WATER MANFLD	MINIMAL	0				0	1	1	4	5	1	1	4	5		
76H	FLOWMETER COUPLER	REMFG	3				0	20	2	4	28	20	2	4	28		
76J	FLOWMETER - GAS	MINIMAL	1	10	1	2	12	10	1	6	16	10	1	6	16		
93A	GAS SUPPLY, ASSORTD	U	U	200	2	8	216	200	2	16	232	200	2	32	264	500.00	
150D	receivers dc-SMHZ	REDESIGN	3				0	200	10	1	210	200	10	1	210		
187A	WASTE STORAGE - DEVICE	REMFG	1	100	20	1	120	100	20	1	120	100	20	2	140		
TOTAL COST ESTIMATE				431	101		532	652	155		807	652	207		859		

## I.5 EQUIPMENT UNIT 4 - PREPARATION AND PRESERVATION UNIT

I.5.1 FUNCTIONAL CAPABILITY AND SUMMARY DATA. This equipment unit provides the capability for the preparation and preservation of biological specimens and whole organisms. Preparation encompasses all the operations necessary for (1) obtaining and preparing specimens for on-board analysis (often by means of equipment within the Biochemical/Biophysics Analysis Unit), and (2) preparing specimens or organisms for preservation and return to ground. This includes such operations as autopsies, dissections, centrifugation, anesthetization, staining, substrate preparation, sterilization, etc. Preservation operations include freezing, lyophilization, fixation, etc.

A summary of properties for this equipment unit are shown in Table I.5-1.

I.5.2. EQUIPMENT ITEMS. Major equipment items include the laminar flow bench, centrifuges, refrigerators, freezers, various kits, and mass measurement devices. The detailed equipment list is given in Table I.5-2, equipment volume and placement in racks and consoles are shown in Figures I.5-1, I.5-2, and I.5-3. The shared and dedicated 7-day laboratories require one rack and one console, whereas the dedicated 30-day laboratory requires 2 racks and one console. The extra rack is required primarily because of the refrigerated high-speed centrifuge and low-temperature freezer aboard the 30-day mission. The largest equipment item external to the racks and consoles for all laboratories is the mobile laminar flow bench.

### I.5.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.5-3.

Data Requirements - See Table I.5-4.

Consumables - Consumables in this E.U. include anesthetizer gas bottles, laminar flow bench liners, chemicals, ion exchange columns, kit materials, millipore filters, and liquid N<sub>2</sub>. All the above materials are relatively inert in their storage form except for the cryogenic N<sub>2</sub>, which may have to be loaded aboard the laboratories several hours before launch. This N<sub>2</sub> would be continuously venting at an estimated rate of 0.8 lb/day.

Launch and Re-entry Operations - It is anticipated that none of the equipment within this E.U. needs to be operating during launch (except for the cryogenic freezer, see above). The other refrigerators, freezers, purge system, etc., can be activated along with the activation of the laboratory in orbit. It may prove advantageous and/or necessary to operate the refrigerators and freezers during launch operations prior to lift-off in order to maintain their contents at proper storage temperatures. Pre-cooling this equipment would also reduce the energy requirements for its activation

in orbit. However, during ascent and descent, it is anticipated that this equipment can be turned off if necessary. The thermal capacity and insulation of this equipment is expected to hold satisfactorily low temperatures during these relatively short phases of the mission.

Electrical Power - The major continuous power consumers in this E.U. are refrigerators and freezers. Large on-duty power consumers include the laminar flow bench, high-speed centrifuge, vacuum cleaner, electronic hematocrit, catalytic oxidizer, and temperature blocks. Peak power for this E.U. was estimated to be approximately twice the on-duty average power, see Table I.5-1. Most of the equipment could be made to utilize 28 v. d.c.

Heat Rejection - Heat loads corresponding to the average on-duty power consumption are:

Shared Lab	257 $w_t$
Dedicated 7-Day Lab	277 $w_t$
Dedicated 30-Day Lab	541 $w_t$

The largest single heat load for all laboratories results from the three temperature blocks (150  $w_t$ ). These are used only during the on-duty period and were assumed to be enclosed in an insulated cold plated cabinet using the Sortie coolant at 296-310°K (73 to 99°F). The other major heat loads are from the freezers and refrigerators, but the exact way in which these will be cooled will depend upon their ultimate design which has not been determined. The use of low temperature coolant for the freezers and refrigerators would decrease the power required for these devices, but the necessary low temperature coolant may not be readily available from the Sortie Module heat rejection system. If not, the heat could either be rejected to the cabin air or to the 296-310°K (73-99°F) liquid coolant. The largest load of 250  $w_t$  from the low temperature freezer was assumed to be cold plated. The others were assumed to reject heat directly to the cabin air.

In general (assuming that 0-g compatible vapor-compression refrigeration systems are used for the freezers and refrigerators), the amount of heat rejected from the refrigeration units will exceed the electrical power input to the units. The exact quantities and directions of these heat flows will depend upon the ultimate design of the freezers and refrigerators. For example, the heat leaking into the cold boxes from the cabin may be pumped out of the refrigeration unit condenser back into the cabin or into the liquid coolant loop. These heat flows were assumed negligible in this study because of its preliminary nature.

Typical Equipment Unit Functional Interfaces - See Table I.5-5.

I.5.4 EQUIPMENT ITEM COST SUMMARY - See Table I.5-6.

TABLE I.5-1. E.U. 4, PREPARATION AND PRESERVATION UNIT -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	2	2	3
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>2064 (72.9)</u>	<u>2067 (73.0)</u>	<u>2819 (99.5)</u>
Racks & Consoles	1488	1488	2232
Distributed & Extra Items	576	579	587
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	316 (696)	360 (792)	533 (1173)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>257</u>	<u>277</u>	<u>541</u>
Estimated d.c.	257	277	541
Estimated a.c.	0	0	0
<u>Off-Duty* Average Power, Total</u>	<u>85</u>	<u>85</u>	<u>335</u>
Estimated d.c.	85	85	335
Estimated a.c.	0	0	0
<u>Estimated On-Duty Peak Power</u>	500	600	1000
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>257</u>	<u>277</u>	<u>541</u>
Estimated Air Cooled Load	107	127	141
Estimated Cold Plated Load	150	150	400
<u>Off Duty Load, Total</u>	<u>85</u>	<u>85</u>	<u>335</u>
Estimated Air Cooled Load	85	85	85
Estimated Cold Plated Load	0	0	250
<u>Development Cost, \$K</u>	5152	6245	6670
<u>Unit Cost, \$K</u>	233	319	484
*12 Hours			

TABLE I.5-2 EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 4

PREPARATION AND PRESERVATION UNIT

E.I. Name	E.I. No.*	No. of Units Req'd.** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
Anesthetizer, Invertebrates	14	2 4 (10)	0.9 (2)	0	1.4 (0.05)	35 (5)	For invertebrates such as gnats. Use CO <sub>2</sub> bottle, valves, etc. Payload specific. Unit values of wt., power, and volume are indicated.
Bench, Laminar Flow	18	1 1	91 (200)	100	460 (16.25)	2000 (25) (1.6) <sup>+</sup>	Sealed portable glove box with laminar air flow to assist in performing zero-g biological and surgical procedures.
Bench Liners, LFB	18A	10 10 (40)	0.0 (2)	0	5.66 (0.2)	100 (1) (0.5) <sup>+</sup>	Laminar Flow Bench Liners. Disposable for E.I. 18
Bench Insert, LFB,	18B	1 1	22.7 (50)	0	56.6 (2.0)	- (6)	Insert for E.I. 18 to provide for handling radioisotopes. Development cost included under E. I. 18A.
Centrifuge, Refrig., Hi Speed	(41)	(1)	68.2 (150)	70	255 (9.0)	175 (25) (3.1) <sup>+</sup>	For separations in support of medical and biological research, 40,000 g's.
Centrifuge, micro	42	1 1	8.2 (18)	25	13.3 (0.47)	75 (5) (0.2)	For centrifugation of small samples.
Chemicals	44	1 1 (3)	4.5 (10)	0	7.1 (0.25)	100 (10) (1) <sup>+</sup>	Miscellaneous and premeasured quantities. Laboratory specific. Estimates quantities for a 7-day mission are indicated.
Chemicals, Radioactive	44A	1 1 (3)	4.5 (10)	0	7.1 (0.25)	- (10) (1) <sup>+</sup>	Premeasured quantities. Estimated weight and volume are for a 7-day mission. Development cost included in E.I. 44.
Cleaner, Vacuum	48	1 1	13.6 (30)	100	56.6 (2.)	200 (50) (.3) <sup>+</sup>	For general purpose use.
Deionizer	63G	0 1	6.8 (15)	0	14.2 (.5)	100 (15) (.2) <sup>+</sup>	For water purification. Ion exchange columns.
Electrophoresis Apparatus	(70)	(1)	9.0 (20)	85	25.5 (0.9)	50 (5) (0.9) <sup>+</sup>	For separation of serum components.
Freezer, Cryogenic	77B	0 1 (2)	22.7 (50)	0	36.8 (1.3)	500 (25) (2.5) <sup>+</sup>	For freezing biological specimens. Includes LN <sub>2</sub> at 0.8 lb/day.
Freezer, General	80	1 1	22.7 (50)	70	198 (7.0)	50 (5) (.2) <sup>+</sup>	General Purpose, for storage of serum, specimens, etc. Approx. 4 ft <sup>3</sup> of storage, -20°C.
Freezer, Low Temp.	(81)	(1)	22.7 (50)	250	113 (4.0)	200 (10) (1.7) <sup>+</sup>	For special items requiring low temp. -70°C, 1 ft <sup>3</sup> storage.
Frig.	83	1 1	9.1 (20)	15	56.6 (2.0)	50 (5) (.2) <sup>+</sup>	Refrigerator. 4°C. Approx. 1 ft <sup>3</sup> storage.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

TABLE I.5-2 EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 4 (cont.)

## PREPARATION AND PRESERVATION UNIT

E.I. Name	E.I. No.*	No. of Units Req'd,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
Frig., Radio. Chem.	84	1 1	-	-	-	-	Refrigerator, for radioisotope storage. 4°C. Use part of E.I. 83.
Hematocrit, Electronic	97A	0 1	2.3 (5)	10	2.8 (0.1)	40 (5) (.3) <sup>+</sup>	For measuring red blood cell volume electronically.
Kit, Bench Chemical Analysis	105	1 1	18.2 (40)	0	113 (4.0)	100 (10) (.3) <sup>+</sup>	
Kit, Hematology	106	1 1	4.5 (10)	0	14.2 (0.5)	7 (1) (.1) <sup>+</sup>	For various blood analysis procedures. Capillary tubes, stain, labstix, etc.
Kit, Histology	108	1 1	5.7 (12.5)	25	42.5 (1.5)	20 (3) (.2) <sup>+</sup>	Fixatives, forceps, slides, operating scissors, plastic bags, etc.
Kit, Microbiology	110	1 1	2.2 (5)	0	28.3 (1.0)	40 (5) (.1) <sup>+</sup>	Syringes, loops, vials, slants, etc.
Kit, microdissection	114A	1 1	4.5 (10)	0	28.3 (1.0)	40 (5) (.1) <sup>+</sup>	Forceps, knife holder, retractors, scissors, etc.
Lyophilizer (Space Vacuum)	118	1 1	22.7 (50)	300	142 (5.0)	200 (20) (1.4) <sup>+</sup>	Freeze drier, with about 0.1 ft <sup>3</sup> freeze chamber. Uses space vacuum.
Mass Measurement Device, Macro.	121	1 1	13.6 (30)	30	142 (5.0)	20 (10) (0.8) <sup>+</sup>	0.1 to 30 kg range. Skylab unit may be usable.
Mass Measurement Device, Micro	122	1 1	4.5 (10)	15	14.2 (0.5)	2000 (20) (1.0) <sup>+</sup>	1 mg. to 100 g. range. New development item.
Microscope, Disecting	126A	1 1	9.1 (20)	63	28.3 (1.0)	10 (5) (0.9) <sup>+</sup>	7X to 25X magnification.
Millipore Filter	128	0 1	0.9 (2)	0	2.8 (0.1)	3 (1) (.1) <sup>+</sup>	For liquid and gas purification and sterilization.
Purge System	143D	1 1	34.1 (75)	100	113 (4.0)	100 (20) (2) <sup>+</sup>	Catalytic Oxidizer, for oxidizing gaseous contaminants in enclosures such as a glove box. Payload and layout sensitive. Wt., pow., and vol. shown are estimates for Sortie mission.
Staining Systems,	159	0 1	6.8 (14)	50	42.5 (1.5)	400 (20) (1.7) <sup>+</sup>	Similar to Wrights staining apparatus.
Temperature Block	179	3 3	3.4 (7.5)	100	4.3 (0.15)	5 (1) (0.1) <sup>+</sup>	To maintain vials or test tubes at constant temperature, 12 tubes per block, several blocks for various temps.
Volumetric Meas., Liquid	186	0 1	2.3 (5)	0	14.2 (0.5)	50 (5)	Liquid Volume Measuring System. Conceptual design item.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 80-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

FIGURE I.5-1 EQUIPMENT VOLUME AND PLACEMENT

Shared Laboratory

E.U. 4 Preparation and Preservation Unit

EQUIPMENT ITEMS IN RACK & CONSOLE

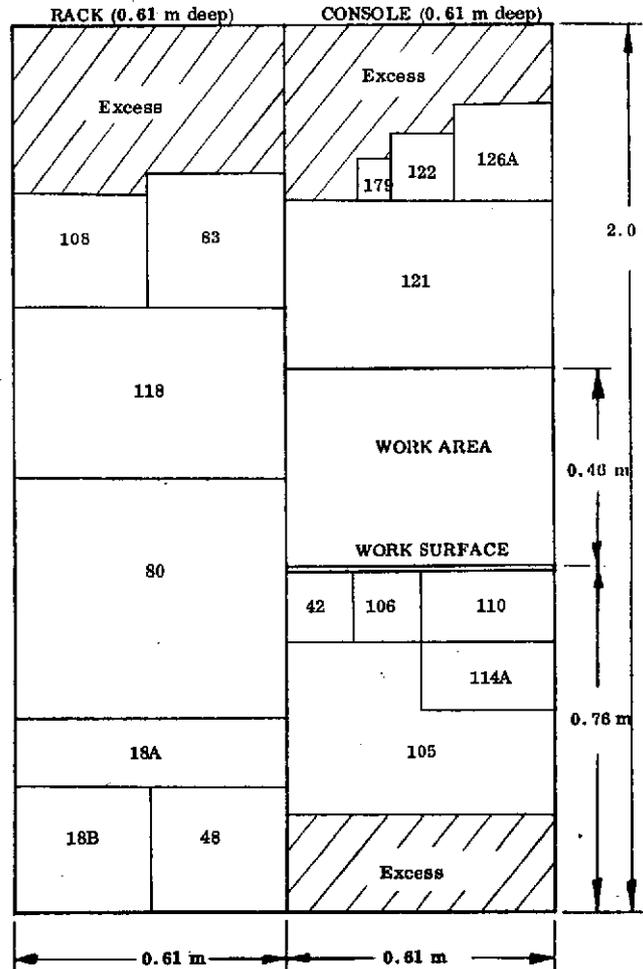
E.I. Number & Name	Vol. dm <sup>3</sup>
<u>In Rack</u>	
18A LFB Liners	56.6
18B LFB Radiation Insert	56.6
48 Vacuum Cleaner	56.6
80 Freezer	198.0
88 Refrigerator	56.6
108 Histology Kit	42.5
118 Lyophilizer	142
Total	608.9
Excess Volume Allowance	135

In Top of Console

121 Mass Meas., Micro	142
122 Mass Meas., Micro	14.2
126A Dissecting Microscope	28.3
179 Temp. Block	4.3
Total	188.8
Excess Volume Allowance	101

In Bottom of Console

42 Centrifuge	13.3
105 Chem. Anal. Kit	113
106 Hematology Kit	14.2
110 Micro. Kit	28.3
114A Microdissect Kit	28.3
Total	197.1
Excess Volume Allowance	86



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
14 Anesthetizer (2)	2.8
18 Laminar Flow Bench	460.0
44 Chemicals (in Chemical Storage Cabinet, E.U. 7, EI 45)	0
44A Radio. Chemicals (in Chemical Storage Cabinet, E.U. 7, E.I. 45)	0
143D Catalytic Oxidizer	113.0
Total	575.8

FIGURE 1.5-2 EQUIPMENT VOLUME AND PLACEMENT

Dedicated 7-Day Laboratory

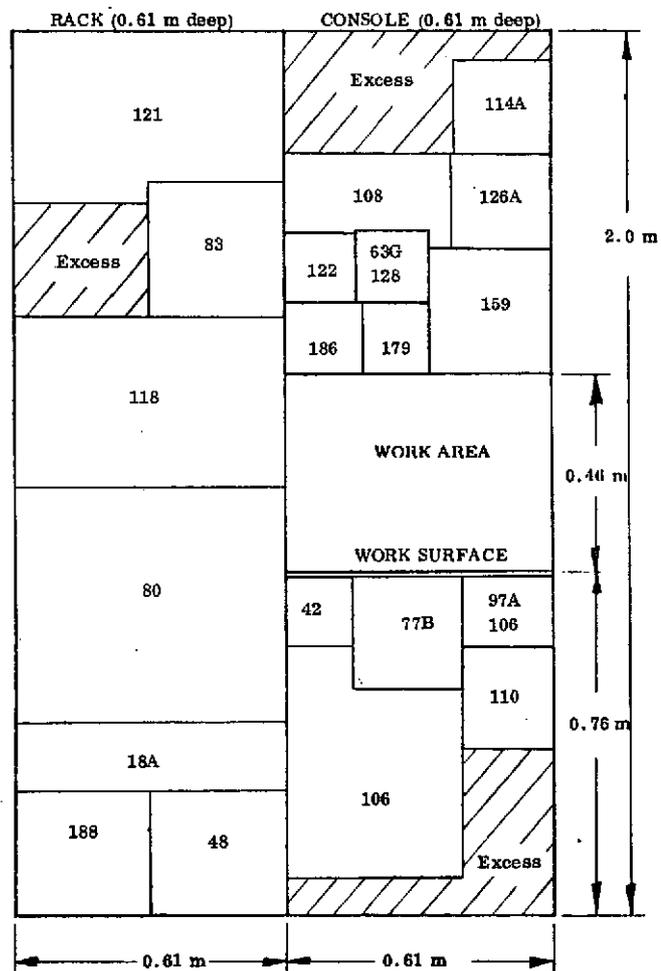
E.U.4 Preparation and Preservation Unit

EQUIPMENT ITEMS IN RACK & CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
<u>In Rack</u>	
18A LFB Liners	56.6
18B LFB Radiation Insert	56.6
48 Vacuum Cleaner	56.6
80 Freezer	198
83 Refrigerator	56.6
118 Lyophilizer	142
121 Mass Meas., Micro	142
<b>Total</b>	<b>708.4</b>
Excess Volume Allowance	36

<u>In Top of Console</u>	
63G Deionizer	14.2
108 Histology Kit	42.5
114A Microdissection Kit	28.3
122 Mass Meas., Micro	14.2
126A Dissection Microscope	28.3
128 Filter Apparatus	2.8
159 Staining System	42.5
179 Temp. Blocks	13.2
186 Liq. Vol. Meas.	14.2
<b>Total</b>	<b>200.2</b>
Excess Volume Allowable	90

<u>In Bottom of Console</u>	
42 Centrifuge	13.2
77B Cryo. Freezer	36.8
97A Hematocrit, Electronic	2.8
105 Chem. Anal. Kit	113.0
106 Hematology Kit	14.2
110 Microbiology Kit	28.3
<b>Total</b>	<b>208.3</b>
Excess Volume Allowable	75



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
14 Anesthetizer (4)	5.6
18 Laminar Flow Bench (LFB)	460
44 Chemicals (in Chemical Storage Cabinet, E.U. 7, E.I. 45)	0
44A Radio, Chemicals (in Chem. Storage Cabinet, E.U. 7, E.I. 45)	0
143D Catalytic Oxidizer	118
<b>Total</b>	<b>578.6</b>

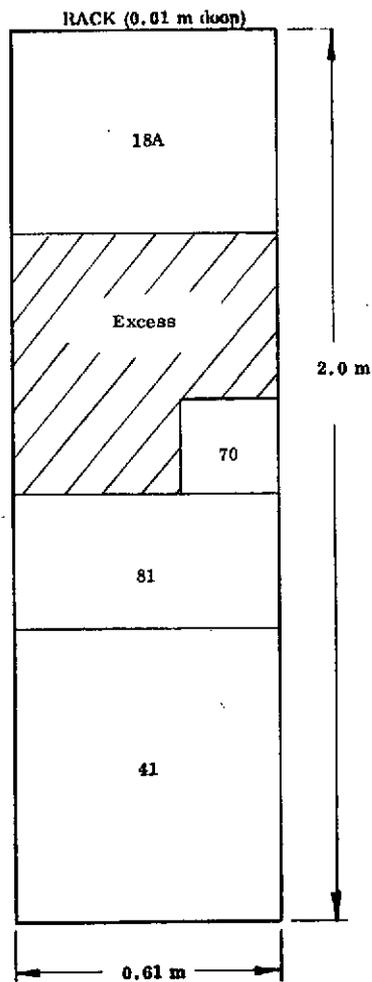
FIGURE I.5-3 EQUIPMENT VOLUME AND PLACEMENT

Extra Equipment for Dedicated 30-Day Laboratory\*

E.U.4 Preparation and Preservation Unit

EQUIPMENT ITEMS IN RACK

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
18A LFB Liners	169.8
41 Refrig. Hi Speed Centrifuge	255.0
70 Electrophoresis Apparatus	25.5
81 Lo Temp. Freezer	113.0
Total	563.3
Excess Volume Allowance	181



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
14 Anesthetizer	8.4
44 Chemicals (in Chem. Storage Cabinet, E.U. 7, E.I. 45)	0
44A Radio. Chemicals (in Chem. Storage Cabinet, E.U. 7 E.I. 45)	0
Total	8.4

\*Other equipment required is identical to that in the Dedicated 7-Day Laboratory

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.5-3. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 4. PREPARATION, PRESERVATION AND RETRIEVAL UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB				
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	
14	ANESTHETZR (INVERT HANDLING) 78A Invertebrate counting & sorting	4 (10)	15 min/dy	15.0 15	0 0	1	5 min/dy	5.0 5	0 0	
18	BENCH, LAM FLO 6A Urine management 8B Feces management 31B Biosampling 78A Invertebrate counting & sorting 91B Plant radiochemistries 92B Vertebrate radiochemistries 93B Invertebrate radiochemistries 94B Cell & Tissue radiochemistries 124A Crew/organism isolation 125A Crew/chemical isolation 353A Culture/sensitivity	1	1/wk 1/wk 6/dy 15 min/dy - 4/wk " " 1/4 hrs " 1/wk	4.0 4.0 30.0 15.0 - 16.0 " " 9.0 " 1.0 108	0.6 0.6 4.2 2.1 - 2.2 " " 1.3 " 0.1 17	1	1/wk 1/wk 3/dy 5 min/dy 2/wk 2/wk " " 1/dy " - -	4.0 4.0 15.0 5.0 8.0 8.0 " " 3.0 " - 66	0.6 0.6 2.1 0.7 1.1 1.1 " " 0.4 " - 9	
18A	BENCH LINERS, LFB 83C Workbench sterilization	10 (40)	4/dy	20.0 20	0 0	10	2/dy	10.0 10	0 0	
18B	BENCH INSERT LFB, RADIOC 95C Radio isotope methodology	1	15 min/wk	3.0 3	0 0	1	10 min/wk	2.0 2	0 0	
41	CENTRIFUGE, FRIG HI SPD 33A Blood preparation 34C Blood electrolytes 36C Blood total protein 149B Urine analysis 185C Cytochemical staining - plants 186C " " - animal sys. 337B Plasma phosphate 408A SGOT 409A SGPT 417A Plasma cholesterol 429A ADH 430A Blood, 17 hydroxycorticosteroids 432A Blood, uric acid 433A Blood, bicarbonate	0 (1)	( 4/dy ) ( 10/wk ) ( 5/wk ) ( 1/wk ) ( 8/wk ) ( " ) (10 min/wk) ( 2/wk ) ( " ) ( " ) ( 2/wk ) ( " ) ( " ) ( " ) ( " ) ( " ) ( " )	( 25.0 ) ( 4.6 ) ( 2.6 ) ( 4.0 ) ( 3.8 ) ( " ) ( 2.0 ) ( 3.0 ) ( " ) ( " ) ( 2.6 ) ( " ) ( " ) ( " ) ( " ) ( " )	( 2.4 ) ( 0.4 ) ( 0.3 ) ( 0.4 ) ( 0.4 ) ( " ) ( 0.2 ) ( 0.3 ) ( " ) ( " ) ( 0.3 ) ( " ) ( " ) ( " ) ( " ) ( " )	0				

TABLE I.5-3. EU 4 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
	434A CPK		( 2/wk )	( 2.6 )	( 0.3 )				
	435A LDH		( " )	( " )	( " )				
	436A ACTH		( " )	( " )	( " )				
	437A Blood TBPA		( " )	( " )	( " )				
	438A Blood histamine		( " )	( " )	( " )				
	439A Lymphocyte karyotyping		( 4/wk )	( 3.8 )	( 0.4 )				
	440A Transferrins, blood		( 2/wk )	( 5.0 )	( 0.5 )				
	442A RBC enzyme measurement		( 2/wk )	( 2.6 )	( 0.3 )				
	443A Complement titration, blood		( " )	( " )	( " )				
	444A Thyroid stimulating hormone		( " )	( " )	( " )				
	445A Blood growth hormone		( " )	( " )	( " )				
	446A Serum parathyroid hormone		( " )	( " )	( " )				
	447A Serum calcitonin		( " )	( " )	( " )				
	448A Insulin assay		( 4/wk )	( 3.2 )	( 0.3 )				
	449A Glucagon assay		( 2/wk )	( 2.4 )	( 0.2 )				
	450A 5HIAA		( 2/wk )	( 1.4 )	( 0.1 )				
				(109)	(11)				
42	CENTRIFUGE MICRO	1				1			
	145A Centrifugation		60 min/dy	<u>10.0</u> 10	<u>2.1</u> 2		60 min/dy	<u>10.0</u> 10	<u>2.1</u> 2
44	CHEMICALS	1				1			
	57C Water vapor monitoring	(3)	1/dy	5.0	0		1/dy	5.0	0
	82A Work bench cleanup		3/dy	25.0	0		2/dy	20.0	0
	83A Work bench sterilization		1/dy	10.0	0		1/dy	10.0	0
	89B Histological sectioning		( 2/wk )	( 4.0 )	( 0 )		-	-	-
	90A Histological staining		2/wk	1.4	0		-	-	-
	105A Organism or sample preservn./gas		2/dy	4.0	0		-	-	-
	167A Anesthesiology - vertebrates		2/wk	8.0	0		1/wk	4.0	0
	314A Biochemical analytical equip. calib.		10 min/wk	<u>2.0</u> 55 (59)	<u>0</u> 0 (0)		10 min/wk	<u>2.0</u> 41	<u>0</u> 0
44A	CHEMICALS - RADIOACTIVE	1				1			
	91A Plant radiochemistries - fixed	(3)	4/wk	16.0	0		-	-	-
	91B " " - LFB		-	-	-		2/wk	8.0	0
	92B Vertebrate radiochemistries		4/wk	16.0	0		2/wk	8.0	0
	93B Invertebrate radiochemistries		"	"	"		"	"	"
	94B Cell & tissue radiochemistries		"	"	"		"	"	"

TABLE I.5-3. EU 4 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
	402A Lung diffusion capacity		2/wk	21.0	0		-	-	-
	405A Blood plasma volume		2/wk	10.0	0		-	-	-
	425A ERG		2/wk	21.0	0		-	-	-
	449B Glucagon assay		2/wk	8.0	0		-	-	-
	451A Angiotension II		4/wk	<u>12.0</u>	<u>0</u>		-	-	-
				136	0			32	0
48	CLEANER, VACUUM	1				1			
	8B Faces management		1/wk	4.0	0.6		1/wk	4.0	0.6
	82A Work bench cleanup		3/dy	<u>25.0</u>	<u>3.5</u>		2/dy	<u>20.0</u>	<u>2.8</u>
				29	4			24	3
63G	DEIONIZER FOR PURE WATER	1				0			
	98B Distilled/sterile water prep.		C	<u>A</u>	<u>0</u>				
				0	0				
70	ELECTROPHRSIS APPARATUS	0				0			
	340A Plasma globulins	(1)	8/wk	(6.0)	(0.7)				
	341A Plasma immunoglobins		3/wk	<u>(6.0)</u>	<u>(0.7)</u>				
				(12)	(1)				
77B	FREEZER, CRYO	1				0			
	106A Organism/sample pres./thermal	(2)			<u>0</u>				
					0				
80	FREEZER, GENL (see note)	1				1			
	30A Gross anatomies								
	106A Organism/sample pres./thermal								
	149C Urine analysis								
	155B Urinary phosphates								
	156B Urine creatinine and creatinine								
	174B Enzyme assay								
	177B Protein assay								
	180B Plant hormones								
	301A Vomitus preservation & storage								
	303A Sweat preservation & storage								
	314A Biochemanalytical equip. calfb.								
	337B Plasma phosphate								
	368A Stool preservation								
	369A Urine preservation								
	373A Fungal identification								

Note:  
The "Equipment Operations Analysis" table is used to determine two things: (1) average EI power requirements, and (2) EI placement and accessibility for crew use. Certain EIs have a very high use factor and it is not necessary to perform the detail analysis of function frequency and crew times to establish this fact.

TABLE I.5-3. EU 4 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
406A	Urine, microscopic analysis								
407A	Urine, chemical analysis								
408A	SGOT								
409A	SGPT								
411A	Mineral balance								
412A	Fecal mass/net weight measmt.								
417A	Plasma cholesterol								
418A	Urine volume								
419A	Nitrogen balance								
420B	Caloric intake								
429A	ADH								
430A	Blood, 17 hydroxycorticosteroids								
431A	BUN								
432A	Blood uric acid								
433A	Blood bicarbonate								
434A	CPK								
435A	LDH								
436A	ACTH								
437A	Blood TBPA								
438A	Blood histamin								
439A	Lymphocyte karyotyping								
440A	Transferrins, blood								
441A	Whole blood methemoglobin								
442A	RBC enzyme measurement								
443A	Complement titration, blood								
444A	Thyroid stimulating hormone								
445A	Blood growth hormone								
446A	Serum parathyroid hormone								
447A	Serum calcitonin								
448A	Insulin assay								
449A	Glucagon assay								
450A	5HIAA (blood)								
453A	Urine, calcium								
454A	Urine, mucoproteins								
455A	Urine, pyrophosphates								
456A	Urine, hydroxyprolines								
457A	Urine, total amino acid								
458A	Urine, aldosterone								
459A	ADH								
460A	Urine, 17, hydroxycorticosterds.								
461A	Urine, 17, ketosteroids								

Note:

The "Equipment Operations Analysis" table is used to determine two things: (1) average EI power requirements, and (2) EI placement and accessibility for crew use. Certain EIs have a very high use factor and it is not necessary to perform the detail analysis of function frequency and crew times to establish this fact.

TABLE I.5-3. EU 4 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
	462A VMA 463A Urine, metanephrines 464A Urine, catecholamines 465A Urine, histamines 466A 5HIAA (urine) 467A Urine, sulfate			†	70			†	70
81	FREEZER, LO TEMP 34C Blood electrolytes 36C Blood total protein 106A Organism/sample pres. - thermal 185C Cytochemical staining - plants 186C Cytochemical staining - animal sys.	0 (1)		†	(250)	0			
83	REFRIGERATOR 79B Organism subculture - substrate prep. 80B " " - plants 81B Media prep. - cell and tissue 87A Microorganism identification 106A Organism/sample pres. - thermal 314A Biochemical analytical equip. calfb. 342A Plasma coagulation	1		†	15	1		†	15
84	REFRIGERATOR, RADIO CHEM STORAG (Part of EI 83) 91A Plant radiochemistries - fixed 91B Plant radiochemistries - LFB 92B Vertebrate radiochemistries 93B Invertebrate radiochemistries 94B Cell & tissue radiochemistries	1				1			
97A	HEMATOCRIT, ELECTRNIC 41B Hematocrit 404A Red blood cell mass	1	2/wk 2/wk	A 3.0 8	0.3 0.4 1	0			

† High frequency of crew use.

TABLE I.5-3. EU 4 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
105	KIT, BENCH CHEM ANAL (see note)	1				1			
	26B Liquid volume msmts. - micro								
	27A " " " - macro								
	28A Mass msmts. - .001 to 100 grams								
	29A " " - 10 - 1000 "								
	33A Blood preparation								
	34C Blood electrolytes								
	36C Blood total protein								
	50A Gas sampling								
	108D Bacterial cell counting								
	177B Protein assay								
	185C Cytochemical staining - plants								
	186C " " - animal sys.								
	226A Cells and tissue population density								
	337B Plasma phosphate								
	406A Urine, microscopic analysis								
	407A Urine, chemical analysis - ground anal.								
	407B Urine, chemical analysis - space anal.								
	408A SGOT								
	409A SGPT								
	411A Mineral balance								
	412A Fecal mass/net weight measmt.								
	417A Plasma cholesterol								
	418A Urine volume								
	419A Nitrogen balance								
	420B Caloric intake								
	429A ADH								
	430A Blood, 17 hydroxycorticosteroids								
	431A BUN								
	432A Blood uric acid								
	433A Blood bicarbonate								
	434A CPK								
	435A LDH								
	436A ACTH								
	437A Blood TBPA								
	438A Blood histamin								
	439A Lymphocyte kariotyping								
	440A Transferrins, blood								
	441A Whole blood methomeglobin								
	442A RBC enzyme measurement								
	443A Complement titration, blood								

Note:

The "Equipment Operations Analysis" table is used to determine two things: (1) average EI power requirements, and (2) EI placement and accessibility for crew use. Certain EIs have a very high use factor and it is not necessary to perform the detail analysis of function frequency and crew times to establish this fact.

TABLE I.5-3. EU 4 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
444A	Thyroid stimulating hormone								
445A	Blood growth hormone								
446A	Serum parathyroid hormone								
447A	Serum calcitonin								
448A	Insulin assay								
449A	Glucagon assay - ground anal.								
449B	Glucagon assay - space anal.								
450A	5HIAA (blood)								
451A	Angiotension II								
452A	Membrane assay and cytogenic anal.								
453A	Urine, calcium - ground anal.								
453B	Urine, calcium - space anal.								
454A	Urine, mucoproteins - ground anal.								
454B	Urine, mucoproteins - space anal.								
455A	Urine, pyrophosphates - ground anal.								
455B	Urine, pyrophosphates - space anal.								
456A	Urine, hydroxyprolines - ground anal.								
456B	Urine, hydroxyprolines - space anal.								
457A	Urine, total amino acid - ground anal.								
457B	Urine, total amino acid - space anal.								
458A	Urine, aldosterone - ground anal.								
458B	Urine, aldosterone - space anal.								
459A	ADH - ground anal.								
459B	ADH - space anal.								
460A	Urine, 17, hydroxycorticosterds. - ground anal.								
460B	Urine, 17, hydroxycorticosterds. - space anal.								
461A	Urine, 17, ketosteroids - ground anal.								
461B	Urine, 17, ketosteroids - space anal.								
462A	VMA - ground anal.								
462B	VMA - space anal.								
463A	Urine, metanephrines - ground anal.								
463B	Urine, metanephrines - space anal.								
464A	Urine, catecholamines - ground anal.								
464B	Urine, catecholamines - space anal.								
465A	Urine, histamines - ground anal.								
465B	Urine, histamines - space anal.								
466A	5HIAA (urine) - ground anal.								
466B	5HIAA (urine) - space anal.								
467A	Urine, sulfate - ground anal.								
467B	Urine, sulfate - space anal.								

Note:

The "Equipment Operations Analysis" table is used to determine two things: (1) average EI power requirements, and (2) EI placement and accessibility for crew use. Certain EIs have a very high use factor and it is not necessary to perform the detail analysis of function frequency and crew times to establish this fact.



TABLE I.5-3. EU 4 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
	441A Whole blood methemoglobin - ground anal. 441B Whole blood methemoglobin - space anal. 442B RBC enzyme measurement - space anal. 443B Complement titration, blood - space anal. 444B Thyroid stimulating hormone - space anal. 445A Blood growth hormone - ground anal. 445B " " " - space anal. 446A Serum parathyroid hormone - ground anal. 446B " " " - space anal. 447A Serum calcitonin - ground anal. 447B " " - space anal. 448A Insulin assay - ground anal. 449A Glucagon assay - ground anal. 450B 5HIAA (blood) - space anal. 451A Angiotension II - ground anal. 452A Membrane assay and cytogenic anal. - ground anal.								
				†	0			†	0
108	KIT, HIST 84A Organism subculturing - cell & tissue 89B Histological sectioning 149B Urine analysis 226A Cell & tissue population density	1	8/dy (2/wk) 1/wk 2/dy	19.0 (4.0) 4.0 7.0 30 (34)	0.7 (0.1) 0.1 0.2 1	1	- - - 1/dy	- - - 5.0 5	- - - 0.2 0
110	KIT, MICROBIOLOGY 84A Organism subculturing - cell & tissue 87A Microorganism identification 88A Bacterial smear staining 108A Bacterial cell counting 142A Microbiological sampling 226A Cell and tissue population density 353A Culture/sensitivity 372A Fungal culturing	1	8/dy 8/wk 25/wk 3/wk 2/dy 2/dy 1/wk -	19.0 16.0 25.0 3.2 10.0 7.0 1.0 -	0 0 0 0 0 0 0 -	1	- 4/wk - - 1/dy 1/dy - 1/wk	- 8.0 - - 5.0 5.0 - 6.0 24	- 0 - - 0 0 - 0 0
114A	KIT, MICRODISSECTION	1				1			
118	LYPHILZR (SPACE VAC) (see note on next page)  34C Blood electrolytes 36C Blood total protein 107A Organism/sample presvn. lyophil.	1				1			



TABLE I.5-3. EU 4 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
128	MILLIPORE FILTER APPARATUS 98B Distilled/sterile water preparation 102C Sterilization of atm. gases	1	C C	A A 0	0 0 0	0			
143D	PURGE SYS, CAT BURN 126A Crew/chemical isolation	1	1/4 hr	$\frac{9.0}{9}$	$\frac{1.3}{1}$	1	1/dy	$\frac{3.0}{3}$	$\frac{0.4}{0}$
159	STAINING SYS, BACTERIOLGCL 86A Bacterial smear staining	1	25/wk	$\frac{25.0}{25}$	$\frac{1.7}{2}$	0			
179	TEMP BLOCK 33A Blood preparation 334A Clotting time	3	4/dy 1/wk	25.0 $\frac{2.0}{27}$	@ 1/2 C $\frac{150}{150}$	3	2/dy -	$\frac{15.0}{15}$	$\frac{150}{150}$
186	VOLUMETRIC MEAS, LIQ. 418B Urine volume 420A Caloric intake	1	4/dy 2/dy	10.0 $\frac{3.0}{13}$	0 0 0	0			
	EU TOTAL				277/85 (541/335)				257/85

TABLE I.5-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

## E.U. 4 - PREPARATION AND PRESERVATION UNIT

EQUIPMENT ITEMS (E.U.#/E.I.#) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS	
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day		
<u>Laminar Flow Bench (4/18)</u>											
On-Off Control	2 position	1 position	Disc.	1	1	cont.	1/sec	1	86K	On 10 min/day	
Air Flow Rate	0-5 scfm	0.1 scfm	Anal.	1	6	162	1/min	negl.	1K		
Air Temperature	20-30°C	0.2°C	Anal.	1	6	162	0.1/sec	1	6K		
Air Relative Humidity	30-95%	1%	Anal.	1	6	162	0.1/sec	1	6K		
Blower Motor Temperature	20-70°C	1°C	Anal.	1	6	162	0.1/sec	1	6K		
<u>Micro Centrifuge (4/42)</u>											
On-Off Control	2 position	1 position	Disc.	1	1	cont.	1/sec	1	86K		
<u>Cryogenic Freezer (4/77B)</u>											
Temperature	70-100°K	1°K	Anal.	1	5	cont.	1/min	negl.	7K		
<u>Freezer, General (4/80)</u>											
Temperature	-30 to 0°C	1°C	Anal.	1	5	cont.	1/min	negl.	7K		
<u>Refrigerator (4/83)</u>											
Temperature	0-15°C	1°C	Anal.	1	4	cont.	1/min	negl.	6K		
<u>Lycophilizer (4/118)</u>											
Vacuum Valve Position	2 positions	1 position	Disc.	1	1	cont.	1/sec	1	86K		
Pressure	10 <sup>-4</sup> to 1 torr	10 <sup>-4</sup> torr	Anal.	1	14	25	1/sec	14	21K		
<u>Mass Measurement Device, Macro and Micro (4/121 &amp; 4/122)</u>											
On-Off Control	2 positions	1 position	Disc.	2	1	cont.	1/sec	2	173K		
Specimen ID	0-200	1	Dig.	1	8	29	0.1/sec	1	1K		
Oscillation Sensor Output	0-5 V	0.05 V	Anal.	1	7	29	500/sec	3500	6.1M		
<u>Purge System (4/143D)</u>											
On-Off Control	2 position	1 position	Disc.	1	1	cont.	1/sec	1	86K		
Purge Gas Flow	0-2 scfm	0.05 scfm	Anal.	1	6	30	1/sec	1	1K		
Gas Temperatures	0-700°F	5°F	Anal.	2	8	30	1/sec	2	3K		
Heater Power	0-300 w	5 w	Anal.	1	6	30	1/sec	1	1K		
Pressure	0-15 psig	1 psig	Anal.	1	4	30	1/sec	negl.	1K		

TABLE I.5-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS (Cont'd)

E. U. 4 - PREPARATION AND PRESERVATION UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Temperature Block (4/179)</u>										
On-Off Control	2 position	1 position	Disc.	1	1	cont.	1/sec	1	86K	
Temperature	20-120°C	0.5°C	Anal.	1	8	27	.1/sec	1	1K	
									6.771M	TOTAL

TABLE I. 5-5. TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES

E. U. 4 - PREPARATION AND PRESERVATION UNIT

EU #	DESCRIPTION OF FUNCTIONAL INTERFACES WITH E. U. 4	CRITI- CALITY*
1	Video and photographic documentation of biological fluid and tissue acquisition and preparation from cage modules via the LFB. Photomicrographic documentation of cell morphology studies.	2
3	Use of crew mobility and restraint aids for use during preparation and preservation tasks.	3
5	Centrifugation of a whole blood sample with subsequent determination of prothrombin time on the plasma phase. Preparation of reagents for automated analysis and standardization of pH instruments.	3
6	Biological specimen maintenance by the use of the LFB in conjunction with the Organism Holding and Management System.	3
7	Storage of chemicals and support items for centrifugation, electrophoresis, and biological kits.	2
40/ 41	Removal of blood samples from selected vertebrates within the LFB with subsequent transferral and processing in the centrifuge for final electrophoresis of the serum phase.	3
42	Measurement of vertebrate blood pressures within the LFB using the pressure cuff transducer. Implanting or mounting biotransducers on specimens in the LFB using the veterinary kit.	3
50	Measuring soil pH and taking plant tissue samples within the LFB and transferring of sampled tissues to the cryogenic freezer, dissecting microscope or lyophilizer.	3
51	Dissection of plant tissue structures using the plant tool kit, LFB, mass measurement device and dissecting microscope.	3
60	Selection of cells for subculturing with the microbiology kit within the LFB.	3
61	Lyophilization of bacteriological cultures obtained from the Air Particle Sample Collector (Anderson Sampler) for preservation and identification of organisms on the ground.	3
70	Use of microdissection kit, LFB and cryogenic freezer for the sampling, preparation and preservation of invertebrate organs and tissues.	3

\* 1 = Minimal, 2 = Nominal, 3 = Maximal.

TABLE I.5-6. COST SUMMARY -  
EQUIPMENT UNIT 4 PREP, PRES & RETRIEVAL UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
14	ANESTHETIZ INVERT	REMFG	1	35	5	1	40	35	5	4	55	35	5	10	85		
18	BENCH, LAM FLO	SRT	4	2000	25	1	2025	2000	25	1	2025	2000	25	1	2025	1600.00	
18A	BENCH LINERS, LFB	SRT	2	100	1	10	110	100	1	10	110	100	1	40	140		
18B	BENCH INSERT-RADIOC	SRT	2		6	1	6		6	1	6		6	1	6		DEV COST IN 018A
41	CENTRIF FRIG HI SPD	REPACK	2			0	0			0	0	175	25	1	200	3100.00	
42	CENTRIF MICRO	REPACK	2	75	5	1	80	75	5	1	80	75	5	1	80	200.00	
44	CHEMICALS	REDESIGN	1	100	10	1	110	100	10	1	110	100	10	3	130	1000.00	
44A	CHEMICALS-RADIOACTIVE	MINIMAL	0	0	10	1	10	0	10	1	10	0	10	3	30	1000.00	
48	CLEANR, VACUUM	REDESIGN	3	200	50	1	250	200	50	1	250	200	50	1	250	300.00	
63G	DEIONIZER PURE WATER	REDESIGN	3			0	0	100	15	1	115	100	15	1	115	173.00	
70	ELECTROPHRESIS APPAR	REPACK	1			0	0			0	0	50	5	1	55	887.00G	
77B	FREZR, CYRO	REDESIGN	3			0	0	500	25	1	525	500	25	2	550	2500.00	
80	FREZR, GEN	REDESIGN	2	50	5	1	55	50	5	1	55	50	5	1	55	235.00	
81	FREZR, LO TEMP	REDESIGN	2			0	0			0	0	200	10	1	210	1675.00	
83	FRIG	REDESIGN	2	50	5	1	55	50	5	1	55	50	5	1	55	235.00	
97A	HEMATOCRT, ELECTRNIC	REMFG	1			0	0	40	5	1	45	40	5	1	45	275.00	
105	KIT-BENCH CHEM ANAL	REPACK	2	100	10	1	110	100	10	1	110	100	10	1	110	300.00	
106	KIT-HEMATOLOGY	REMFG	1	7	1	1	8	7	1	1	8	7	1	1	8	75.00	
108	KIT, HIST	REMFG	2	20	3	1	23	20	3	1	23	20	3	1	23	150.00	
110	KIT, MICROBIOLOGY	REMFG	1	40	5	1	45	40	5	1	45	40	5	1	45	50.00	
114A	KIT, MICRODISSECTION	REMFG	2	40	5	1	45	40	5	1	45	40	5	1	45	75.00	
118	LYPHILZR	REDESIGN	2	200	20	1	220	200	20	1	220	200	20	1	220	1400.00	
121	MASS MEAS, MACRO	MINIMAL	1	20	10	1	30	20	10	1	30	20	10	1	30	760.00	SKYLAB DEVELOPED
122	MASS MEAS, MICRO	REDESIGN	3	2000	20	1	2020	2000	20	1	2020	2000	20	1	2020	980.00	
126A	MICRSCP, DISECTING	MINIMAL	1	10	5	1	15	10	5	1	15	10	5	1	15	900.00	
128	MILLIFORE, FLT APPRFS	MINIMAL	0			0	0	3	1	1	4	3	1	1	4	50.00	
143D	PURGE SYS, CAT BURN	REMFG	2	100	20	1	120	100	20	1	120	100	20	1	120	2000.00	
159	STAIN SYS, BACTERIOL	REDESIGN	4			0	0	400	20	1	420	400	20	1	420	1715.00	

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TABLE I.5-6. COST SUMMARY -  
EQUIPMENT UNIT 4 - PREP, PRES & RETRIEVAL UNIT  
EU4

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
179	TEMP BLOCK	MINIMAL	1	5	1	3	8	5	1	3	8	5	1	3	8	100.00	
186	VOLMTRC MEAS, LIQ	REDESIGN	2			0	0	50	5	1	55	50	5	1	55		
TOTAL COST ESTIMATES				5152	233		5385	6245	319		6564	6670	484		7154		

## I.6 EQUIPMENT UNIT 5 - BIOCHEMICAL/BIOPHYSICAL ANALYSIS UNIT

I.6.1 FUNCTIONAL CAPABILITY & SUMMARY DATA. This unit performs the major measurements and analyses of experiment specimens and parameters, generally requiring more than simple instrumentation. These include measurements of blood and urine constituents and properties, gas compositions, and sound levels. The summary of pertinent properties for this E.U. are given in Table I.6-1.

I.6.2 EQUIPMENT ITEMS. Major equipment items include an automatic blood analyzer, spectrophotometer, blood cell counter, blood gas analyzer, mass spectrometer, and gas chromatograph, see Table I.6-2. The placement of equipment items is shown in Figures I.6-1, I.6-2, and I.6-3.

### I.6.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - The details of the equipment operations analysis for E.U. 5 are given in Table I.6-3.

Data Requirements - Estimated sampled data requirements are shown in Table I.6-4.

Consumables - Liquid nitrogen (LN<sub>2</sub>) is required for the trace gas concentrator (180A). Approximately 3 lb/day have been estimated or 21 lbs for a 7 day mission, and 90 lbs for a 30 day mission. The trace gas concentrator will require filling during launch operations.

Other consumables include chemicals for the various analyzers and bottled gas for the gas chromatograph. However, these are not time limited with respect to Sortie launch operations.

Launch and Reentry Operations - None of the equipment in this E.U. is expected to be functioning except during orbital experiment operations. Nitrogen boil-off from the freeze trap (E.I. 180A) will have to be vented during launch.

Electrical Power - Electrical power requirements for this equipment unit are indicated in Table I.6-1. The estimated breakdown between a.c. and d.c. power was based largely on the type of power required for commercial instruments of similar function to the flight instruments in this equipment unit. Naturally, most of the commercial instruments utilize 115 volt a.c. power. However, much of this equipment could be converted to utilize 28 v d.c. if desirable.

Peak power for the dedicated laboratories was estimated at approximately 1.0 kw. This might correspond to the average on-duty power of approximately 300 watts plus the gas chromatograph and mass spectrometer operating (750 watts). For the shared laboratories, a peak power of 500 watts was estimated.

Heat Rejection - The heat loads corresponding to the average on-duty power consumption are:

Shared Lab	88 w <sub>t</sub> (300 Btu/hr)
Dedicated 7-Day Lab	315 w <sub>t</sub> (904 Btu/hr)
Dedicated 30-Day Lab	320 w <sub>t</sub> (925 Btu/hr)

In general, these heat loads are of an electronic nature and could be rejected to a liquid heat sink in the specified Sortie Module range of 296-310°K (73-99°F). However, most of the heat loads are relatively small and would most likely be rejected to the cabin air. As a preliminary estimate, 50 percent of the load was assumed to be transferred to the liquid coolant and 50 percent to the cabin air.

Typical Equipment Unit Functional Interfaces - As a core unit, the biochemical and biophysical analysis unit has many functional interfaces with the other equipment units of the life sciences payload. Examples of these are given in Table I.6-5.

#### I.6.4 EQUIPMENT ITEM COST SUMMARY - See Table I.6-6.

TABLE I.6-1. E.U. 5, BIOCHEMICAL/BIOPHYSICAL ANALYSIS UNIT -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	1	2	2 $\frac{1}{2}$
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>881 (312)</u>	<u>1671 (590)</u>	<u>2099 (743)</u>
Racks & Consoles	744	1488	1860
Distributed & Extra Items	137	183	239
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	<u>230 (506)</u>	<u>453 (997)</u>	<u>582 (1280)</u>
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>88</u>	<u>315</u>	<u>320</u>
Estimated d.c.	80	100	105
Estimated a.c.	8	215	215
<u>Off-Duty* Average Power, Total</u>	<u>80</u>	<u>225</u>	<u>225</u>
Estimated d.c.	80	100	100
Estimated a.c.	0	125	125
<u>Estimated On-Duty Peak Power</u>	<u>500</u>	<u>1000</u>	<u>1000</u>
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>88</u>	<u>315</u>	<u>320</u>
Estimated Air Cooled Load	44	158	160
Estimated Cold Plated Load	44	158	160
<u>Off Duty Load, Total</u>	<u>80</u>	<u>225</u>	<u>225</u>
Estimated Air Cooled Load	40	113	113
Estimated Cold Plated Load	40	113	113
<u>Development Cost, \$K</u>	<u>1706</u>	<u>5109</u>	<u>6494</u>
<u>Unit Cost, \$K</u>	<u>347</u>	<u>823</u>	<u>928</u>
*12 Hours			

TABLE I.6-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 5

## BIOCHEMICAL &amp; BIOPHYSICS ANALYSIS UNIT

E.I. Name	E.I. No.*	No. of Units		Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
		Reqd.**	Shared, Ded.					
Autoanalyzer, Multiple	7	0	1	114 (250)	400	425 (15)	700 (100) (69.5) <sup>+</sup>	To perform various analyses on blood and other metabolic fluids.
Analyzer, Atom. Abs. Spectroph.	(8A)	(1)		36 (80)	110	113 (4.0)	1200 (60) (4) <sup>+</sup>	Atomic Absorption Spectrophotometer to analyze metallic and semi-metallic elements in solution.
Analyzer, Genl. Spectropho.	11	1	1	136 (300)	450	283 (10)	350 (50) (5.5) <sup>+</sup>	General Purpose Spectrophotometer for spectral analysis of gases and liquids.
Analyzer, Urine, Automatic	13	0	1	-	-	-	-	Part of autoanalyzer, E.I. 7.
Atmospheric Sampling, Manifold	15A	1	1	23 (50)	0	28 (1.0)	0 (0)	Gas sampling manifold for periodic sampling of cage and cage module atmospheres. Laboratory specific, and estimates for wt. and vol. shown.
Audiometer	(16B)	(1)		5 (10)	25	4 (0.15)	35 (5)	For sound source to earphones or bone vibrators. 125 to 8000 Hz. For measurements on man.
Bench, Genl. Experiment	(19)	(1)		45 (100)	50	255 (9.0)	100 (10)	
Commutator, Gas Manifold	50A	0	1	2 (5)	20	14 (0.5)	200 (20)	Automatic gas manifold valving system for control of cage and cage module atmospheric gas sampling.
Counter, Cell	52	0	1	9 (20)	40	57 (2.0)	200 (30)	Blood Cell Counter similar to a Coulter counter which measures numbers of white blood cells and red blood cells.
Counter, Colony, (Auto)	(53)	(1)		5 (10)	20	28 (1.0)	50 (10)	To determine counts on substrate. Development item.
Counter, Colony, Manual	54	1	1	1.4 (3)	50	14 (0.5)	10 (2) (0.1) <sup>+</sup>	Manual Colony Counter. Lighted Grid with magnifying glass, including mechanical counter.
Fibrometer, Blood Clot	76L	0	1	5 (10)	40	20 (0.7)	100 (10) (1) <sup>+</sup>	For automatic measurement of plasma coagulation.
Gas Analyzer, Auto Physiological	85	0	1	8 (18)	55	45 (1.6)	200 (50) (5.3) <sup>+</sup>	Automatic Blood Gas Analyzer to measure O <sub>2</sub> , CO <sub>2</sub> , and pH.
Gas Analyzer, CO <sub>2</sub>	86	1	1	1 (2.6)	1	1 (0.04)	75 (10) (2.2) <sup>+</sup>	To measure approx. 1-20 mm Hg pp CO <sub>2</sub> in air and other gas mixtures.
Gas Analyzer, GC	89	0	1	48 (105)	500	207 (7.3)	850 (120) (5.2) <sup>+</sup>	Gas Chromatograph to measure gas, liquid, and solid constituents of biological samples.
Gas Analyzer, Mass Spec.	90	0	1	23 (50)	250	57 (2.0)	1000 (100) (7) <sup>+</sup>	To provide measurements from 1 to 400 amu. This is a comprehensive research unit to identify gases.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

TABLE I.6-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT #5 (cont.)

## BIOCHEMICAL &amp; BIOPHYSICS ANALYSIS UNIT

E.I. Name	E.I. No.*	No. of Units		Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
		Reqd.**	Shared, Ded.					
Gas Analyzer, Mass Spec.	91	2	2	3	40	6	800	Mass Spectrometer, special purpose to monitor environmental gases. 0-60 amu.
				(7)		(0.2)	(100) (10.5) <sup>+</sup>	
Gas Analyzer, RH	93	6	6	5	6	13	70	Water Vapor Meter (Dew Point) to monitor primarily atmospheric air.
		8		(11.5)		(0.47)	(10) (0.5)	
Meters, Assorted	125B	4	4	1	1	0.3	150	Needed throughout the laboratory, laboratory specific, average estimated wt., power, & vol. are shown.
				(2)		(0.01)	(1)	
Meter, AOTS	125C	0	0	0.5	0	0.1	3	American Optical (AO) total solids (TS) refractometer. A hand-held optical device for the measurement of total dissolved solids in liquids.
		1		(1.0)		(0.005)	(1) (0.3) <sup>+</sup>	
Microphone	126B	4	4	0.2	0	0.1	0	For monitoring organisms, data recording, remote blood pressure measurements, etc. Cost included in E.I. 126C.
		5		(0.5)		(0.005)	(0) (0.1) <sup>+</sup>	
Microphone Amplifier	126C	2	2	0.05	10	0.3	20	For microphone signals to provide output to speakers. Will probably be provided on a solid state plug-in type card.
		4		(0.1)		(0.01)	(2)	
pH Meter	138	0	0	3	5	23	150	General purpose
		1		(7)		(0.8)	(20) (0.6) <sup>+</sup>	
Sound Level Meter	157	1	1	6.8	0	28	30	For sound level (including frequency) measurements.
				15)		(1.0)	(5) (2.5) <sup>+</sup>	
Thermocouples	179A	2	2	0.5	0	0.3	1	Package of 20.
		3		(1.0)		(0.01)	(1)	
Trace Gas Concentrator	180A	1	1	19	0	28	200	For freezing out ethylene from air in order to concentrate and measure it (essentially a freeze trap). Wt. and vol. are estimates for an LN <sub>2</sub> trap.
		1 (3)		(41)		(1.0)	(10)	

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

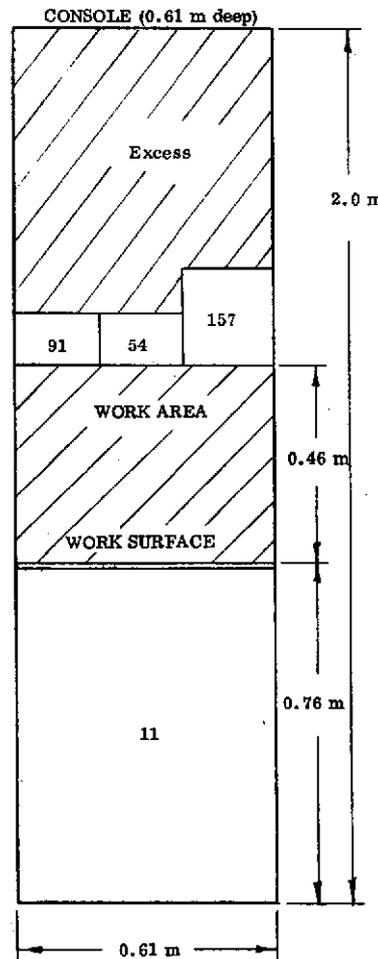
FIGURE I.6-1 EQUIPMENT VOLUME AND PLACEMENT

Shared 7-Day Laboratory

E.U. 5 Biochemistry/Biophysics Analysis Unit

EQUIPMENT ITEMS IN CONSOLE

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
<u>In Top of Console:</u>	
54 Colony Counter	14
91 Mass Spectrometers	12
126B Microphones	negl.
157 Sound Meter	28
179A Thermocouples	negl.
Total	54
Excess Volume Allowance	236
<u>In Bottom of Console:</u>	
11 Spectrophotometer	283
Total	283
Excess Volume Allowance	0



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
15A Gas Manifold	28
86 CO <sub>2</sub> Analyzer	1
93 Dew Point Meters (6)	78
125B Meters	1
126C Amplifiers	1
180A Gas Concentrator	28
Total	137

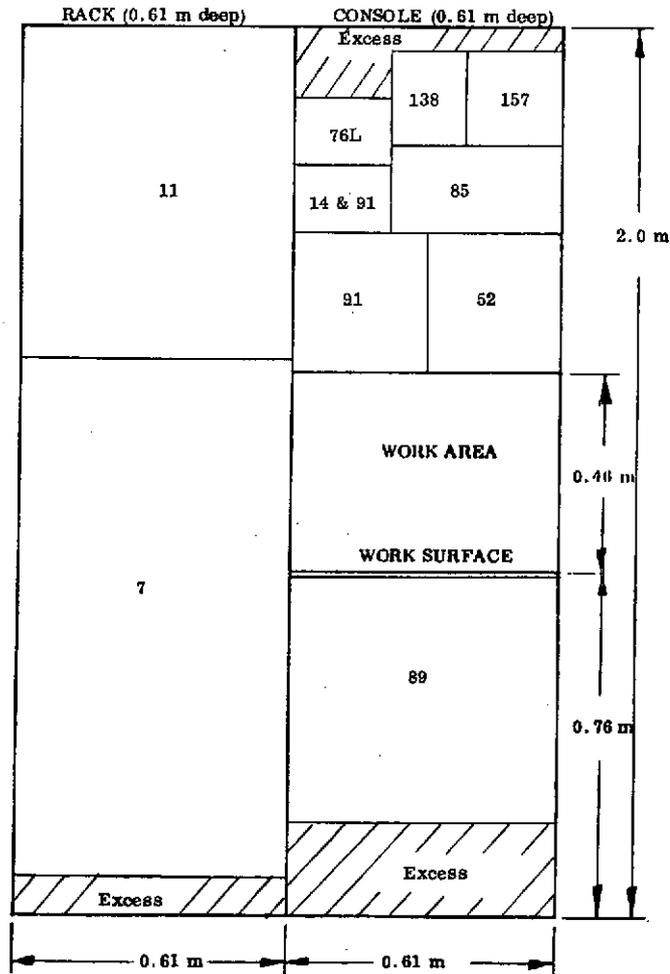
FIGURE 1.6-2 EQUIPMENT VOLUME AND PLACEMENT

Dedicated 7-Day Laboratory

E.U. 5 Biochemistry/Biophysics Analysis Unit

EQUIPMENT ITEMS IN RACK & CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
<b>In Rack:</b>	
7 Autoanalyzer	425
11 Spectrophotometer	283
<b>Total</b>	<b>708</b>
Excess Volume Allowance	36
<b>In Top of Console:</b>	
52 Cell Counter	57
54 Colony Counter	14
76L Fibrometer	20
85 Blood Gas Analyzer	45
90 Mass Spectrometer	57
91 Mass Spectrometer (1)	6
138 PH Meter	23
157 Sound Meter	28
<b>Total</b>	<b>250</b>
Excess Volume Allowance	40
<b>In Bottom of Console:</b>	
89 Gas Chromatograph	207
125C Refractometer	} 1 (negl.)
126B Microphones (5)	
179A Thermocouples	
<b>Total</b>	<b>208</b>
Excess Volume Allowance	75



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
15A Gas Manifold	28
50A Manifold Flow Control	14
86 CO <sub>2</sub> Analyzer	1
91 Mass Spectrometer (1)	6
93 Dew Point Sensors	104
125B Meters (misc.)	1
126C Amplifiers	1
180A Trace Gas Concentrator	28
<b>Total</b>	<b>183</b>

FIGURE I.6-3 EQUIPMENT VOLUME AND PLACEMENT

Extra Equipment Required for 30-Day Laboratory\*

E.U. 5 Biochemistry/Biophysics Analysis Unit

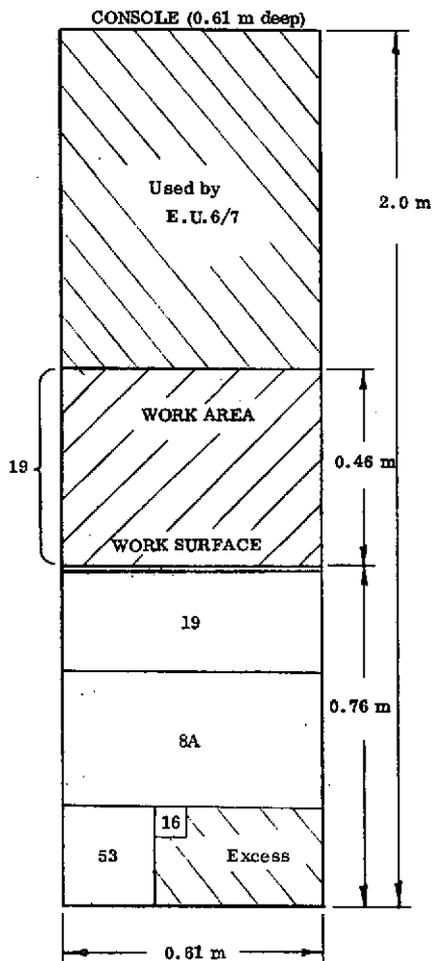
EQUIPMENT ITEMS IN CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
<u>In Bottom of Console:</u>	
8A Atomic Abs. Spectrophotometer	113
16 Audiometer	4
19 Exper. Bench	255
53 Auto. Colony Counter	28
Total	400
Excess Volume Allowance (including work area)	54

DISTRIBUTED OR EXTRA EQUIPMENT ITEMS

(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
180A Trace Gas Concentrator	56
Total	56



\*Other equipment required is identical to that in the Dedicated 7-Day Laboratory

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.6-3. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 5. BIOCHEMICAL AND BIOPHYSICAL ANALYSIS UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
7	AUTOANALYZER, MULTIPLE	1				0			
	336A Plasma Glucose		3/wk	1.8	1.0				
	338A Plasma Aklaline Phosphates		"	"	"				
	339A Plasma Bilirubin		"	"	"				
	408B SGOT (serum glutamic oxalacetic transaminase)		2/wk	1.6	0.9				
	409B SGPT (serum glutamic-pyruvic transaminase)		"	"	"				
	417B Plasma cholesterol		"	"	"				
	429B Serum antidiuretic hormone (ADH)		"	"	"				
	430B Blood, 17 hydroxycorticosteroids		"	"	"				
	431B Blood urea nitrogen (BUN)		"	"	"				
	432B Blood uric acid		"	"	"				
	433B Blood histamin		"	"	"				
	434B Creatinine phosphokinase (CPK) blood		"	"	"				
	435B Serum lactic acid dehydrogenase (LDH) & LDH isoenzymes		"	"	"				
	436B Blood adrenocorticotropic hormone (ACTH)		"	"	"				
	437B Blood TBPA		"	"	"				
	438B Blood histamin		"	"	"				
	441B Whole blood methemoglobin		4/wk	2.0	1.1				
	445B Blood growth, hormone		2/wk	1.6	0.9				
	446B Serum parathyroid hormone		"	"	"				
	447B Serum calcitonin		"	"	"				
				33	19				
8A	ANLZR, ATOM ADS SPTRPH	0				0			
	52B Trace Gas Analysis Inorganics	(1)	(10 min/wk)	(A)	(0.3)				
				0	0				
11	ANLZR, GENL, SPECTROPHO	1				1			
	42A Hemoglobin-Msur Cone Oxyhgb or Carboxyhgb		2/wk	3.6	2.3		1/wk	3.0	1.9
	108D Bacterial cell counting		-	-	-		2/wk	2.4	1.5
	226A Cells and tissue population density		2/dy	7.0	4.4		1/dy	5.0	3.1
	404A Red blood cell mass (RBC Mass)		2/wk	3.0	1.9		-	-	-
				14	9			10	7
13 ( 7)	ANLZR, URNE, AUTO (use Autoanalyzer, E.I. #7)	1				0			
	407B Urine chemical analysis (bile, acetone, etc.)		2/dy	40.0	22.2				
	440B Transferrins, blood		2/wk	1.6	0.9				
	442B RBC Enzyme Measurement		"	"	"				
	443B Complement Titration, Blood		"	"	"				
	444B Thyroid Stimulating Hormone		"	"	"				
	450B Blood Serotonin (5HIAA)		"	"	"				

TABLE I.6-3. EU 5 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
	453B Urine, Calcium		2/wk	1.6	0.9				
	454B Urine, Mucoproteins		"	"	"				
	455B Urine, Pyrophosphates		"	"	"				
	456B Urine, Hydroxyprolines		"	"	"				
	457B Urine, Total Amino Acid		"	"	"				
	458B Urine, Aldosterone		"	"	"				
	459B Urine, Antidiuretic Hormone (ADH)		"	"	"				
	460B Urine, 17, Hydroxycorticosteroids		"	"	"				
	461B Urine, 17 Ketosteroids		"	"	"				
	462B Urine, Vinyl Mandelic Acid (VMA)		"	"	"				
	463B Urine, Metanephrines		"	"	"				
	464B Urine, Catacholoamines		"	"	"				
	465B Urine, Histamines		"	"	"				
	466B Urine, Serotonine (5HIAA)		1/dy	5.0	2.8				
	467B Urine, Sulfate		2/wk	1.6	0.9				
				75	42				
15A	ATMOS SAMPLING - MNFD SYS	1				1			
	50B Gas Sampling - Obtain gas from site Xfer to Instmt		C	A	0		C	A	0
				0	0			0	0
16B	AUDIOMETER	0				0			
	715A Auditory - absolute threshold	(1)	(2/3 dy)	(1.3)	(0.1)				
	716A Auditory - pitch discrimination		"	"	"				
	717A Auditory - temporal acuity		"	"	"				
				(4)	0				
19	BENCH, GENL EXPER	0				0			
	14B Bioelectric Xcdr Installation & Setup/CRT Check-precalf	(1)	(2/2 dy)	(10.0)	(0.7)				
	14C Bioelectric Xcdr Installation & Setup/Preinstal		(1/dy)	(1.0)	(0.1)				
	82A Work Bench Cleanup		(3/dy)	(25.0)	(1.7)				
	91A Plant Radiochemistries		(4/wk)	(16.0)	(1.1)				
				(52)	(5)				
50A	COMMUTATOR, GAS MANIFLD	1				0			
	112B Oxygen Msmts Mmb		1/6 C	A	20-c				
	113B Carbon Dioxide Msmts Mmb		"	"	"				
				0	20				

TABLE I.6-3. EU 5 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
52	COUNTR CELL 108A Bacterial Cell Counting 404A Red Blood Cell Mass (RBC Mass)	1				0			
			3/wk	3.2	0.2				
			2/wk	3.0	0.2				
				6	0				
53	COUNTR, COLONY (AUTO) 86A Bacterial Colony Counting	0 (1)	(5/wk)	(3.0) (3)	(0.1) (0)	0			
54	COUNTER, COLONY, MANUAL 86B Bacterial Colony Counting	1	--	-- 0	-- 0	1	3/wk	6.0 6	0.4 0
76L	FIBROMETER-BLOOD CLOT 426A Prothrombin Consumption	1	2/wk	4.0 4	0.2 0	0			
85	GAS ANLZR, AUTO PHYSIO 35A Blood PH PCO <sub>2</sub> O <sub>2</sub> - Msur Conc of Dissolved GS in Blood	1	10/wk	4.0 4	0.3 0	0			
86	GAS ANLZR, CO <sub>2</sub> 501E Analysis of Gas Mixtures for O <sub>2</sub> , N <sub>2</sub> , CO <sub>2</sub> , CO, CH <sub>4</sub> , H <sub>2</sub> O, H <sub>2</sub> , NH <sub>3</sub> , etc.	1	5 min/dy	A 0	0.1 0	1	2 min/dy	A 0	0.1 0
89	GAS ANLZR, GC (COMPLX) 51A Trace Gas Analysis Hydrocarbons - Specific Compound/ Predeterm List 59A Atmospheric Ethylene Monitoring - Sens to Soppb 501A Analysis of Gas Mixtures for O <sub>2</sub> , N <sub>2</sub> , CO <sub>2</sub> , CO, CH <sub>4</sub> , H <sub>2</sub> O, H <sub>2</sub> , NH <sub>3</sub> , etc.	1	15 min/dy 1/4 C 5 min/dy	A A A 0	10.4 125.0 3.5 139	0			
90	GAS ANLZR, MASS SPEC 51B Trace Gas Analysis Hydrocarbons - Specific Compound/ Predeterm List 52A Trace Gas Analysis Inorganics	1	10 min/dy 5 min/dy	A A 0	3.5 1.7 5	0			
91	GAS ANLZR, MASS SPEC 20A Respiratory Rate Monitoring 53B Oxygen Monitoring	2	1/6 C 1/4 C	A A	6.7 10.0	2	-- 1/4 C	-- A	-- 10.0

TABLE I.6-3. EU 5 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
	54B Carbon Dioxide Monitoring		1/4 C	A	10.0		1/4 C	A	10.0
	55B Nitrogen Monitoring		1/4 C	A	10.0		1/4 C	A	10.0
	56C Carbon Monoxide Monitoring		1/4 C	A	10.0		1/4 C	A	10.0
	57A Water Vapor Monitoring		1/4 C	A	10.0		1/4 C	A	10.0
	58C Ammonia Monitoring		1/4 C	A	10.0		1/4 C	A	10.0
	112B Oxygen Msmts MMB		1/6 C	A	6.7		--	--	--
	113B Carbon Dioxide Msmts MMB		1/6 C	A	6.7		--	--	--
				0	80			0	80
93	GAS ANLZR, RH	8				6			
	57C Water Vapor Monitoring		1/dy	5.0	0.8		1/dy	5.0	0.6
				5	1			5	1
125B	METERS, ASSORTED	4				4			
	43B Digital Records - Recording of Instrument Data		1/dy	5.0			1/dy	5.0	
	49A Pressure Monitoring		1/dy	3.0			--	--	--
	55C Nitrogen Monitoring/Total Pressure Difference		C	A			C	A	
	510A Electrical Power System for Experiment Support		2 min/dy	2.0			2 min/dy	2.0	
	512A Electrical Amperage Measurements		5 min/dy	5.0			5 min/dy	5.0	
	515A Supply of Coolant		5 min/dy	5.0			5 min/dy	5.0	
				20	*			17	*
125C	METER, AO TS	1				0			
	149B Urine Analysis		1/wk	4.0	0				
				4	0				
126B	MICROPHONE					4			
	64A Noise Monitoring	5	C	A	0		C	A	0
	161A Arterial Blood Pressure		2/dy	10.0	0		-	-	-
	730A Cognitive/Complex Perceptual - Speech Intelligibility		2/3 dy	10.0	0		-	-	-
				20	0			0	0
126C	MICROPHONE AMPLIFIER	4				2			
	161A Arterial Blood Pressure		2/dy	10.0	0.1				0
				10	0				0
138	PH MTR	1				0			
	81B Media Preparation - Cells and Tissue		30 min/wk	6.0	0.1				
	149B Urine Analysis		1/wk	4.0	0.1				
				10	0				

\*payload specific

TABLE I.6-3. EU 5 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
157	SOUND LEVEL METER 64A Noise Monitoring	1	C	$\frac{A}{0}$	$\frac{0}{0}$	1	C	$\frac{A}{0}$	$\frac{0}{0}$
179A	THERMOCOUPLES 70A Air Movement	3	C	$\frac{A}{0}$	$\frac{0}{0}$	2	C	$\frac{A}{0}$	$\frac{0}{0}$
180A	TRACE GAS CONCENTRATOR 59A Atmospheric Ethylene Monitoring - SENS to SOPPB	1 (3)	1/4 C	$\frac{A}{0}$	$\frac{0}{0}$	1	1/4 C	$\frac{A}{0}$	$\frac{0}{0}$
	EU AVE. PWR (Averaged over 12-Hr Shift)				315/225 (320/225)				88/80

**TABLE I.6-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS**  
**E. U. 5 - BIOCHEMICAL AND BIOPHYSICS ANALYSIS UNIT**

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chas.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<b>Autoanalyzer (5/7)</b>										
On-Off Control	2 level	1 level	Dis.	1	1	cont.	1/sec	1	86 K	
Specimen/Organism I. D.	1-200	1	Dig.	1	8	33	0.1/sec	1	2 K	
Time of Specimen	0-7 days	1 sec	Dig.	1	20	33	0.1/sec	2	4 K	
Type of Analysis	1-30	1 value	Dig.	1	5	33	0.1/sec	1	1 K	
Measured Value	Variable	0.1%	Dig.	1	10	33	0.1/sec	1	2 K	
<b>General Spectrophotometer (5/11)</b>										
Wavelength Monitor	0-5 V	5 mV	Anal.	1	10	9	500/sec	5000	2.7 M	} For maximum scanning rate
Detector Signal	0.5 V	15 mV	Anal.	1	9	9	5000/sec	45 K	24.3 M	
On/Off Control	2 position	1 position	Dis.	1	1	cont.	1/sec	1	86 K	
Output Range Select	1-4	1	Dig.	1	2	9	1/sec	2	1 K	
Scan Speed Select	1-6	1	Dig.	1	3	9	1/sec	3	2 K	
Specimen I. D.	1-100	1	Dig.	1	7	9	0.1/sec	1	negl.	
<b>Auto. Urine Analyzer (5/13) (use E. I. #7)</b>										
Power On/Off	2 positions	1 position	Dis.	1	1	cont.	1/sec	1	86 K	
Specimen/Organism I. D.	1-200	1	Dig.	1	8	75	0.1/sec	1	4 K	
Time of Specimen	0-7 days	1 sec	Dig.	1	20	75	0.1/sec	2	9 K	
Type of Analysis	1-21	1	Dig.	1	5	75	0.1/sec	1	2 K	
Measured Value	Variable	0.1%	Dig.	1	10	75	0.1/sec	1	5 K	
<b>Audiometer (5/16B)</b>										
Tone Signal Output	500-6 KHz	10 Hz	Anal.	1	-	4	-	-	-	} Hardwire to analog equipment
Amplifier Gain	5 levels	1 level	Dig.	2	3	4	1/sec	3	1 K	
On-Off Control	2 positions	1 position	Dig.	1	1	cont.	1/sec	1	86 K	
Response Keys	1-12	1	Dig.	1	4	4	1/sec	4	1 K	
Tone Control	0-5 V	0.05 V	Anal.	1	7	4	0.1/sec	1	negl.	
<b>Gas Sampling Commutator (5/50A)</b>										
Gas line being sampled	0-12	1	Dig.	1	4	cont.	1/min	negl.	6 K	
<b>Blood Cell Counter (5/52)</b>										
Power On/Off	2 positions	1 position	Dis.	1	1	cont.	1/sec	1	86 K	
Specimen/Organism I. D.	1-100	1	Dig.	1	7	6	0.1/sec	1	negl.	
Time of Specimen	0-7 days	1 sec	Dig.	1	20	6	0.1/sec	2	1 K	
Type of Analysis	1-7	1	Dig.	1	3	6	0.1/sec	negl.	negl.	
Measured Analysis	Variable	0.1%	Dig.	1	10	6	0.1/sec	1	negl.	

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TABLE I.6-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS (Cont'd)

E.U. 5

EQUIPMENT ITEMS (E.U.#/E.I.#) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Blood Clot Fibrometer (5/76L)</u>										
Power On/Off	2 positions	1 position	Dis.	1	1	cont	1/sec	1	86K	
Specimen/Organism I.D.	1-20	1	Dig.	1	5	4	1/min	negl.	negl.	
Time of Specimen		1 sec	Dig.	1	20	4	1/min	negl.	negl.	
Clotting Time	0-30 sec	0.1 sec	Dig	1	9	4	1/min	negl.	negl.	
<u>Blood Gas Analyzer (5/85)</u>										
Power On/Off	2 positions	1 position	Dis.	1	1	cont.	1/sec	1	86K	
Specimen I.D.	1-20	1	Dig.	1	5	4	1/min	negl.	negl.	
Time of Specimen	0-7 days	1 sec	Dig.	1	20	4	1/min	negl.	negl.	
Parameter Measured & Value	Variable	0.1%	Dig.	1	12	4	1/min	negl.	negl.	
<u>CO<sub>2</sub> Analyzer (5/86)</u>										
CO <sub>2</sub> Partial Pressure	0-5V (1-20MM Hg)	25mV	Anal.	1	8	cont.	1/sec	8	.69M	
<u>Gas Chromatograph (5/89)</u>										
Column Temperature	0-300°C	5°C	Anal.	1	8	cont.	0.1/sec	1	69K	
Detector Current	0-1 amp	5mA	Anal.	1	8	cont.	0.1/sec	1	69K	
Carrier Gas Flow	0-28/hr	0.05%/hr	Anal.	1	6	cont.	1/min	negl.	9K	
Detector Output	0-5V	0.05V	Anal.	1	7	cont.	5/sec	35	3.02M	
<u>Mass Spectrometer (5/90)</u>										
On/Off Control	2 position	1 position	Disc.	1	1	cont.	1/sec	1	86K	
Mass Scan Encoder	0-400 amu	3/2 amu	Anal.	1	9	5	100/sec	900	270K	
Output Range Select	4 positions	1 position	Dig.	1	2	5	1/sec	2	1K	
Gas Concentration Sensor	Variable	0.5% FS	Anal.	1	8	5	300/sec	2400	720K	
Vacuum Monitor	10 <sup>-4</sup> -10 <sup>-14</sup> torr	10 <sup>-14</sup> torr	Anal.	1	30	5	10/min	5	2K	
<u>Mass Spectrometer, Special (5/91)</u>										
On-Off Control	2 position	1 position	Disc.	1	1	cont.	1/sec	1	86K	
Mass Scan Encoder	0-60 amu	0.5 amu	Anal.	2	7	80	60/sec	840	4.03M	
Output Range Select	3 position	1 position	Dig	2	2	80	1/sec	4	19K	
Gas Concentration Sensor	Variable	0.5% F.S.	Anal.	2	8	80	300/sec	4800	23.04M	
Vacuum Monitor	10 <sup>-4</sup> -10 <sup>-14</sup> torr	10 <sup>-14</sup> torr	Anal.	2	30	80	10/min	10	48K	

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TABLE I.6-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS (Cont'd)

E.U. 5

EQUIPMENT ITEMS (E.U.#/E.I.#) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Water Vapor Meters (5/93)</u>										
Moisture Content	0-.02 g/air	.1% F.S.	Anal.	8	8	cont.	1/sec	64	5.53M	
<u>Microphones (5/126B)</u>										
Audible Sound	30-100 db 50-20 KHz	1 db	Anal	8	-	20	-	-	-	Hardwire to control console and wide band recorder.
<u>Sound Level Meter (5/157)</u>										
Sound Level Monitor	30-100 db	1 db	Anal.	1	7	cont.	2/sec	14	1.21M	
<u>Trace Gas Concentrator (5/180A)</u>										
Cryogenic Temperature	70-170°K	1°K	Anal.	1	7	cont.	1/min	negl.	10K	
									66.552 M	TOTAL

TABLE I.6-5. TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES  
E.U. 5 - BIOCHEMICAL/BIOPHYSICS ANALYSIS UNIT

E.U. #	DESCRIPTION OF TYPICAL FUNCTIONAL INTERFACE WITH E.U. 5	CRITI- CALITY*
1	Video and photographic documentation of measurement operations. Conducting blood counts, and urine sediment analysis.	2
2	Processing and signal conditioning of signals from automated clinical analyzers. Analysis of data received from gas chromatograph and mass spectrograph for trace gas monitoring.	3
3	Gas chromatograph calibration, and water flow determinations for animal intake and output measurements.	3
4	Centrifugation of a whole blood sample with subsequent determination of prothrombin time on the plasma phase. Preparation of reagents for automated analysis and standardization of all pH instruments.	3
6	Special calibration procedures for the gas chromatograph and mass spectrometer using the electro-mechanical bench.	1
7	Storage of ancillary equipment for the gas chromatograph and autoanalyzers.	2
12	Measurement with the blood gas analyzer of arterialized venous blood samples obtained from subjects on the Rotating Litter Chair.	2
31	Blood gas determinations and blood cell counts supportive to metabolic and pulmonary function studies (metabolic analyzer) conducted on the bicycle ergometer.	3
40/ 41	Determination of gas concentrations within the vertebrate holding unit by means of gas chromatography, mass spectroscopy, and CO <sub>2</sub> gas analysis.	3
42	Use of the autoanalyzer for the determination of electrolyte concentrations in rat serum obtained with the veterinary kit and hematology kit.	3
50	Determination of CO <sub>2</sub> concentration and humidity within the plant module using the CO <sub>2</sub> gas analyzer and the water vapor meter.	3
51	Determination of radioisotope uptake in plants using the clinostat, gas circulating pump and radiation counter.	3
60/ 61	Measurement of pH of tissue culture media.	2
70	Determination of CO <sub>2</sub> concentration and water vapor within the invertebrate cage module.	3
80	Monitoring of gas concentrations by gas chromatography and mass spectroscopy.	3
91	Use of the audiometer, sound level meter and stereo headset for determining aural acuity and frequency discrimination among crew members.	1

\*1 = Minimal  
2 = Nominal  
3 = Maximal

TABLE I.6-6. COST SUMMARY -  
EQUIPMENT UNIT - 5 BIO CHEM & BIOPHYSICS ANALYSIS UNIT  
EU5

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
7	AUTOANALYZER, MULTIPLE	REDESIGN	2			0	0	700	100	1	800	700	100	1	800	69.5K	
8A	ANLZR ATOM ADS SPTRRH	REDESIGN	3			0	0			0	0	1200	60	1	1260	8000.00	
11	ANALZR, GENL, SPECTRPHO	REPACK	1	350	50	1	400	350	50	1	400	350	50	1	400	4000.00	
15A	ATMOS SAMPLING-MNFD SYS	U	U	0	0	1	0	0	0	1	0	0	0	1	0	5500.00	
16B	AUDIOMETER	REMFG	2			0	0	35	5	1	40	35	5	1	40		
19	BENCH, GEN EXPER	REDESIGN	3			0	0			0	0	100	10	1	110		
50A	COMMUTATOR, GAS MNFD	REDESIGN	3			0	0	200	20	1	220	200	20	1	220		
52	COUNTR CELL	REMFG	1			0	0	200	30	1	230	200	30	1	230		
53	COUNTER COLONY AUTO	REMFG	2			0	0			0	0	50	10	1	60		
54	COUNTR COLONY, MANUAL	REPACK	1	10	2	1	12	10	2	1	12	10	2	1	12		
76L	FIBROMETER-BLOOD-CLOT	REDESIGN	2			0	0	100	10	1	110	100	10	1	110	1000.00	
85	GAS ANALYZER, AUTO PHYSIO	REPACK	1			0	0	200	50	1	250	200	50	1	250	5300.00	
86	GAS ANALYZR, CO2	REMFG	2	75	10	1	85	75	10	1	85	75	10	1	85	2200.00	
89	GAS ANALYZR, GC (COMPLX)	REMFG	3			0	0	850	120	1	970	850	120	1	970	5200.00	
90	GAS ANALYZR, MASS SPEC	REDESIGN	4			0	0	1000	100	1	1100	1000	100	1	1100	7000.00	
91	GAS ANALYZR, MASS SPEC	REMFG	2	800	100	2	1000	800	100	2	1000	800	100	2	1000	10500.00	
93	GAS ANALYZR, RH	REMFG	2	70	10	6	130	70	10	8	150	70	10	8	150	475.00	
125B	METERS, ASSORTED	REMFG	2	150	1	4	154	150	1	4	154	150	1	4	154		
125C	METER AO TS	MINIMAL	0			0	0	3	1	1	4	3	1	1	4	300.00	
126B	MICROPHONE	REPACK	1	0	0	4	0	0	0	5	0	0	0	5	0	100.00	
126C	MICROPHONE AMPLIFIER	REMFG	3	20	2	2	24	20	2	4	28	20	2	4	28		
138	PH METER	REMFG	1			0	0	150	20	1	170	150	20	1	170	600.00	
137	SOUND LEVEL METER	REMFG	1	30	5	1	35	30	5	1	35	30	5	1	35	2500.00	
179A	THERMO COUPLES	MINIMAL	0	1	1	2	3	1	1	3	4	1	1	3	4		
180A	TRACE GAS CONCENTRATR	REDESIGN	2	200	10	1	210	200	10	1	210	200	10	3	230		
TOTAL COST ESTIMATE				1706	347		2053	5109	823		5932	6494	928		7422		

## I.7 EQUIPMENT UNIT 6/7 - MAINTENANCE, REPAIR & FABRICATION UNIT (6), AND ANCILLARY STORAGE UNIT (7)

I.7.1 FUNCTIONAL CAPABILITY. Equipment unit 6 is intended to provide for maintenance, repair, or fabrication of payload equipment. For the short 7- and 30-day missions under consideration for the Sortie Module, the primary function will be one of maintenance, with minor emphasis on repair and fabrication. Equipment unit 7 is ancillary storage space for primarily consumable items. A summary of the pertinent properties of E.U. 6/7 is given in Table I.7-1.

I.7.2 EQUIPMENT ITEMS. Major equipment items in E.U. 6 include a hand cleansing and sterilization device, waste solids compactor, clean-up kit, tool kit, and electronic equipment for the maintenance and calibration of electrophysiological sensors. Equipment unit 7 consists of storage cabinets. The complete equipment list is given in Table 7-2, and equipment volume and placement are shown in Figures I.7-1, -2, and -3.

### I.7.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.7-3.

Consumables - Minor consumables are used in E.U. 6 such as plastic bags, compactor bags, wipes, etc. These weigh a few pounds and present no special problems.

The major consumable in E.U. 6 is water for use in the hand washer (E.I. 49A). Conservatively assuming no water purification and reuse for the 7- and 30-day missions, the fresh water required was estimated to be approximately 10 lb/day or approximately 70 lbs and 300 lbs for the 7- and 30-day missions.

Electric Power - Average electric power required for E.U. 6/7 is quite low and is shown in Tables I.7-1 and I.7-3. The tool sterilizer (E.I. 165) was assumed to require a.c. since it operates on an induction heating principle. The other power required was assumed to be 28 v. d.c. Peak power for the Shared 7-Day Laboratory was estimated to be approximately 400 watts when the hand cleaner (300 w) and several other small power consumers are on. For the dedicated laboratories, peak power may occasionally be as high as approximately 900 watts when the hand cleaner, compactor, and sterilizer are on.

Heat Load - The average on-duty heat loads correspond to the average electrical power consumption and are very low. Probably these heat loads will be dissipated to the cabin air.

Typical Equipment Unit Functional Interfaces - Typical functional interfaces for E.U. 6 are shown in Table I.7-4. E.U. 7 provides the same function (storage) for any of the other equipment units in the payload which require it.

I.7.4 EQUIPMENT ITEM COST SUMMARY - See Tables I.7-5 and I.7-6.

TABLE I.7-1. E.U. 6/7, MAINTENANCE, REPAIR & FABRICATION/ANCILLARY STORAGE  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	1	1	1½
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>744</u> (263)	<u>744</u> (263)	<u>1116</u> (394)
Racks & Consoles	372	744	1116
Distributed & Extra Items	0	0	0
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	94 (207)	156 (343)	331 (728)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>10</u>	<u>27</u>	<u>27</u>
Estimated d.c.	10	14	14
Estimated a.c.	0	13	13
<u>Off-Duty* Average Power, Total</u>	<u>0</u>	<u>0</u>	<u>0</u>
Estimated d.c.	0	0	0
Estimated a.c.	0	0	0
<u>Estimated On-Duty Peak Power</u>	400	900	900
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>10</u>	<u>27</u>	<u>27</u>
Estimated Air Cooled Load	10	27	27
Estimated Cold Plated Load	0	0	0
<u>Off Duty Load, Total</u>	<u>0</u>	<u>0</u>	<u>0</u>
Estimated Air Cooled Load	0	0	0
Estimated Cold Plated Load	0	0	0
<u>Development Cost, \$K</u>	238	303	303
<u>Unit Cost, \$K</u>	54	81	107
*12 Hours			

TABLE I. 7-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 6/7 -  
MAINTENANCE, REPAIR & FABRICATION UNIT (6) AND ANCILLARY STORAGE UNIT (7)

E.I. Name	E.I. No.*	No. of Units Req'd.** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
<u>E. U. 6 - Maintenance, Repair &amp; Fabrication Unit</u>							
Bags, Plastic	16E	60 125 (250)	0.05 (0.1)	0	.03 (0.001)	0 (0)	Gas Permeable, for waste sterilization and storage.
Cleaner, Hand, Sterilizer	49A	1 1 (4)	45 (100)	300	57 (2.0)	50 (5)	Washer for hand cleansing and sterilization. Conceptual design item. Wt. & vol. include water estimated at 10 lb/day. The 4 units required for 30 days is to account for the extra water required only.
Compactor (Solids)	50B	0 1	18 (40)	100	113 (4.0)	14 (2) (0.2) <sup>+</sup>	Waste Compactor. Similar to commercial models.
Electrometer	69A	1 1	8 (17)	46	17 (0.6)	70 (15) (0.6) <sup>+</sup>	For measurement of bioelectric potentials.
Kit, Clean-up	106A	1 1	2.3 (5)	0	5.7 (0.2)	5 (1)	General purpose sponges, wipes, etc.
Kit, Linear Measurement	109	0 1	9 (20)	0	57 (2.0)	0 (0)	Rules, calipers, grids, etc.
Kit, Organism Holding/Management	110B	1 1	9 (20)	0	57 (2.0)	25 (3)	Tools and equipment used during transfer of organisms, cleaning cages, etc. Tongs, harnesses, etc.
Kit, Genl. Tool	113	1 1	9 (20)	50	28 (1.0)	40 (5)	Pliers, screwdriver, cutters, flashlight, scissors, clamps, etc.
Sensors, Assorted	153B	6 12 (16)	0.5 (1)	0	0.3 (0.01)	15 (2)	Experiment specific.
Sterilizer, Tool	165	0 1	0.5 (1)	500	2.8 (0.1)	40 (10) (0.1) <sup>+</sup>	For individual tools. Electric heater device.
Tags, I.D., Organism	168A	1 2	0.05 (0.1)	0	0.03 (0.001)	0 (0)	Identification Tags, package of 16. Experiment specific.
Trash Can	181G	0 1	0.5 (1)	0	28 (1.0)	10 (1)	For inert waste material (paper, plastic, etc.)
Voltmeter, DVM	185	1 1	1 (2)	5	0.3 (0.01)	12 (2) (1) <sup>+</sup>	Digital Voltmeter, General purpose
<u>E. U. 7 - Ancillary Storage Unit</u>							
Chemical Storage Cabinet	45	1 1	9 (20)	0	57 (2.0)	20 (10)	General purpose, cabin temperature, sealed, hold-downs, etc. Conceptual design item.
Storage, Genl.	167B	1 2 (4)	4.5 (10.0)	0	28 (1.0)	1 (1)	For general inert solid material.
Storage, Film	167C	0 1 (2)	23 (50)	0	28 (1.0)	1 (1)	Film Cabinet, lead lined for protection from high energy particles

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

FIGURE I, 7-1 EQUIPMENT VOLUME AND PLACEMENT

Shared 7-Day Laboratory

E.U. 6/7 Maintenance, Repair, and Fabrication Unit and Ancillary Storage Unit

EQUIPMENT ITEMS IN CONSOLE

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
In Bottom of Console:	
16E Plastic Bags	2
45 Chemical Storage	57
49A Hand Cleaner	57
69A Electrometer	17
106A Clean-up Kit	6
110B Organism Holding Kit	57
113 Genl. Tool Kit	28
153B Assorted Sensors	2
167B General Storage	28
168A I.D. Tags	negl.
185 Digital Voltmeter	negl.
<b>Total</b>	<b>254</b>
Excess Volume Allowance	29

DISTRIBUTED OR EXTRA EQUIPMENT ITEMS

(Not in Rack or Console)

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
None	

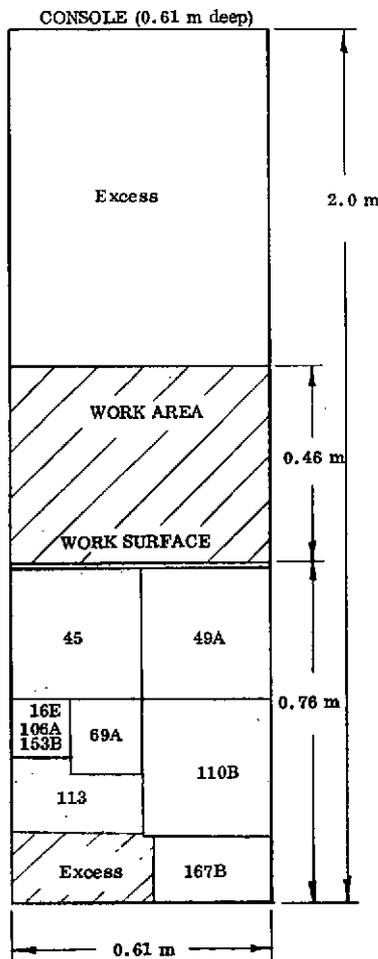


FIGURE I, 7-2 EQUIPMENT VOLUME AND PLACEMENT

Dedicated 7-Day Laboratory

E.U. 6/7 Maintenance, Repair, and Fabrication Unit and Ancillary Storage Unit

EQUIPMENT ITEMS IN CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
<u>In Top of Console:</u>	
45 Chem. Storage	57
106A Clean-up Kit	57
110B Organism Hold. Kit	57
113 Genl. Tool Kit	28
153B Sensors	4
167B General Storage	56
167C Film Storage	28
168A I.D. Tags	negl.
185 Digital Voltmeter	negl.
Total	287

Excess Volume Allowance      negl.

In Bottom of Console:

16E Plastic Bags	4
49A Hand Cleaner	57
50B Waste Compactor	113
69A Electrometer	17
109 Linear Measurement Kit	57
165 Tool Sterilizer	3
181G Trash Can	28
Total	279

Excess Volume Allowance      negl.

DISTRIBUTED OR EXTRA EQUIPMENT ITEMS

(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
None	

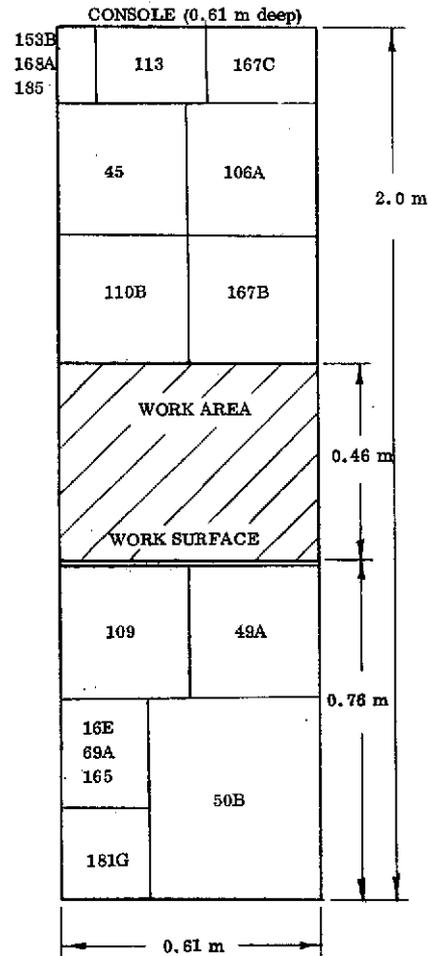


FIGURE I.7-3 EQUIPMENT VOLUME AND PLACEMENT

Extra Equipment for Dedicated 30-Day Laboratory\*

E.U. 6/7 Maintenance, Repair and Fabrication Unit and Ancillary Storage Unit

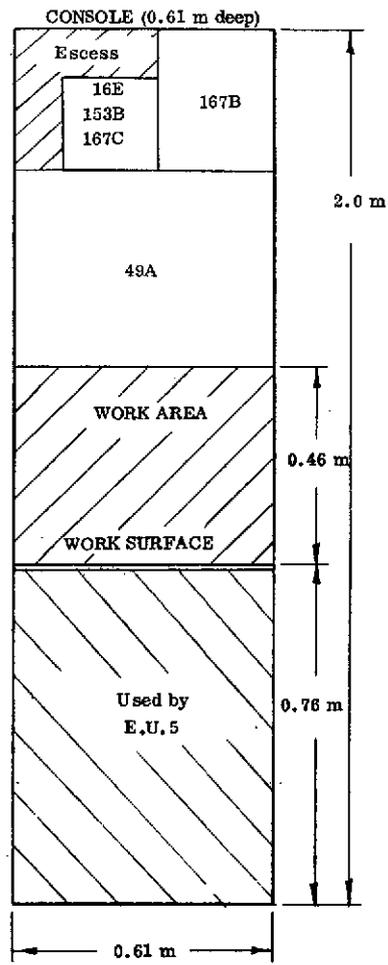
EQUIPMENT ITEMS IN CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
16E Plastic Bags	4
49A Hand Cleaner (water tanks)	171
153B Sensors	2
167B General Storage	56
167C Film Storage	28
Total	261
Excess Volume	
Allowance	29

DISTRIBUTED OR EXTRA EQUIPMENT ITEMS

(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
None	



\*Other equipment required is identical to that in the Dedicated 7-Day Laboratory

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	Included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.7-3B. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 7. ANCILLARY STORAGE UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
45	CHEMICAL STORAGE CABINET	1				1			
	82A Work bench cleanup		3/dy	25.0	0		2/dy	20.0	0
	315A Total body water		1/wk	<u>12.0</u>	<u>0</u>		-	<u>-</u>	<u>0</u>
				37	0		20	0	
167B	STORAGE, GENERAL	2				1			
	43B Digital records	(4)	1/dy	5.0	0	1/dy	5.0	0	
	44B Analog records		1/dy	5.0	0	1/dy	5.0	0	
	83C Workbench sterilization		4/dy	<u>45.0</u>	<u>0</u>	2/dy	<u>35.0</u>	<u>0</u>	
				55	0		45	0	
167C	STORAGE, FILM	1				0			
	63A Radiation monitoring throughout lab	(2)	C	<u>A</u>	<u>0</u>				
				0	0				
	EU TOTAL				0/0 (0/0)				0/0

TABLE I.7-3A. EU 6 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
165	STERILIZER, TOOL 84A Organism subculturing - cell & tissue	1	8/dy	$\frac{19.0}{19}$	$\frac{13.2}{13}$	0			
168A	TAGS, ID, ORGANISM 68A Organism identification film 72A " " video recds.	2	C C	A $\frac{A}{0}$	0 $\frac{0}{0}$	1	C C	A $\frac{A}{0}$	0 $\frac{0}{0}$
181G	TRASH CAN 518A Trash disposal	1	2 min/dy	$\frac{2.0}{2}$	$\frac{0}{0}$	0			
185	VOLTMETER, DIGITAL 511A Elect. continuity & voltage measmts.	1	5 min/dy	$\frac{5.0}{5}$	$\frac{0.2}{0}$	1	5 min/dy	$\frac{5.0}{5}$	$\frac{0.2}{0}$
	EU TOTAL				$\frac{27.0}{(27/0)}$				10/0

TABLE I.7-3A. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 6. MAINTENANCE, REPAIR, AND FABRICATION UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
16E	BAGS - PLASTIC, PERMEABLE 97A Experiment waste management	125 (250)	10 min/dy	$\frac{10.0}{10}$	$\frac{0}{0}$	60	10 min/dy	$\frac{10.0}{10}$	$\frac{0}{0}$
49A	CLEANER, HAND, STERILE 82A Work bench cleanup	1	3/dy	$\frac{25.0}{25}$	$\frac{10.4}{10}$	1	2/dy	$\frac{20.0}{20}$	$\frac{8.3}{8}$
50B	COMPACTOR (SOLIDS) 518A Trash disposal	1	2 min/dy	$\frac{2.0}{2}$	$\frac{0.2}{0}$	0			
69A	ELECTROMETER 511A Elect. continuity and voltage measmts	1	5 min/dy	$\frac{5.0}{5}$	$\frac{0.3}{0}$	1	5 min/dy	$\frac{5.0}{5}$	$\frac{0.3}{0}$
106A	KIT, CLEAN-UP 517A Clean-up, liquid and solid 950A Routine equipment maintenance	1	5 min/dy 10 min/dy	$\frac{5.0}{10.0}$ $\frac{10.0}{15}$	$\frac{0}{0}$	1	5 min/dy -	$\frac{5.0}{-}$ $\frac{-}{5}$	$\frac{0}{-}$ $\frac{-}{0}$
109	KIT, LINEAR MEASUREMENTS 955A Muscle strength and size	1	2/wk	$\frac{7.0}{7}$	$\frac{0}{0}$	0			
110B	KIT, ORGANISM HOLDING/MANAGEMENT 6A Urine management	1	1/wk	$\frac{20.0}{20}$	$\frac{0}{0}$	1	1/wk	$\frac{20.0}{20}$	$\frac{0}{0}$
113	KIT, TOOL, GENERAL 82A Work bench cleanup 83A Work bench sterilization 507A Liquid transfer 950A Routine equipment maintenance	1	3/dy 1/dy 10 min/dy 10 min/dy	$\frac{25.0}{10.0}$ $\frac{10.0}{10.0}$ $\frac{10.0}{10.0}$ $\frac{10.0}{55}$	$\frac{1.7}{0.7}$ $\frac{0.7}{0.7}$ $\frac{0.7}{0.7}$ $\frac{4}{4}$	1	2/dy 1/dy - -	$\frac{20.0}{10.0}$ $\frac{10.0}{-}$ $\frac{-}{-}$ $\frac{30}{30}$	$\frac{1.4}{0.7}$ $\frac{0.7}{-}$ $\frac{-}{-}$ $\frac{2}{2}$
153B	SENSORS, ASSORTED 165B Event monitoring 508A Vacuum supply 515A Supply of coolant	12* (16)				6*			

\*Use is payload and/or experiment specific.

TABLE I.7-4. TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES -  
 E. U. 6 - MAINTENANCE, REPAIR AND FABRICATION UNIT

EU #	DESCRIPTION OF INTERFACE WITH E. U. 6	CRITI- CALITY*
3	Transfer of waste materials to compactor or waste can.	3
4	Biological organism maintenance by the use of the LFB in conjunction with the Organism Holding and Management System.	3
12	Linear measurement of selected anatomical sites in addition to body mass measurements for zero-g adaptation studies in man.	1
40/ 41	Maintenance of vertebrate organisms using the organism holding and management kit, solid waste compactor and clean-up kit.	3
50	Maintenance of plant specimens using the tool sterilizer, plant tool kit and linear measurement kit.	3
70	Determination of invertebrate growth by use of the linear measurement kits within the LFB; procedure also requires anesthesia equipment and microdissection kit.	2

\* 1 = Minimal, 2 = Nominal, 3 = Maximal.

TABLE I.7-5. COST SUMMARY -  
EQUIPMENT UNIT - 6 MAINTENANCE, FABRICATION & REPAIR UNIT

EU 6

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
16E	BAGS PLASTIC PERMEABL	U	U	0	0	60	0	0	0	125	0	0	0	250	0		
49A	CLEANR, HAND, STERIL	REDESIGN	1	50	5	1	55	50	5	1	55	50	5	4	70		
50B	LSPS COMPACTOR SOLIDS	REMFG	1			0	0	14	2	1	61	14	2	1	16	200.00	
69A	ELECTROMETER	REMFG	2	70	15	1	85	70	15	1	85	70	15	1	85	550.00	
106A	KIT, CLEAN UP	REPAIR	1	5	1	1	6	5	1	1	6	5	1	1	6		
109	KIT LINEAR MEAS	MINIMAL	0			0	0	0	0	1	0	0	0	1	0		
110B	KIT ORG HLDG/MGMT	REMFG	2	25	3	1	28	25	3	1	28	25	3	1	28		
113	KIT TOOL GENERAL	REMFG	2	40	5	1	45	40	5	1	45	40	5	1	45		
153B	SENSORS, ASSORTED	REPAIR	2	15	2	6	27	15	2	12	39	15	2	16	47		
165	STERILIZOR, TOOL	REPAIR	1			0	0	40	10	1	50	40	10	1	50	45.00	
168A	TAGS ID ORGANISM	MINIMAL	0	0	0	1	0	0	0	2	0	0	0	2	0		
181G	TRASH CAN	REMFG	1			0	0	10	1	1	11	10	1	1	11		
185	VOLT MTR (DWM)	REMFG	1	12	2	1	14	12	2	1	14	12	2	1	14	1000.00	
	TOTAL COST ESTIMATE			217	43		260	281	68		349	281	91		372		

TABLE I.7-6. COST SUMMARY -  
EQUIPMENT UNIT - 7 ANCILLARY STORAGE UNIT  
EU 7

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
45	CHEM STOR CABINET	MINIMAL	1	20	10	1	30	20	10	1	30	20	10	1	30		
167B	STORAGE, GENL	MINIMAL	1	1	1	1	2	1	1	2	3	1	1	4	5		
167C	STORAGE, FILM	MINIMAL	1			0	0	1	1	1	2	1	1	2	3		
	ESTIMATED TOTAL COST			21	11		32	22	13		35	22	16		38		

101-1

## I.8 EQUIPMENT UNIT 11 - AIRLOCK & EVA CAPABILITY

I.8.1 FUNCTIONAL CAPABILITY & SUMMARY DATA. This equipment unit includes the major items required for EVA activities in support of life sciences testing. By NASA direction, EVA test activities will not be performed aboard the shared laboratory. Therefore, EVA equipment is needed only aboard the dedicated laboratories. The summary of pertinent properties for this E.U. are given in Table I.8-1.

I.8.2 EQUIPMENT ITEMS. This equipment unit includes an air lock, teleoperator control console, and pressure suits, Table 8-2. The Shuttle Orbiter airlock will be used for EVA. The Sortie Module has no provisions for a pressure suit ventilation circuit. Thus, portable life support systems (PLSS) backpacks will be used during suited tests. These are included in E.U. 80, Life Support Subsystem Test Unit.

A rack is provided for the storage of the four pressure suits in this equipment unit, Figure I.8-1.

### I.8.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.8-3.

Data Requirements - See Table I.8-4.

EVA Operations (On-Orbit) - Crew EVA experiment operations will be conducted in complete conformance with the general EVA procedures for the use of the Shuttle airlock. It is anticipated that two crewmen at a time will participate in EVA activities.

### I.8.4 EQUIPMENT ITEM COST SUMMARY - See Table I.8-5.

TABLE I.8-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 11 -  
AIRLOCK EVA CAPABILITY

E.I. Name	E.I. No.*	No. of Units Req'd,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume <sup>3</sup> dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
Air Lock	3B	0 1	-	-	-	-	Part of spacecraft structure.
Teleoperator Control Console	119A	0 1	91 (200)	40	283 (10.0)	1000 (50)	For MSI tests on astronauts' ability to do EVA tasks remotely from inside spacecraft. Control panel with switches, levers, viewing screens and windows, etc.
Spacesuit	172	0 4	36 (80)	1	198 (7.0)	0 (2)	For use in conjunction with MSI performance tests.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

TABLE I.8-1. E.U. 11, AIR LOCK & EVA CAPABILITY -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	0	1	1
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>0</u>	<u>744(263)</u>	<u>744(263)</u>
Racks & Consoles		744	744
Distributed & Extra Items		283	283
Small Storage Items (Misc.)		0	0
<u>Fixed Weight, kg (lb)</u>	0	235 (517)	235 (517)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>0</u>	<u>0</u>	<u>0</u>
Estimated d.c.			
Estimated a.c.			
<u>Off-Duty* Average Power, Total</u>	<u>0</u>	<u>0</u>	<u>0</u>
Estimated d.c.			
Estimated a.c.			
<u>Estimated On-Duty Peak Power</u>	<u>0</u>	<u>40</u>	<u>40</u>
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>0</u>	<u>0</u>	<u>0</u>
Estimated Air Cooled Load			
Estimated Cold Plated Load			
<u>Off Duty Load, Total</u>	<u>0</u>	<u>0</u>	<u>0</u>
Estimated Air Cooled Load			
Estimated Cold Plated Load			
<u>Development Cost, \$K</u>	0	1000	1000
<u>Unit Cost, \$K</u>	0	58	58
*12 Hours			

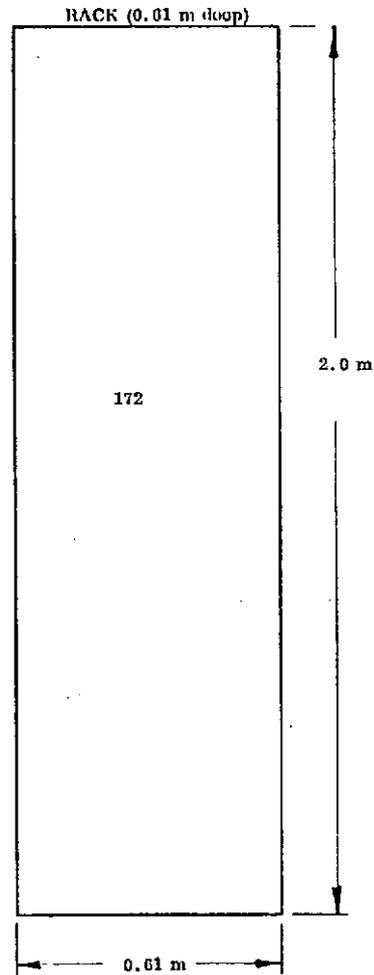
FIGURE I.8-1 EQUIPMENT VOLUME AND PLACEMENT

Dedicated 7 and 30 Day Laboratories

E,U,11 Airlock/EVA Capability

EQUIPMENT ITEMS IN RACK

<u>E.I. Number &amp; Name</u>		<u>Vol.</u>
		<u>dm<sup>3</sup></u>
172	Pressure Suits	792
	Total	792
	Excess Volume Allowance	None



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

<u>E.I. Number &amp; Name</u>		<u>Vol.</u>
		<u>dm<sup>3</sup></u>
3B	Airlock - part of spacecraft structure	
119A	Teleoperator Control Console	283
	Total	283

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.6-3. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 11. AIRLOCK/EVA CAPABILITY UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
3B	AIRLOCK, EVA 523A Ingress/egress (laboratory-EVA)	1				0			
119A	TELEOPERATOR CONSOLE 846A Remote manipulation	1	30 min/wk	$\frac{6.0}{6}$	$\frac{0.3}{0}$	0			
172	SPACESUIT + 50 FT UMBILICAL 840B Max. mass transportable 841B Max. volume transportable 842B Max. transportable MOI about handle 843B Max. mass alignable 844B Max. volume alignable 845B Max. alignable MOI about handle	4	5 min/wk " " " "	1.0 1.0 1.0 1.0 1.0	0 0 0 0 0	0			
	EU TOTAL			$\frac{6}{6}$	$\frac{0}{0}$ (0/0)				0/0

TABLE I.8-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E. U. 11 - AIRLOCK & EVA CAPABILITY

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Airlock (11/3B)</u>										
Pressure Sensor Monitor	0-15 psia	0.2 psia	Anal.	1	7	cont.	6/min	1	60K	
Temperature Sensor	20-30°C	0.2°C	Anal.	1	6	cont.	6/min.	1	52K	
<u>Teleoperator Control Console (11/119A)</u>										
On-Off Control	2 level	1 level	Disc.	1	1	cont.	6/min	1	60K	
Numeric Keyboard	0-10,000	1	Dig.	1	14	6	1/sec	14	5K	
									177K	TOTAL

TABLE I.8-5. COST SUMMARY -  
EQUIPMENT UNIT-011 AIRLOCK/EVA CAPABILITY UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
3B	AIRLOCK, EVA	-	-			0		-	-	1		-	-	1		SORTIE SYSTEM	
119A	TELEOPERATOR CONTROL CONSOLE	REDESIGN	3			0		1000	50	1	1050	1000	50	1			
172	SPASUIT + SOFT UMBILICAL	MINIMAL	1			0		0	2	4	8	0	2	4			
TOTAL COST ESTIMATE						0	0	1000	58		1058	1000	58		1058		

I.9 EQUIPMENT UNIT 12/31 - BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT (12), AND BIOMEDICAL RESEARCH SUPPORT UNIT (31)

I.9.1 FUNCTIONAL CAPABILITY & SUMMARY DATA. These equipment units contain equipment intended to provide the functions necessary for M.S.I. and biomedical research. Equipment unit 31 contains equipment necessary for biomedical research but not needed for M.S.I. research. Equipment unit 12 contains equipment necessary for both M.S.I. and biomedical research. In this way, if only M.S.I. research is to be performed aboard a payload, E.U. 12 is selected for inclusion in the payload complement of equipment. However, if biomedical research is to be done, both E.U. 12 and E.U. 31 are required.

The summary of pertinent properties of E.U. 12/31 are presented in Table I.9-1.

I.9.2 EQUIPMENT ITEMS. Major equipment items in E.U. 12/31 are the body mass measurement device, experimenter's control console, electrophysiology display, rotating litter chair, and bicycle ergometer. The complete list is shown in Table I.9-2, and the volume and placement of the equipment items are shown in Figures I.9-1 and I.9-2.

I.9.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.9-3.

Data Requirements - See Table I.9-4.

Launch and Re-entry Operations - These equipment units support tests requiring man as a subject. Thus, it is anticipated that the equipment in these equipment units will not be operating during ascent or descent. Also, no particular launch or recovery problems are foreseen.

Electrical Power - Average power values for each laboratory were obtained from Table I.9-3 and are summarized in Table I.9-1. Peak power for E.U. 12/31 was estimated as follows:

Potential Simultaneously Operating High Power Consumers

E.I. # & Name	Peak Power Contribution, w		
	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
Average On-Duty Power	26	56	56
51D Control Console	0	96	96
153A Litter Chair	<u>163</u>	<u>141</u>	<u>141</u>
TOTALS	189	291	291
Approx. Peak Power Assumed	200	300	300

In the table, the power contribution shown for the individual equipment item was reduced by the amount of its contribution to the average power for each laboratory.

In estimating the amount of a.c. and d.c., it was found that the current IMBLMS rotating litter chair was the only item specifically requiring a.c. The rest of the power consumers shown in Table I.9-3 appear to be compatible with the use of d.c. power.

Heat Rejection - E.U. 12/31 heat rejection corresponds to the electrical power consumption. The average quantities are small and were all assumed to be rejected to the cabin air. The largest single power consumer is the rotating litter chair. Reviewing the IMBLMS descriptions of this item, it is apparently naturally air-cooled. All other equipment items do not reject enough heat to warrant cold plating (unless done collectively in cold plated cabinets).

Typical Equipment Unit Functional Interfaces - See Table I.9-5.

I.9.4 EQUIPMENT ITEM COST SUMMARY - See Tables I.9-6 & I.9-7.

TABLE I.9-1. E.U. 12/31, BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT/ BIOMEDICAL RESEARCH SUPPORT UNIT - SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	1	1½	1½
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>5132 (181)</u>	<u>5504 (194)</u>	<u>5504 (194)</u>
Racks & Consoles	744	1116	1116
Distributed & Extra Items	4388	4388	4388
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	<u>326 (717)</u>	<u>383 (843)</u>	<u>383 (843)</u>
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>26</u>	<u>56</u>	<u>56</u>
Estimated d.c.	9	17	17
Estimated a.c.	17	39	39
<u>Off-Duty* Average Power, Total</u>	<u>6</u>	<u>6</u>	<u>6</u>
Estimated d.c.	6	6	6
Estimated a.c.	0	0	0
<u>Estimated On-Duty Peak Power</u>	<u>200</u>	<u>300</u>	<u>300</u>
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>26</u>	<u>56</u>	<u>56</u>
Estimated Air Cooled Load	26	56	56
Estimated Cold Plated Load	0	0	0
<u>Off Duty Load, Total</u>	<u>6</u>	<u>6</u>	<u>6</u>
Estimated Air Cooled Load	6	6	6
Estimated Cold Plated Load	0	0	0
<u>Development Cost, \$K</u>	<u>577</u>	<u>794</u>	<u>794</u>
<u>Unit Cost, \$K</u>	<u>373</u>	<u>446</u>	<u>446</u>
*12 Hours			

TABLE I.9-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 12/31,  
BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT (12), BIOMEDICAL RESEARCH SUPPORT UNIT (31)

E.I. Name	E.I. No.*	No. of Units Req'd,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
<u>E. U. 12 - Biomedical/Behavioral Research Support Unit</u>							
Custom Bite Boards	18D	3 3	0.2 (0.5)	0	0.03 (0.001)	1 (1)	Stainless steel bite boards with cast materials of each subject's dental impressions to precisely and comfortably position the head.
Body Mass Measurement	19D	1 1	11.4 (25)	2	793 (28)	20 (20)	Mass Measurement Device, for human subjects. Envelope volume shown when in use. Skylab equipment
Control Console, Experimenter	51D	0 1	45 (100)	100	170 (6.0)	150 (50)	For biomedical and MSI experiments. Allows real-time on-board control of experimental stimuli.
Electrophysiology Backpack	65B	1 1	2.3 (5)	0	5.7 (0.2)	100 (25) (0.8) <sup>+</sup>	Signal Transmitter, for use on human subjects. For ECG, EOG, EEG, etc.
Electrophysiology Receiver	65C	1 1	4.5 (10)	5	14 (0.5)	100 (25) (3.3) <sup>+</sup>	For receiving and discriminating signals transmitted from E.I. 65B.
Electrophysiology Display	65D	1 1	18 (40)	20	28 (1.0)	100 (25) (2.2) <sup>+</sup>	Portable, to be used in conjunction with E.I. 65B and E.I. 65C.
Non-Visual Direction Indicator	131E	0 1	4 (9)	0	2.8 (0.1)	2 (2)	Pointer and display device to test human subjects' non-visual orientation capability. Skylab device.
Otolith Test Goggles	133	1 1	0.5 (1)	0	2.8 (0.1)	20 (20)	Goggles with special built-in optics and visual images.
Psychogalvanometer, GSR	144B	1 2	0.5 (1)	1	.3 (0.01)	1 (1)	For measuring galvanic skin response. Coupler. May be incorporated in E.I. 65B.
Recorder, Voice	153	0 1	4.5 (10)	0	2.8 (0.1)	35 (5)	General purpose, portable.
Rotating Litter Chair	153A	1 1	120 (265)	180	2830 (100.0)	20 (100)	Articulated rotatable chair for tests on man. Volume shown is approximate envelope volume when in use. Skylab equipment.
<u>E. U. 31 - Biomedical Research Support Unit</u>							
Coupler, Ballisto-Cardiogram	16F	0 1	0.1 (0.2)	1	1.0 (0.036)	5 (1)	See E.I. 156 definition sheet, E.U. 2.
Bicycle Ergometer	18C	1 1	45 (100)	48	765 (27.0)	5 (5)	Developed for Skylab. Volume shown is envelope required when in use.
Camera, Iris, 35 mm	36	1 1	0.7 (1.5)	0	5.7 (0.2)	20 (20)	Special camera for human iris photography during tests on human eye movement.
Flowmeter, Doppler	76K	2 2	0.5 (1.0)	1	0.3 (0.01)	5 (1)	Blood Flowmeter. Doppler type for measurement of pulse velocity and contour in conjunction with ECG. FPE specific.
Coupler, Impedance Cardiogram	104E	0 2	0.2 (0.5)	1	0.3 (0.01)	5 (1)	Definition sheet for E.I. 156, E.U. 2 applies.
Impedance Pneumograph	104F	0 1	0.2 (0.5)	1	2.8 (0.1)	10 (2)	To measure breathing cycle characteristics as well as variations in thoracic conduction during respiration.
Kit, Physiology	110C	1 1	6.8 (15)	0	57 (2)	100 (10)	Sponges, sponge squeezer, vials, caloric stimulator for ear canal, questionnaires, syringes, thermometer, tonometer, etc.
Kit, Medical-Surgical	112	1 1	9 (20)	0	28 (1.0)	40 (5)	For various minor surgical procedures. Forceps, knife holder, scissors, retractors, plastic bags, etc.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

TABLE I.9-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 12/31, (cont'd)  
 BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT (12), BIOMEDICAL RESEARCH SUPPORT UNIT (31)

E.I. Name	E.I. No.*	No. of Units Req'd.,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
Metabolic Analyzer	125D	1 1	100 (220)	30	300 (10.6)	20 (100)	Measures respiratory parameters, such as air way resistance, lung compliance, gas concentration, etc. Item developed for Skylab.
Plethysmograph, Limb	139	0 1	2.3 (5)	5	5.7 (0.2)	10 (10)	For limb peripheral measurement. Includes coupler.
Coupler, Phono/ Vibrocardiogram	140	1 1	0.2 (0.4)	1	0.3 (0.01)	5 (1)	E.I. 156, E.U. 2 definition sheet applies.
Transducer, Plethysmograph	181B	6 6	0.5 (1)	1	0.3 (0.01)	35 (5)	Part of E.I. 139.
Coupler, Vectocardiogram	182J	1 1	0.05 (0.1)	1	1.0 (0.036)	5 (1)	Coupler. See E.I. 156, E.U. 2 definition sheet.
Vomitus Bags & Holders	186A	4 4	0.5 (1)	0	0.7 (0.025)	0 (0)	Emergency bags for human test subjects.

\* E.I. No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

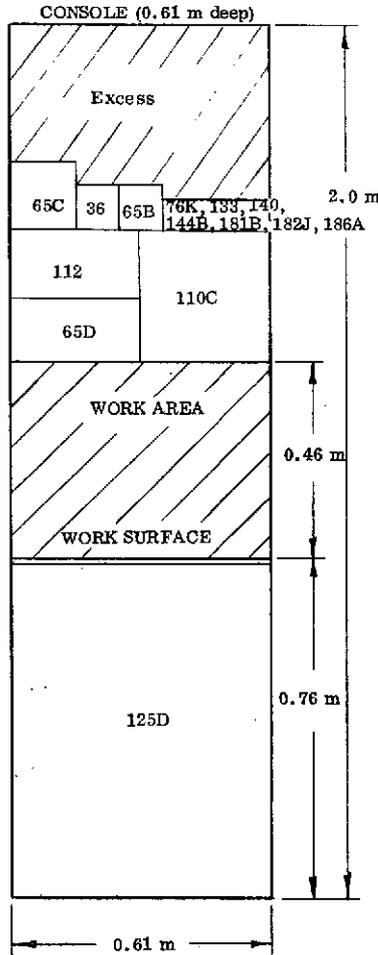
FIGURE I. 9-1 EQUIPMENT VOLUME AND PLACEMENT

Shared 7-Day Laboratory

E.U. 12/31 Biomedical/Behavioral Research Support Unit and  
Biomedical Research Support Unit

EQUIPMENT ITEMS IN CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
<u>In Top of Console:</u>	
18D Custom Bite Boards	negl.
36 Iris Camera	5.7
65B Electrophysiological Backpack	5.7
65C Electrophysiological Receiver	14
65D Electrophysiological Display	28
76K Blood Flowmeter	0.6
110C Physiology Kit	57
112 Medical/Surgical Kit	28
133 Otolith Test Goggles	2.8
140 Coupler, Vibrocardiogram	0.3
144B Psychogalvanometer	0.3
181B Plethysmograph Transducer	1.8
182J Coupler, Vectocard.	1.0
186A Vomitus Bags	2.8
<b>Total</b>	<b>148.0</b>
Excess Volume	
Allowance	142
<u>In Bottom Console:</u>	
125C Metabolic Analyzer	300
<b>Total</b>	<b>300</b>
Excess Volume	
Allowance	None



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
18C Bicycle Ergometer (envelope volume when in use)	765
190 Body Mass Meas. Device (envelope volume when in use)	793
153A Rotating Litter Chair (envelope volume when in use)	2830
<b>Total</b>	<b>4388</b>

FIGURE I.9-2 EQUIPMENT VOLUME AND PLACEMENT

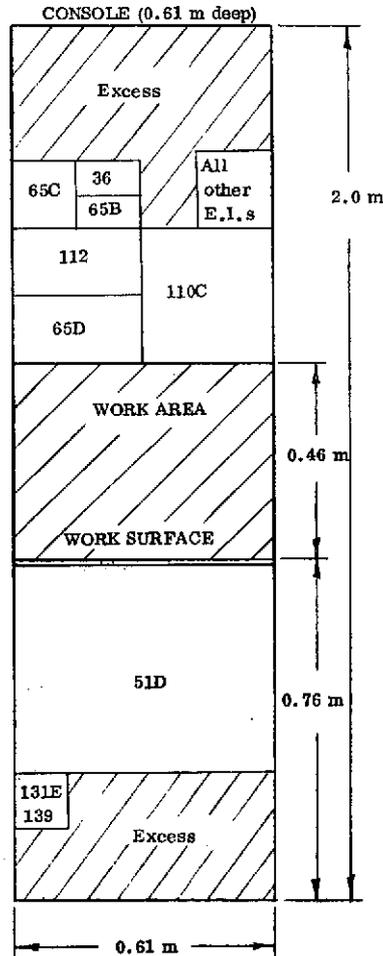
Dedicated Laboratories

E.U. 12/31 Biomedical/Behavioral Research Support Unit and  
Biomedical Research Support Unit

EQUIPMENT ITEMS IN CONSOLE

E.I. Number & Name	Vol. dm <sup>3</sup>
<u>In Top of Console:</u>	
16F Coupler, Ballistocard.	1
18D Custom Bite Boards	negl.
36 Iris Camera	5.7
65B Electrophys. Backpack	5.7
65C Electrophys. Receiver	14
65D Electrophys. Display	28
76K Blood Flowmeter	0.6
104E Couplers, Cardiogram	0.6
104F Pneumograph	2.8
110C Physiology Kit	57
112 Medical/Surgical Kit	28
133 Otolith Goggles	2.8
140 Coupler Vibrocardiogram	0.3
144B Psychogalvanometer	0.6
153 Voice Recorder	2.8
181B Plethysmograph Transducer	1.8
182J Coupler, Vectocardiogram	1.0
186A Vomitus Bags	2.8
<b>Total</b>	<b>155.5</b>
Excess Volume Allowance	134
<u>In Bottom of Console:</u>	
51D Control Console	170
131E Direction Indicator	3
139 Plethysmograph	6
<b>Total</b>	<b>179</b>
Excess Volume Allowance	104

Note: Entire bottom of E.U. 91/93 console is used to house E.I. 125D Metabolic Analyzer 300 dm<sup>3</sup>



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

E.I. Number & Name	Vol. dm <sup>3</sup>
18C Bicycle Ergometer (envelope volume when in use)	765
19D Body Mass Measurement Device (envelope volume when in use)	793
153A Rotating Litter Chair (envelope volume when in use)	2830
<b>Total</b>	<b>4388</b>

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.9-3A. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 12. BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
16F	COUPLER BALLISTOCARDIOGRAM 326B Ballistocardiography (BCG)	1	15 min/wk	$\frac{3.0}{3}$	$\frac{0.1}{0}$	0			
18C	BICYCLE ERGOMETER 310A Bicycle ergometry 310B " "	1	2/3 dy -	37.0 -	2.6 -	1	2/wk	- 22.0 22	- 1.6 2
76K	FLOWMETER, DOPPLER 324A Pulse wave velocity 325A Pulse wave contour 327A Respiratory vital capacity, etc. 415A Lung volumes	2	1/wk 1/wk 2/wk 2/wk	9.0 9.0 10.0 $\frac{3.0}{31}$	0.1 0.1 0.1 0	2	- - 1/wk -	- - 6.0 6	- - 0.1 0
104E	COUPLER IMPEDANCE CARDIOGRAM 321B Impedance cardiography (ZCG)	2	15 min/3 dy	$\frac{5.0}{5}$	$\frac{0.1}{0}$	0			
104F	IMPEDANCE PNEUMOGRAPH 414B Impedance pneumogram for man	1	2/wk	$\frac{6.0}{6}$	$\frac{0.1}{0}$	0			
110C	KIT, PHYSIOLOGY 31C Biosampling - obtaining blood 302A Sweat sample collection 303A Sweat preservation and storage 306A Ear canal caloric stimulation 307A Spatial localization 315A Total body water 335A Erythrocyte survival 347A Intraocular pressures 354A Ear canal temperature 355A Muscle strength and size 356B Subject instrumentation and cleanup 358B Biomedical equipment cleanup/disposal	1	2/3 dy 3/wk 3/wk 2/wk 2/wk 1/wk 1/wk 1/wk 2/wk 2/wk 20 min/dy 10 min/dy	5.0 2.8 1.8 16.0 21.0 12.0 12.0 3.0 2.0 7.0 20.0 10.0 112	0 0 0 0 0 0 0 0 0 0 0 0 0	1	- - - 1/wk - - - - 1/wk 1/wk - 10 min/dy -	- - - 12.0 - - - - 1.0 4.0 10.0 10.0 27	- - - 0 - - - - 0 0 0 0 0 0

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TABLE I.9-3A. EU 12 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
112	KIT, MEDICAL SURGICAL	1				1			
	164A Peripheral venous blood pressure		2/wk	6.0	0		-	-	-
	187A Anesthesiology - vertebrates		2/wk	8.0	0		1/wk	4.0	0
	405A Blood plasma volume		2/wk	10.0	0		-	-	-
	425A Blood rheology/ERG		2/wk	<u>21.0</u>	<u>0</u>		-	-	-
				45	0			4	0
125D	METABOLIC ANALYZER FIXED	1				1			
	309A Routine metabolic gas monitoring		2/3 dy	16.7	0.7		-	-	-
	310A Bicycle ergometry		2/3 dy	57.7	2.4		-	-	-
	330A Respiratory dead space, etc.		2/wk	<u>3.0</u>	<u>0.1</u>		1/wk	<u>2.0</u>	<u>0.1</u>
				77	3			2	0
139	PLETHYSMOGRAPH, LIMB	1				0			
	365A Venous compliance		3/wk	<u>4.0</u>	<u>0.1</u>				
				4	0				
140	COUPLER PHONO/VIBROCARDIOGRAM	1				1			
	320B Phono/vibrocardiography		15 min/3 dy	<u>5.0</u>	<u>0.1</u>		10 min/3 dy	<u>3.3</u>	<u>0.1</u>
				5	0			3	0
181B	TRANSDUCER - PLYTHESMGPH.	6				6			
	49B Pressure monitoring		C	<u>A</u>	<u>6</u>		C	<u>A</u>	<u>6</u>
				0	6			0	6
182J	COUPLER, VECTORCARDIOGRAM	1				1			
	319B Vectorcardiography		15 min/3 dy	<u>5.0</u>	<u>0.1</u>		10 min/3 dy	<u>3.3</u>	<u>0.1</u>
				5	0			3	0
186A	VOMITUS BAGS AND HOLDERS	4				4			
	300A Vomitus collection		0	<u>0</u>	<u>0</u>		0	<u>0</u>	<u>0</u>
				0	0			0	0
	EU TOTAL				12/6 (12/6)				8/6

TABLE 1.9-3B. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 31. BIOMEDICAL RESEARCH SUPPORT UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
18D	CUSTOM BITE BOARDS	3				3			
	307A Spatial localization		2/wk	21.0	0		-	-	-
	317A Ocular counter-rolling		2/wk	24.0	0		1/wk	12.0	0
	318A Oculogyral illusion		2/wk	4.0	0		1/wk	2.0	0
	345A Angular acceleration threshold		2/wk	15.0	0		1/wk	9.0	0
				64	0			23	0
19D	BODY MASS MEASUREMENT (BMMD)	1				1			
	343A Body mass measurement		2/dy	4.0	0.1		2/dy	4.0	0.1
				4	0			4	0
51D	CONTROL CONSOLE, EXPERIMENTER'S	1				0			
	700A Visual - acuity, static - near and far		2/3 dy	1.3	0.2				
	702A " - stereopsis (depth perception)		"	"	"				
	704A " - brightness threshold		"	"	"				
	706A " - color perception		"	0.7	0.1				
	707A " - critical flicker fusion frequency		"	1.3	0.2				
	708A " - phorias, lateral and vertical		"	"	"				
	709A " - glare recovery (photo stress)		"	"	"				
	710A " - dark adaptation		"	13.3	"				
	713A " - peripheral field		"	2.0	0.3				
	715A Auditory - absolute threshold		"	1.3	0.2				
	716A " - pitch discrimination		"	1.7	0.2				
	717A " - temporal acuity		"	1.7	0.2				
	730A Cognitive/complex perceptual-speech intell.		"	3.3	0.5				
	760A Fine psychomotor-manipulative ability		"	3.3	0.5				
	768A Fine psychomotor - gross positioning		"	1.6	0.2				
	770A " " - reaction time, simpl		"	1.0	0.1				
	771A " " - " " , cmplx		"	0.6	0.1				
				38	4				
65B	ELECTROPHYSIOLOGY BACKPACK	1				1			
	17F Monitor ECG		30 min/wk	6.0	0		15 min/wk	3.0	0
	18F Monitor EEG		5 min/3 dy	1.7	0		-	-	-
	19F Monitor EMG		5 min/wk	1.0	0		-	-	-
	308B Electro-oculogram (EOG)		10 min/dy	10.0	0		5 min/dy	5.0	0
	310A Bicycle ergometry		2/3 dy	57.7	0		-	-	-
	318A Oculogyral illusion		2/wk	4.0	0		1/wk	2.0	0
	319B Vectorcardiogram (VCG)		15 min/3 dy	5.0	0		10 min/3 dy	3.3	0
	320B Phono/vibrocardiogram		"	5.0	0		"	3.3	0

TABLE I.9-3B. EU 31 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
65B	(CONT)								
	321B Impedance cardiography (ZCG)		15 min/3 dy	5.0	0		-	-	-
	324A Pulse wave velocity		1/wk	9.0	0		-	-	-
	325A Pulse wave contour		1/wk	9.0	0		-	-	-
	326B Ballistocardiography (BCG)		15 min/wk	3.0	0		-	-	-
	344B Electronystagmogram (ENG)		30 min/3 dy	10.0	0		20 min/3 dy	6.7	0
	345A Angular acceleration threshold		2/wk	15.0	0		1/wk	9.0	0
	414B Impedance pneumogram for man		"	6.0	0		-	-	-
	422A Coriolis sickness susceptibility		"	30.0	0		1/wk	18.0	0
				177	0			50	0
65C	ELECTROPHYSIOLOGY RECEIVER	1				1			
	17F Monitor ECG		30 min/wk	6.0	0.1		15 min/wk	3.0	0.1
	18F Monitor EEG		5 min/3 dy	1.7	0.1		-	-	-
	19F Monitor EMG		5 min/wk	1.0	0.1		-	-	-
	308B Electro-oculogram (EOG)		10 min/dy	10.0	0.1		5 min/dy	5.0	0.1
	310B Bicycle ergometry		-	-	-		2/wk	34.6	0.2
	319B Vectorcardiogram (VCG)		15 min/3 dy	5.0	0.1		10 min/3 dy	3.3	0.1
	320B Phono/vibrocardiogram		"	5.0	0.1		"	3.3	0.1
	321B Impedance cardiography (ZCG)		"	5.0	0.1		-	-	-
	326B Ballistocardiography (BCG)		15 min/wk	3.0	0.1		-	-	-
	344B Electronystagmogram (ENG)		30 min/3 dy	10.0	0.1		20 min/3 dy	6.7	0.1
	414B Impedance pneumogram for man		2/wk	6.0	0.1		-	-	-
				53	0			56	0
65D	ELECTROPHYSIOLOGY DISPLAY	1				1			
	17F Monitor ECG		30 min/wk	6.0	0.2		15 min/wk	3.0	0.1
	18F Monitor EEG		5 min/3 dy	1.7	0.1		-	-	-
	19F Monitor EMG		5 min/wk	1.0	0.1		-	-	-
	308B Electro-oculogram (EOG)		10 min/dy	10.0	0.3		5 min/dy	5.0	0.1
	319B Vectorcardiogram (VCG)		15 min/3 dy	5.0	0.1		10 min/3 dy	3.3	0.1
	320B Phono/vibrocardiogram		"	5.0	0.1		"	3.3	0.1
	321B Impedance cardiography (ZCG)		"	5.0	0.1		"	3.3	0.1
	326B Ballistocardiography (BCG)		15 min/wk	3.0	0.1		-	-	-
	344B Electronystagmogram (ENG)		30 min/3 dy	10.0	0.3		20 min/3 dy	6.7	0.2
				47	1			25	1
131E	NON-VISUAL DIRECTION INDICATOR	1				0			
	307A Spatial localization		2/wk	21.0	0				
				21	0				



TABLE I.9-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS  
 E.U. 12/31 - BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT AND BIOMEDICAL RESEARCH SUPPORT UNIT

EQUIPMENT ITEMS (E.U.#/E.I.#) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Body Mass Measurement Device (12/19D)</u>										
Oscillation Output	0-5 V	25 mV	Anal.	1	8	4	100/sec	800	192K	
Oscillation Calibration	6 levels	1 level	Dig.	1	3	4	1/min	negl.	negl.	
Power On/Off	2 positions	1 position	Disc.	1	1	cont.	6/min	negl.	9K	
<u>Control Console (12/51D)</u>										
										This console used by experimenter to control stimuli presented to the subject at the crew station console. Hardware interconnection are anticipated.
<u>Electrophysiological Review (12/65C)</u>										
Typical Signal Output	0-5 V	50 mV	Anal.	4	7	177	500/sec	14K	148.7M	
<u>Otolith Test Goggles (12/133)</u>										
Image Command Signal	1-10	1	Dig.	1	4	40	1/sec	4	96K	
<u>Rotating Litter Chair (12/153A)</u>										
Monitor Motor Current	0-10 amp	0.1 amp	Anal.	1	7	188	320/sec	2.24K	25.3M	
Monitor Motor Speed	0-20 rpm	0.1 rpm	Anal.	1	7	188	40/sec	280	3.2M	
Accelerometer Readout	0-.2 g	0.01 g	Anal.	6	5	188	1/sec	30	338K	
Head Motion Acknowledgement	0-180 deg	1 deg	Anal.	1	8	188	1/sec	8	90K	
Cadance Signal Acknowledgement	2 level	1 level	Disc.	1	1	188	1/sec	1	11K	
+Converter Voltage	0-5 V	50 mV	Anal.	1	7	188	1/sec	7	79K	
-Converter Voltage	0-5 V	50 mV	Anal.	1	7	188	1/sec	7	79K	
Experiment State	2 positions	1 position	Disc.	1	1	188	10/sec	10	113K	
"Question Subject" Lamp On/Off	2 positions	1 position	Disc.	1	1	188	10/sec	10	113K	
Experiment ID	1-16	1	Dig.	1	4	188	10/sec	40	451K	
Subject ID	1-4	1	Dig.	1	2	188	10/sec	20	226K	
OGI Response Matrix	1-4	1	Dig.	1	2	188	10/sec	20	226K	
MS Response Matrix	1-16	1	Dig.	1	4	188	10/sec	40	451K	
RPM Range	12 levels	1 level	Disc.	1	4	188	10/sec	40	451K	
On-Off Control	2 positions	1 position	Disc.	1	1	cont.	1/sec	1	86K	

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Rotating litter chair signals and sampling rates were taken from Reference Earth Orbital Research and Applications Investigations (Blue Book), Vol. VIII, Life Sciences, NASA Report NHB 7150.1 January 15, 1971.

TABLE I.9-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS (Cont'd)

E. U. 12/31 - BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT AND BIOMEDICAL RESEARCH SUPPORT UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Bicycle Ergometer (31/18C)</u>										
Respiration Rate (Flowmeter)	5 V	50 mV	Analog	1	7	58	1/sec	7	24K	
Flowmeter Calibration	6 levels	1 level	Digital	1	3	58	1/min	negl.	negl.	
Heart Rate	5 V	50 mV	Analog	1	7	58	1/sec	7	24K	
Body Temperature	98.3±3°F	.1°F	Analog	1	6	58	5/min	1	2K	
Blood Pressure	60-20mm Hg	2 mm Hg	Analog	1	7	58	1/min	negl.	negl.	
Ergometer Output	50-300 watts	2 watts	Analog	1	7	58	1/sec	7	24K	
Ergometer Speed Monitor	40-90 rpm	1 rpm	Analog	1	6	58	1/sec	6	21K	
Ergometer Motor Control	12 levels	1 level	Digital	1	4	58	5/min	negl.	1K	
On/Off Control	2 levels	1 level	Disc.	1	1	cont.	1/sec	1	86K	
<u>Blood Flowmeter (31/76K)</u>										
Pulse Signal	0-5 V	50 mV	Anal.	1	7	31	50/sec	350	651K	
<u>Couplers (31/16F, 104E, 140, &amp; 182J)</u>										
Typical Output Signal	0-5 V	50 mV	Anal.	7	7	18	500/sec	3500	3.78M	
<u>Metabolic Analyzer (31/125D)</u>										
Data obtained will be entered manually into DMS.										
<u>Plethysmograph, Limb (31/139)</u>										
Pressure Pulse	0-5 V	50 mV	Anal.	1	7	49	50/sec	350	1.03M	
									185.879M	TOTAL

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TABLE I. 9-5 TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES  
EQUIPMENT UNIT 12/31 - BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT AND  
BIOMEDICAL RESEARCH SUPPORT UNIT

EU #	DESCRIPTION OF FUNCTIONAL INTERFACE WITH E.U. 12/31	CRITI- CALITY <sup>1</sup>
1	Video recording and monitoring devices such as electrophysiological display, bicycle ergometer, etc. Use of cameras to record experiment phenomena.	3
2	Processing biotransducer signals (accelerometer, plyphesmograph) acquired from the electro-physiology signal receiver and (1) display results on CRT, (2) add annotation (time, subject, date) to CRT display, and (3) store CRT display on tape. Processing of electrophysiological signals from subject on bicycle ergometer by (1) extracting data only from a representative time interval, (2) performing a programmed waveform analysis on the representative data, (3) specifying experiment parameters on CRT.	3
3	Accelerometer measurements during Rotating Litter Chair experiments.	2
5	Measurements with blood gas analyzer of arterialized venous blood samples obtained from subjects on Rotating Litter Chair. Blood gas determinations and blood cell counts.	3
6	Linear measurement of selected anatomical sites in addition to body mass measurements for zero-g adaptation studies on man.	2
91	Monitoring of electrophysiological phenomena during various psychomotor performance tests.	3

\*1 = Minimal, 2 = Nominal 3 = Maximal

TABLE I.9-6. COST SUMMARY -  
EQUIPMENT UNIT 12 - BIOMEDICAL/BEHAVIORAL RESEARCH SUPPORT UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
18D	CUSTOM BIT BOARD	MINIMAL	1	1	1	3	4	1	1	3	4	1	1	3	4		IMBIMS DEVELOPED
19D	BODY MASS MEASUREMENT	MINIMAL	1	20	20	1	40	20	20	1	40	20	20	1	40		SKYLAB DEVELOPED
51D	CONT. CONSOLE EXPMTR	REPACK	2			0		150	50	1	200	150	50	1	200		IMBIMS DEVELOPED
65B	ELECTROPHYSIOLOGY BACKDACK	REPACK	2	100	25	1	125	100	25	1	125	100	25	1	125	783.00	
65C	ELECTROPHYSIOLOGY RECR	REPACK	1	100	25	1	125	100	25	1	125	100	25	1	125	3250.00	
65D	ELECTROPHYSIOLOGY DISPY	REPACK	1	100	25	1	125	100	25	1	125	100	25	1	125	2200.00	
131E	NON-VISUL DIRCTN INDCTR	MINIMAL	0			0		2	2	1	4	2	2	1	4		IMBIMS DEVELOPED
133	OTOLITH TEST GOGGLE	MINIMAL	0	20	20	1	40	20	20	1	40	20	20	1	40		IMBIMS DEVELOPED
144B	PSYCHO GALVANOMTR GSR	MINIMAL	1	1	1	1	2	1	1	2	3	1	1	2	3		
153	RCRDR VOICE	REMPG	1			0		35	5	1	40	35	5	1	40		
153A	ROTATING LITTER CHAIR	MINIMAL	1	20	100	1	120	20	100	1	120	20	100	1	120		SKYLAB DEVELOPED
	TOTAL COST ESTIMATE			362	219		581	549	277		826	549	277		826		

TABLE I.9-7. COST SUMMARY -  
EQUIPMENT UNIT - 31 BIOMEDICAL RESEARCH SUPPORT UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
16F	COPLR BALLISTOCARDGRM	REPACK	1			0		5	1	1	6	5	1	1	6		
18C	BICYCLE ERGOMETER	MINIMAL	1	5	5	1	10	5	5	1	10	5	5	1	10		SKYLAB DEVELOPED
76K	FLOWMETER, DOPPLER	REPACK	1			0		5	1	2	7	5	1	2	7		
104E	COPLR IMPEDNCE CIRDIGRM	REPACK	1			0		5	1	2	7	5	1	2	7		
104F	IMPEDNCE PNEUMOGRAPH	REPACK	1	10	2	1	12	10	2	1	12	10	2	1	12		
110C	KIT PHYSIOLOGY	REDESIGN	2	100	10	1	110	100	10	1	110	100	10	1	110	500.00	
112	KIT MEDCL SURGICAL	REMPG	2	40	5	1	45	40	5	1	45	40	5	1	45		
125D	METABLC ANALYZ FIXED	REPACK	2	20	100	1	120	20	100	1	120	20	100	1	120	7,800.00	SKYLAB DEVELOPED.
139	PLETHYSMOGRAPH LIMB	MINIMAL	1			0		10	10	1	20	10	10	1	20		
140	COPLR PHONO/VIBROCARDGRM	REPACK	1	5	1	1	6	5	1	1	6	5	1	1	6		
181B	TRANSDCR - PLYTHESMBPH	REPACK	1	35	5	6	65	35	5	6	65	35	5	6	65		
182J	COPLR, VECTORCARDIOGRM	U	0	5	1	1	6	5	1	1	6	5	1	1	6		
186A	VOMITUS BAGS - HOLDERS	MINIMAL	0	0	0	4	0	0	0	4	0	0	0	4	0		
	TOTAL COST ESTIMATE			215	154		369	245	169		414	245	169		414		

## I.10 EQUIPMENT UNIT 26 - RADIOBIOLOGY SUPPORT UNIT

I.10.1 FUNCTIONAL CAPABILITY AND SUMMARY DATA. This unit supports radiobiological studies and provides the capability for irradiating organisms or specimens, and measuring radioisotope tracers. A summary of properties is given in Table I.10-1.

I.10.2 EQUIPMENT ITEMS. Major equipment items are the radiation detector, radiation source and radiation source storage (in the dedicated 30-day laboratory only), and radiation counter, see Table I.10-2. The placement of this equipment is indicated in Figure I.10-1.

I.10.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.10-3.

Data Requirements - See Table I.10-4.

Consumables - None.

Launch & Reentry Operations - No special requirements.

Electrical Power - The equipment requiring the most power when on is the radiation detection and counting equipment. As noted in the definition sheets for this equipment, it could probably be modified to use 28 v. d.c. power. Thus, essentially all of the power required for E.U. 26 is d.c., as shown in Table I.10-1.

Peak power for all the laboratories (240 w.) will result when the radiation detector and counter are turned on.

Heat Rejection - The average on-duty heat rejection is small and was assumed to be dissipated to the cabin air.

I.10.4 EQUIPMENT ITEM COST SUMMARY - See Table I.10-5.

TABLE I.10-1. E.U. 26, RADIOBIOLOGY SUPPORT UNIT -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	372 (13.1)	372 (13.1)	372 (13.1)
Racks & Consoles	372	372	372
Distributed & Extra Items	0	0	0
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	114 (252)	115 (253)	183 (403)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>5</u>	<u>14</u>	<u>15</u>
Estimated d.c.	5	14	15
Estimated a.c.	0	0	0
<u>Off-Duty* Average Power, Total</u>	<u>0</u>	<u>0</u>	<u>0</u>
Estimated d.c.			
Estimated a.c.			
<u>Estimated On-Duty Peak Power</u>	240	240	240
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>5</u>	<u>14</u>	<u>15</u>
Estimated Air Cooled Load	5	14	15
Estimated Cold Plated Load	0	0	0
<u>Off Duty Load, Total</u>	<u>0</u>	<u>0</u>	<u>0</u>
Estimated Air Cooled Load			
Estimated Cold Plated Load			
<u>Development Cost, \$K</u>	715	715	1215
<u>Unit Cost, \$K</u>	102	102	202
*12 Hours			

TABLE I.10-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 26 -

## RADIOBIOLOGY SUPPORT UNIT

E.I. Name	E.I. No.*	No. of Units Req'd.** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
Badges, Radiation	16D	0 10 (52)	0.05 (0.1)	0	0.03 (0.001)	0 (0)	Radiation Exposure Badges. Standard film type.
Radiation Detector	144C	1 1	0.45 (1)	0	0.5 (0.016)	15 (2) (2) <sup>+</sup>	Dosimeter, portable, ranges 0-200 mr and 0-500 r.
Radiation Detector, Genl.	145	1 1	23 (50)	150	69 (2.42)	350 (50) (20) <sup>+</sup>	Measures alpha, beta, gamma, x-ray, or neutron radiation.
Radiation Detector	147	1 1	91 (200)	90	57 (2.0)	350 (50) (50) <sup>+</sup>	Radiation Counters, Biochemical Sample. Automatic transport system to be used in conjunction with E.I. 145.
Radiation Source, Prepackaged	(149G)	(1)	23 (50)	5	7 (0.25)	150 (50) (3) <sup>+</sup>	Experiment specific. Portable self-contained radioisotope.
Radiation Source Storage	(150)	(1)	45 (100)	0	28 (1.0)	350 (50) (0.5) <sup>+</sup>	For radioisotope storage.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

FIGURE I.10-1 EQUIPMENT VOLUME AND PLACEMENT

Shared and Dedicated Laboratories

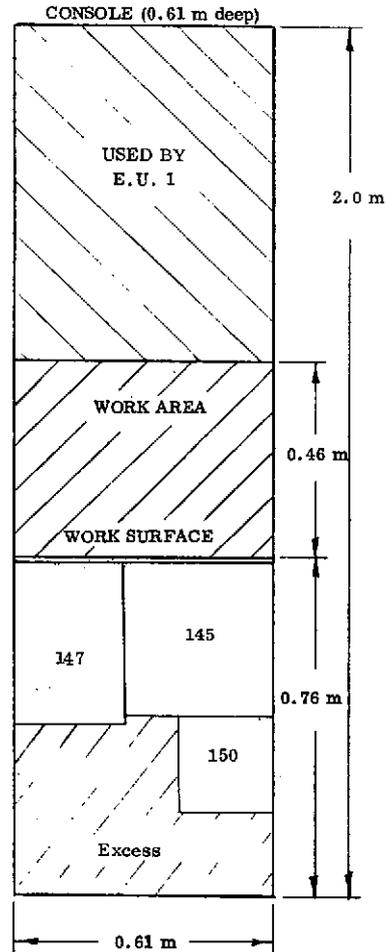
E.U. 26 Radiobiology Support Unit

EQUIPMENT ITEMS IN CONSOLE

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
<u>In Bottom of Console:</u>	
16D Radiation Badges	negl.
144C Radiation Dosimeter	negl.
145 Radiation Detector	68
147 Radiation Counter	57
Total for Shared 7-Day Lab, & Dedicated 7-Day Lab.	125
Excess Allowance	158

Additional E.I.s for Dedicated 30-Day Lab.

149G Radiation Source (in storage)	0
150 Radiation Source Storage	28
Total for Dedicated 30-Day Lab.	153
Excess Allowance	130



DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
None	

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.10-3. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 26, RADIOBIOLOGY SUPPORT UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
16D	BADGES - RADIATION, STANDARD FILM 63A Radiation monitoring throughout lab	10 (52)	C	$\frac{A}{0}$	$\frac{0}{0}$	0			
144C	RADIATION DETECTOR, DOSIMETER 63B Radiation monitoring throughout lab	1	2/wk	$\frac{4.0}{4}$	$\frac{0}{0}$	1	2/wk	$\frac{4.0}{4}$	$\frac{0}{0}$
145	RADIATION DETECTOR, GENERAL 63C Radiation monitoring throughout lab	1	2/wk	$\frac{4.0}{4}$	$\frac{0.8}{1}$	1	2/wk	$\frac{4.0}{4}$	$\frac{0.8}{1}$
147	RADIATION DETECTOR, SCINT 91A Plant radiochemistry (fixed) 91B Plant radiochemistry (portable) 92B Vertebrate radiochemistry 93B Invertebrate radiochemistry 94B Cells and tissue radiochemistry 315A Total body water 335A Erythrocyte survival 405A Blood plasma volume 449B Glucagon assay 451A Angiotension II	1	4/wk - 4/wk " " 1/wk 1/wk 2/wk 2/wk 4/wk	16.0 - 16.0 " " 12.0 2.0 3.0 8.0 <u>12.0</u> 101	2.0 - 2.0 2.0 2.0 1.5 0.2 0.4 1.0 <u>1.5</u> 13	1	- 2/wk " " " - - - - -	- 8.0 " " " - - - - - 32	- 1.0 1.0 1.0 1.0 - - - - - 4
149G	RADIATION SOURCE, PREPACKAGED 335A Erythrocyte survival	0 (1)	(1/wk)	$\frac{(12.0)}{(12)}$	$\frac{0.5}{(1)}$	0			
150	RADIATION SOURCE STOR	0 (1)				0			
	EU TOTAL				$\frac{14}{(15/0)}$				$\frac{5}{0}$

TABLE I.10-4. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E. U. 26 RADIOBIOLOGY SUPPORT UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Radiation Counter/Detector (26/145 &amp; 147)</u>										
On/Off Control	2 positions	1 position	Disc.	1	1	cont.	1/sec	1	86K	
Hi Volt Power Supply	170-1700V	5V	Anal.	1	9	101	1/sec	9	54K	
Count Value	0-10 <sup>6</sup>	1%	Dig	1	17	101	1/min	negl.	2K	
Counting Interval	0-120 min	10 sec	Dig.	1	10	101	1/min	negl.	1K	
Specimen I.D.	1-100	1	Dig.	1	6	101	1/min	negl.	1K	
Background Radiation	0-300 cpm	0.5 cpm	Dig.	1	6	101	1/min	negl.	1K	
Gas Flow	0-0.1 scfh	1% F.S.	Anal.	1	7	101	1/min	negl.	1K	
									146K	TOTAL

TABLE I.10-5. COST SUMMARY -  
EQUIPMENT UNIT - 26 RADIOBIOLOGY SUPPORT UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
16D	BADGES-RAD, STD FILM	U	U					0	0	10	0	0	0	10	0		
144C	RADIATION DETECTOR	REMPG	1	15	2	1	17	15	2	1	17	15	2	1	17	2000.00	
145	RADIATION DETECTOR, GEN	REPACK	2	350	50	1	400	350	50	1	400	350	50	1	400	20000.00	
147	RADIATION DETECTOR, SCINT	REPACK	1	350	50	1	400	350	50	1	400	350	50	1	400	50000.00	
149G	RADIATION SOURCE, PRE PACK	REDESIGN	1									150	50	1	200	3000.00	
150	RADIATION, SOURCE STOR	REPACK	1									350	50	1	400	500.00	
	TOTAL COST ESTIMATE			715	102		817	715	102		817	1215	202		1417		

I.11 EQUIPMENT UNIT 40/41/42 - SMALL VERTEBRATE HOLDING UNIT (40), PRIMATE HOLDING UNIT (41), VERTEBRATE RESEARCH SUPPORT UNIT (42)

I.11.1 FUNCTIONAL CAPABILITY AND SUMMARY DATA. This equipment unit provides for holding (caging) of vertebrates as well as for research supporting functions specific to the vertebrate organisms. The life support and environmental control equipment necessary for the support of the vertebrates is presented separately in Volume II of this report. A summary of pertinent properties of E.U. 40/41/42 is given in Table I.11-1.

I.11.2 EQUIPMENT ITEMS. Major equipment items include two vertebrate cage modules, two primate cages (dedicated laboratories only), and metabolic mass balance measuring equipment. The full equipment list is given in Table I.11-2, and the volume of the equipment is indicated in Table I.11-3. There are no racks or consoles required for these EUs; however, a drawing of a typical cage module is shown in Figure I.11-1 for completeness. The primate cages are shown in Figure 4-2 of Volume II.

I.11.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.11-4.

Data Requirements - See Table I.11-5.

Consumables - Consumables in these equipment units include urine and fecal collection pads and filters, food, and miscellaneous equipment within the veterinary kit. These are all small items for the mission durations being considered, and no special problems are anticipated. All these items are of the type that will not need replacement until the end of a particular flight. Water is a relatively large consumable but is included as part of the organism ECS and is presented in Volume II.

Launch and Reentry Operations - Equipment units 40 and 41 house the vertebrate organisms and therefore will require special launch and reentry considerations. Among them are:

- a. Organism should be placed aboard the Sortie Module as close to lift-off as is practical, and removed as soon after landing as practical.
- b. While the organisms are aboard during launch operations, ascent, descent, and recovery, provisions should be available for monitoring the organisms. The launch phase during which they should be monitored and the type of monitoring will depend upon the particular experiment. At least TV and electrophysiological capability should be available if needed. Thus, the data management subsystem must be capable of operation during launch and reentry.

- c. The ECS for the organisms must also be functioning during launch and recovery.
- d. Orientation of the organisms with respect to gravitational, acceleration, and air drag forces is an aspect involving launch and reentry operations which will need additional detailed study. The organisms will undergo various acceleration and gravitational forces in various directions throughout the flight. They must be kept as calm and quiet as possible, in order to prevent injury and trauma, whether self-inflicted or externally caused. For this purpose, some form of restraint system has been assumed for this study. Many types of restraint and protection systems can be envisioned (harnesses, cushions, air bags, etc.) but the details of such a system are considered beyond the scope of this study. However, assuming that a restraint system is used, it will require emplacement prior to ascent and descent, and removal upon achieving orbit and upon organism ground recovery.

Also, assuming that a restraint system is to be used allows the vertebrate cages (and cage modules) a greater degree of freedom in their orientation in the Sortie Module. That is, they are not constrained by the direction of the ascent and descent acceleration vectors so long as these vectors are compatible with the restraint system/cage design. The launch loads should be in a direction compatible with organism comfort and safety, and also should be in a direction so that urination and defecation will not result in organism harm or functional damage to the caging system, e.g., saturation of food pellets, shorting of electrical connections, etc.

Electrical Power - Average electrical power for these E.U.s is shown in Table I.11-1. The values for on- and off-duty power are equal since the significant power consumers are all automatically operating equipment and not dependent upon crew occupancy of the laboratory. This automatic equipment is comprised mostly of lights within the vertebrate cages. The ECS power is included in a separate section and the bioinstrumentation power is included under the specific couplers listed in the equipment inventory. The lights will be operating approximately one-half of the time but the schedule of operation will depend upon the specific experiments being conducted. Since these are not known at this time, the light power was averaged over the full 24-hour period. The maximum peak power for these E.U.s will be twice the average value as shown in Table I.11-1. All the power in these E.U.s is anticipated to be d.c.

Heat Rejection - Most of the heat comes from the lights and this will be dissipated primarily to the ECS air flow through the cages. This heat will be rejected to the dehumidification condenser and cooler in the ECS loop, and thus to the Sortie

Module liquid coolant. Also, it will have to be rejected to coolant at low temperature, which is discussed in more detail in Volume II, Section 3.1. It was assumed that all the heat from this equipment unit would be rejected to the spacecraft liquid coolant.

Typical Equipment Unit Functional Interfaces - See Table I.11-6.

I.11.4 EQUIPMENT ITEM COST SUMMARY - See Tables I.11-7, I.11-8, & I.11-9.

TABLE I.11-1. E. U. 40/41/42, SMALL VERTEBRATE HOLDING UNIT/ PRIMATE HOLDING UNIT/  
VERTEBRATE RESEARCH SUPPORT UNIT - SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	0	0	0
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>432 (15.2)</u>	<u>1577 (55.7)</u>	<u>1669 (58.9)</u>
Racks & Consoles	0	0	0
Distributed & Extra Items	376	1508	1600
Small Storage Items (Misc.)	56	69	69
<u>Fixed Weight, kg (lb)</u>	210 (462)	330 (726)	380 (836)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>82</u>	<u>195</u>	<u>230</u>
Estimated d.c.	82	195	230
Estimated a.c.	0	0	0
<u>Off-Duty* Average Power, Total</u>	<u>82</u>	<u>195</u>	<u>230</u>
Estimated d.c.	82	195	230
Estimated a.c.	0	0	0
<u>Estimated On-Duty Peak Power</u>	164	370	440
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>122**</u>	<u>295**</u>	<u>330**</u>
Estimated Air Cooled Load	0	0	0
Estimated Cold Plated Load	122	295	330
<u>Off Duty Load, Total</u>	<u>122**</u>	<u>295**</u>	<u>330**</u>
Estimated Air Cooled Load	0	0	0
Estimated Cold Plated Load	122	295	330
<u>Development Cost, \$K</u>	6576	7036	8036
<u>Unit Cost, \$K</u>	89	234	332
** Includes Organism Heat Load *12 Hours			

TABLE I.11-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 40/41/42 -  
 SMALL VERTEBRATE HOLDING UNIT (40), PRIMATE HOLDING UNIT (41), VERTEBRATE RESEARCH SUPPORT UNIT (42)

E.I. Name	E.I. No.*	No. of Units Req'd,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
<u>E. U. 40 - Small Vertebrate Holding Unit</u>							
Cage, MMB, Rats	28	1 1	2.3 (5)	20	28 (1.0)	1000 (10)	Cage for Metabolic Mass Measurements on Rats. Conceptual design item.
Cage, Rat/Hampster	30A	16 16	2.3 (5.1)	9	7 (0.25)	100 (1)	Includes urine pad holders and urine pads. Power is for lighting.
Holding Unit, Small Vertebrates	103	2 2	27 (60)	0	188 (6.64)	5000 (10)	A cage module which can house several individual vertebrate cages and provides an isolated controlled environment. Includes electronic instrumentation provisions.
Manifold, Organism Water	118D	1 1	0.9 (2)	0	0.3 (0.01)	0 (5)	Manifold for organism watering. Laboratory specific.
Tank, Vertebrate Water	174	- -	- -	- -	- -	- -	Part of organism ECS.
<u>E. U. 41 - Primate Holding Unit</u>							
Cage, Monkey	28A	0 2	114 (250)	100	566 (20)	400 (25) 0	Cage to support 16-20 lb monkeys. Ventilated enclosure with provision for connections to ECS.
Holding Unit, MMB, Primate	(100)	(1)	41 (90)	70	142 (5)	1000 (100)	Holding Unit Devices for Metabolic Mass Balance Measurements on Primates. Equipment to be added to E. I. 28A.
Signal Conditioner Rack	(156E)	(4)	2.3 (5)	0	23 (0.8)	0 (0)	To be used in conjunction with metabolic mass balance equipment. Dev. cost in E. I. 103. Unit cost in holding units.
<u>E. U. 42 - Vertebrate Research Support Unit</u>							
Flowmeter, Ultrasonic	76G	0 2	0.2 (0.4)	0	1.4 (0.05)	1 (1)	Implantable, to measure cardiac output. Experiment specific.
Kit, Veterinary	115	1 1	2.3 (5)	0	28 (1.0)	75 (10) (0.5) <sup>+</sup>	Dissection equipment, electrophysiology equipment, restraint systems, etc.
Oscillator, VCO	132A	0 3	0.05 (0.1)	1	0.3 (0.01)	3 (1)	Voltage Controlled Oscillator, standard type.
Pressure Cuff	143E	0 1	0.3 (0.5)	0	1.4 (0.05)	15 (3)	With transducer for blood pressure measurement.
Pressure Cuff Pump	143F	0 1	0.5 (1.0)	20	2.8 (0.1)	5 (1)	Air pump for automated measurement of primate blood pressure.
Receiver	150B	1 2	0.05 (0.1)	10	2.3 (0.1)	400 (20) (0.8) <sup>+</sup>	Receiver and Data Processing Unit, to allow data acquisition of biophysiological events via a telemetry system. Organism is provided with a transducer and microbackpack transmitter.
Sensor, Implanted	155A	0 12	0.05 (0.1)	0	0.03 (0.001)	1 (1)	Deep Body Temperature Measurement.
Temp. Sensor, Body	177	8 32	0.1 (0.2)	0	0.03 (0.001)	1 (1)	For vertebrate body temperature measurements.
Transducer, Blood Pressure	181C	0 6	0.05 (0.1)	1	1.0 (0.036)	35 (5)	

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

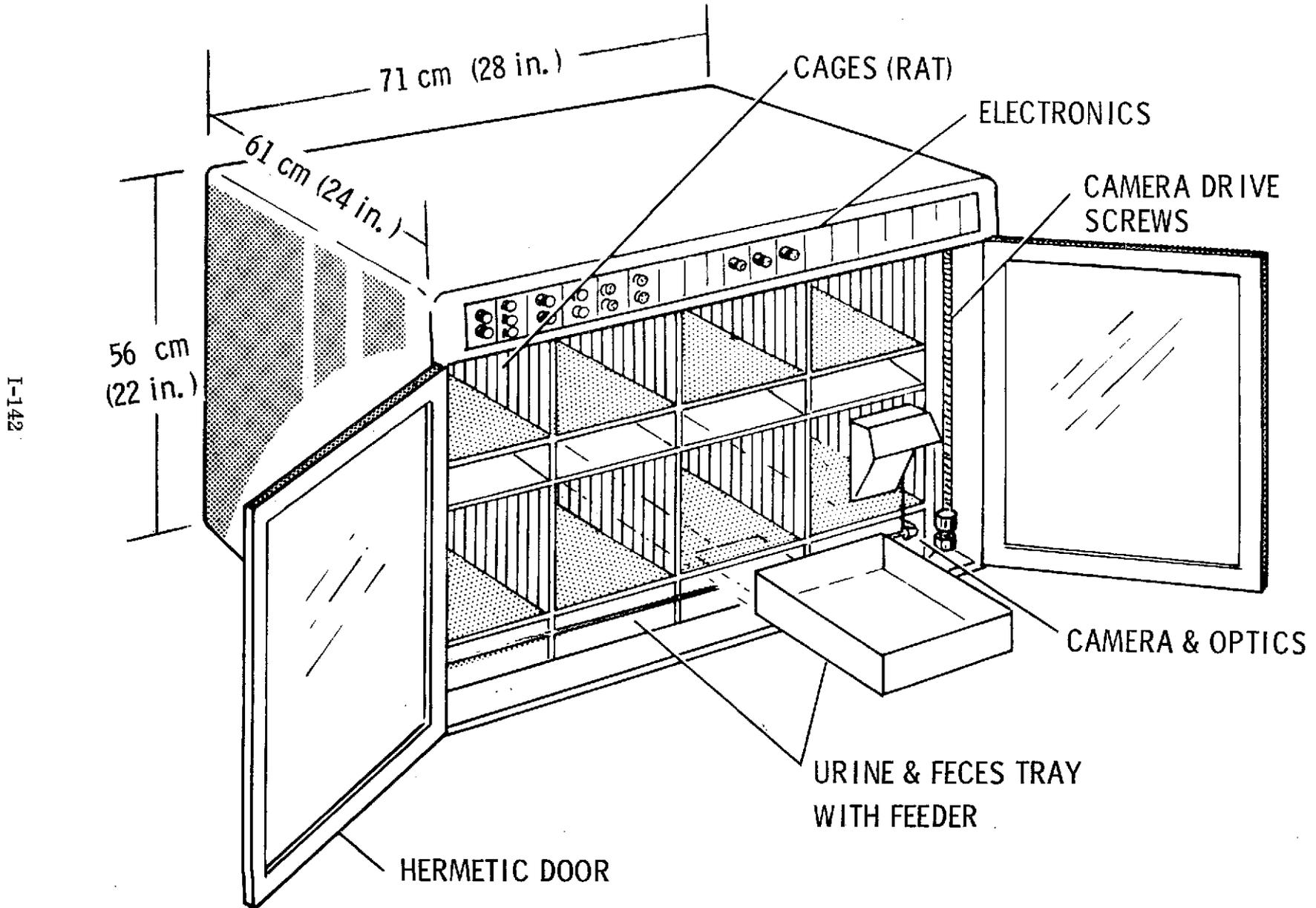
TABLE I.11-3 - EQUIPMENT VOLUME AND PLACEMENT  
SHARED AND DEDICATED LABORATORIES

E. U. 40/41/42 - SMALL VERTEBRATE HOLDING UNIT,  
PRIMATE HOLDING UNIT, AND VERTEBRATE RESEARCH SUPPORT UNIT  
(NO RACK OR CONSOLE REQUIRED)

Items (E.I.s)		Volume, dm <sup>3</sup> (ft <sup>3</sup> )		
		Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>DISTRIBUTED OR EXTRA EQUIPMENT ITEMS</u>				
28A	Small Primate Cages	0	1132	1132
30A	Rat Cages - in Cage Module Volume	0	0	0
100	Metabolic Mass Balance Devices for Primates (in Monkey Cages)	0	0	0
103	Small Vertebrate Cage Modules	376	376	376
118D	Manifold	negl.	negl.	negl.
132A	VCOs - in Cage Module Volume	0	0	0
150B	Receiver - in Cage Module Volume	0	0	0
156E	Signal Conditioner Rack	0	0	92
TOTALS		376 (13.3)	1508 (53.3)	1600 (56.5)
<u>SMALL STORAGE EQUIPMENT ITEMS</u>				
(Can be stored in miscellaneous small storage areas)				
28	Metabolic Mass Balance Cage	28	28	28
76G	Ultrasonic Flowmeter	0	3	3
115	Veterinary Kit	28	28	28
143E	Pressure Cuff with Transducer	0	1	1
143F	Pressure Cuff Pump	0	3	3
155A	Implantable Sensor	negl.	negl.	negl.
177	Temperature Sensors	negl.	negl.	negl.
181C	Blood Pressure Transducer	0	6	6
TOTALS		56 (2)	69 (2.4)	69 (2.4)

Figure I. 11-1

# CAGE MODULE



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## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.11-4A. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 40. SMALL VERTEBRATE HOLDING UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
28	CAGE, MMB, RAT	1*				1*			
30A	CAGE, RAT/HAMP/QUAIL	16				16			
	4A Vertebrate watering		C	A	-		C	A	-
	130A Holding, mice and mice size animals		1/2 C	A	-		-	-	-
	131A Holding, rats, quail, etc.		1/2 C	A	72		1/2 C	A	72
				0	72			0	72
103	HOLDING UNIT, SMALL VERTEBRATES	2				2			
	131A Holding, rats, quail, etc.		1/2 C	A	0		1/2 C	A	0
	134A Holding, rabbits, cats, marmots, etc.		1/2 C	A	0		-	-	-
	137A Holding, colony, mice, hamsters, etc.		1/2 C	A	0		-	-	-
				0	0			0	0
118D	MANIFOLD, ORGANISM, WATER	1				1			
	4A Vertebrate watering		C	A	0		C	A	0
	130A Holding - mice and mice size animals		1/2 C	A	0		-	-	-
	131A Holding - rats, quail, etc.		1/2 C	A	0		1/2 C	A	0
	134A Holding - rabbits, cats, marmots, etc.		1/2 C	A	0		-	-	-
				0	0			0	0
174	TANK, VERTEBRATE WATER	1*				1*			
					72/72 (72/72)				72/72
	EU TOTAL								

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\*Use is experiment specific.

<sup>4</sup> Part of ECS.

TABLE I.11-4B. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 41. PRIMATE HOLDING UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
28A	CAGE, MONK, MACAC 129C Holding, primates 129D Holding, primates	2	1/2 C (1/2 C)	A <u>(A)</u> 0	100 <u>+</u> 100	0			
100	HOLDING UNIT, MMB, PRIMATE 10C Holding, primates, metabolic msts. 129D " "	0 (1)	(1/2 C) (1/2 C)	(A) <u>(A)</u> 0	(35) <u>(+)</u> (35)	0			
156E	SIGNAL COND. RACK 129C Holding, primates	0 (4)	1/2 C	<u>(A)</u> 0	<u>(0)</u> 0	0			
	EU TOTAL				100/100 (135/135)				0/0

TABLE I.11-4C. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 42. VERTEBRATE RESEARCH SUPPORT UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
76G	FLOWMETER, ULTRASONIC 21B Cardiac output	2	1/wk	$\frac{2.0}{2}$	$\frac{0}{0}$	0			
115	KIT, VETERINARY 9A Organism mass measurements (restraints for primates, verts., plants, inverts.) 14B Bioelectric transducer install. & setup (FET electrode transducers) 21A Cardiac output (restraint systems) 30A Gross anatomies 31B Biosampling 92B Vertebrate radiochemistries (syringes and needles) 218B Deep body temperature	1	1/3 dy 2/2 dy 2/wk - 6/dy 4/wk C	1.7 10.0 4.0 - 30.0 16.0 $\frac{A}{62}$	0 0 0 - 0 0 $\frac{0}{0}$	1	1/wk - - 1/wk 3/dy 2/wk -	1.0 - - 4.0 15.0 8.0 - 28	0 - - 0 0 0 - 0
132A	OSCILLATOR, VCO 17B Monitor ECG 18B Monitor EEG 19B Monitor EMG	3	C C C	1.8 1.4 $\frac{1.4}{5}$	1 1 $\frac{1}{3}$	0			
143E	PRESSURECUFF W/TRANSDUCER 161A Arterial blood pressure 424A Carotid body stimulation response	1	2/dy 2/wk	10.0 $\frac{11.0}{21}$	0 $\frac{0}{0}$	0			
143F	PRESSURECUFF PUMP 161A Arterial blood pressure	1	2/dy	$\frac{10.0}{10}$	$\frac{0.3}{0}$	0			
150B	RECEIVER - EXG, CAGE MODULE 17C Monitor ECG	2	2/wk	$\frac{4.0}{4}$	$\frac{20-C}{20}$	1	2/wk	$\frac{4.0}{4}$	$\frac{10-C}{10}$

TABLE I.11-4C. EU 42 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
155A	SENSOR, IMPLANTED 218B Deep body temperature	12	C	$\frac{A}{0}$	$\frac{0}{0}$	0			
177	TEMPERATURE SENSOR, BODY 22A Temperature measmts. (thrmcpl) 22B " " (thrmstr) 403A Average skin temperature (thrmstr)	32	10 min/wk 10 min/wk 4/wk	2.0 2.0 $\frac{4.0}{8}$	0 0 $\frac{0}{0}$	8	5 min/wk 5 min/wk -	1.0 1.0 $\frac{-}{2}$	0 0 $\frac{-}{0}$
181C	TRANSDUCER, BLOOD PRESSURE 164A Peripheral venous blood pressure	6	2/wk	$\frac{6.0}{6}$	$\frac{0.1}{0}$	0			
	EU TOTAL				$\frac{23}{0}$ 23/23 (23/23)				10/10

TABLE I.11-5. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E.U. 40/41/42 SMALL VERT. HOLDING UNIT/PRIMATE HOLD. UNIT/VERT. RES. SUPPORT UNIT

EQUIPMENT ITEMS (E.U.#/E.I.#) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Vertebrate Cage Modules (2) (40/103)</u> <u>&amp; Primate Cylinders (2) (41/28A)</u>										
Temperature Monitor	20-30°C	0.5°C	Anal.	4	5	cont.	6/min	2	173K	
Temperature Control (On-Off)	2 positions	1 position	Disc.	4	1	cont.	6/min	negl.	35K	
ECS Flow Rate Monitor	0-5 V	0.1 V	Anal.	4	6	cont.	6/min	2.4	207K	
ECS Flow Rate Control	2 positions	1 position	Disc.	4	1	cont.	6/min	negl.	35K	
Relative Humidity Monitor	30-95%	1%	Anal.	4	7	cont.	6/min	3	242K	
Relative Humidity Control	2 positions	1 position	Disc.	4	1	cont.	6/min	negl.	35K	
pCO2 Monitor	1-8mm Hg	0.1mm Hg	Anal.	4	7	cont.	6/min	3	242K	
pO2 Monitor	140-180mm Hg	1mm Hg	Anal.	4	6	cont.	6/min	2	207K	
pO2 Control	2 positions	1 position	Disc.	4	1	cont.	6/min	negl.	35K	
Total Pressure Monitor	760±20mm Hg	2mm Hg	Anal.	4	5	cont.	6/min	2.0	173K	
Pressure Control	2 positions	1 position	Disc.	4	1	cont.	6/min	negl.	35K	
Water Flow Monitor	0-5 V	50 mV	Anal.	18	7	cont.	1/min	2	181K	
Water Supply Control	2 positions	1 position	Disc.	18	1	cont.	1/min	negl.	26K	
Feeder Control	2 positions	1 position	Disc.	18	1	cont.	6/hr	negl.	3K	
<u>Voltage Controlled Oscillator (42/132A)</u>										
Output Signal	0-5 V (0-100 Hz)	50 mV	Anal.	1	7	5	500/sec	3500	1.0M	
<u>Blood Pressure (42/143E &amp; 181C)</u>										
Coupler Output	0-5 V (0-10 Hz)	50 mV	Anal.	1	7	27	50/sec	350	567K	
									<b>3.196 M</b>	<b>TOTAL</b>

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TABLE I. 11-6. TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES

EU #	DESCRIPTION OF FUNCTIONAL INTERFACE WITH E.U. 40/41/42	CRITI- CALITY*
1	Video recording and photographic documentation of vertebrate behavior within the holding units.	2
2	Display, processing, and storage of electrophysiological signals from vertebrate holding units.	3
3	Use of crew restraints while working with vertebrates.	2
4	Removal of blood samples from selected vertebrates within the LFB with subsequent transfer and processing in centrifuge for final electrophoresis of the serum phase.	3
5	Determination of gas concentrations within the vertebrate holding units by means of gas chromatography, mass spectroscopy, etc. Use of the autoanalyzer for the determination of electrolyte concentrations in rat serum obtained with the veterinary kit and hematology kit.	3
6	Maintenance of vertebrate organisms using organism holding and management kit and clean-up kit.	3

\*1 = Minimal, 2 = Nominal 3 = Maximal

TABLE I.11-7. COST SUMMARY -  
EQUIPMENT UNIT - 40 SMALL VERTEBRATE HOLDING UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$ K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
28	CAGE, MMB, RAT	REDESIGN	4	1000	10	1	1010	1000	10	1	1010	1000	10	1	1010		
30A	CAGE, RAT/HAMP/QUAIL	SRT	4	100	1	16	116	100	1	16	116	100	1	16	116		
103	HOLDNG UNIT, SM VERTS	SRT	3	5000	10	2	5020	5000	10	2	5020	5000	10	2	5020		
118D	MANIFOLD, ORGANSM, WATER	REMPG	1	-	5	1	5	-	5	1	5	-	5	1	5		R&D COST IN E1103
	TOTAL COST ESTIMATE			6100	51		6151	6100	51		6151	6100	51		6151		

TABLE I.11-8. COST SUMMARY -  
EQUIPMENT UNIT - 41 PRIMATE HOLDING UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER-	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	CIAL COSTS	
28A	CAGE, MONK, MACAC	REPACK	1			0	0	400	25	2	450	400	25	2	450		
100	HOLD UNIT MMB PRMTE	REDESIGN	1			0	0					1000	100	1	1100		
156E	SIGNL COND RACK	REPACK	2			0	0					0	0	4	0		COST IN E1103
	TOTAL COST ESTIMATE			0	0		0	400	50		450	1400	150		1550		

TABLE I.11-9. COST SUMMARY -  
EQUIPMENT UNIT - 42 - VERT RESEARCH SUPPORT UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
76G	FLOWMETER, ULTRASONIC	MINIMAL	0			0		1	1	2	3	1	1	2	3		
115	KIT, VETERINARY	REMPG	1	75	10	1	85	75	10	1	85	75	10	1	85	500.00	
132A	OSCILLATOR, VCO	MINIMAL	1			0	0	3	1	3	6	3	1	3	6		
143E	PRESS CUFF W/XDCR	MINIMAL	1			0	0	15	3	1	18	15	3	1	6		
143F	PRESS CUFF PUMP	MINIMAL	1			0	0	5	1	1	6	5	1	1	16		
150B	RECVR-EXG CAGE MOD	REDESIGN	3	400	20	1	420	400	20	2	440	400	20	2	440		
155A	SENSOR, IMPLNTD	MINIMAL	0			0	0	1	1	12	13	1	1	12	13		
177	T SENS, BODY	MINIMAL	0	1	1	8	9	1	1	32	33	1	1	32	33		
181C	XDCR BLOOD PRESS	REPACK	1			0	0	35	5	6	65	35	5	6	65		
	TOTAL COST ESTIMATE			476	38		514	536	133		669	536	133		669		

I.12 EQUIPMENT UNIT 50/51/70 - PLANT HOLDING UNIT (50), PLANT RESEARCH SUPPORT UNIT (51), & INVERTEBRATE HOLDING UNIT (70)

I.12.1 FUNCTIONAL CAPABILITY AND SUMMARY DATA. These equipment units provide the environmental enclosures and equipment support for the growth of plant organisms and housing of invertebrate organisms. A summary of their combined properties is given in Table I.12-1.

I.12.2 EQUIPMENT ITEMS. Major equipment items include the plant holding unit (cage module), an enclosure for making metabolic mass balance measurements on plants, a clinostat, a plant tool kit, and a holding unit for invertebrates. The equipment list is given in Table I.12-2, and volume and placement of this equipment are indicated in Table I.12-3. There are no racks or consoles required for these EUs; however, a drawing of a typical cage module (vertebrate configuration) is shown in Figure I.12-1 for completeness.

I.12.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.12-4.

Data Requirements - See Table I.12-5.

Launch and Re-entry Operations. Launch and reentry considerations for the plants and invertebrates are similar to those for the vertebrates, see Section I.11.3. The organisms should be loaded as late in the launch sequence as practical and recovered as soon after landing as practical. Depending upon the experiment, some data management equipment may be required during ascent and descent. Ascent and descent acceleration and vibration forces will probably require special protective devices during these mission phases. The plant supports will require emplacement prior to ascent and descent, and removal upon achieving orbit and landing.

Electrical Power. For these E.U.s, the estimated maximum peak electrical power was obtained by adding up all the power consuming equipment given in Table I.12-2. It was estimated that all this equipment could be operating simultaneously.

The major power consumers are the lights in the plant holding unit, which are generally a.c. powered fluorescent lamps. For this reason, 70 watts of the on-duty average power was assumed to be a.c. The remainder was assumed to be d.c., including 50 watts d.c. for the invertebrate holding unit heaters.

Heat Rejection. The major heat load results from the plant cage module lighting. In the current prototype plant cage module (built by Convair), these lights are cooled by the cabin air. The other heat loads would also be cooled by the cabin air. Therefore, the total heat load was assumed to be rejected to the cabin air.

Typical Equipment Unit Functional Interfaces - See Table I.12-6.

I.12.4 EQUIPMENT ITEM COST SUMMARY. See Tables I.12-7, I.12-8 & I.12-9.

TABLE I.12-1. E.U. 50/51/70      PLANT HOLDING UNIT/  
 PLANT RESEARCH SUPPORT UNIT/INVERTEBRATE HOLDING UNIT -  
 SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	0	0	0
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>592 (20.9)</u>	<u>592 (20.9)</u>	<u>592 (20.9)</u>
Racks & Consoles	0	0	0
Distributed & Extra Items	376	376	376
Small Storage Items (Misc.)	216	216	216
<u>Fixed Weight, kg (lb)</u>	112 (246)	125 (275)	125 (275)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>130</u>	<u>131</u>	<u>131</u>
Estimated d.c.	60	61	61
Estimated a.c.	70	70	70
<u>Off-Duty* Average Power, Total</u>	<u>130</u>	<u>130</u>	<u>130</u>
Estimated d.c.	60	60	60
Estimated a.c.	70	70	70
<u>Estimated On-Duty Peak Power</u>	240	240	240
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>130</u>	<u>131</u>	<u>131</u>
Estimated Air Cooled Load	130	131	131
Estimated Cold Plated Load	0	0	0
<u>Off Duty Load, Total</u>	<u>130</u>	<u>130</u>	<u>130</u>
Estimated Air Cooled Load	130	130	130
Estimated Cold Plated Load	0	0	0
<u>Development Cost, \$K</u>	1278	1278	1278
<u>Unit Cost, \$K</u>	44	61	61
*12 Hours			

TABLE I.12-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT # 50/51/70  
 PLANT HOLDING UNIT (50), PLANT RESEARCH SUPPORT UNIT (51)  
 & INVERTEBRATE HOLDING UNIT (70)

E.I. Name	E.I. No.*	No. of Units Req'd.** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
<u>E. U. 50 - Plant Holding Unit</u>							
Cage, MMB, Plant	26B	1 2	11 (25)	30	77 (2.73)	1000 (10)	Cage for Metabolic Mass Balance Measurements on Plants. Conceptual design item.
Cage, Plant	29	1 1	4.5 (10)	0	57 (2.0)	100 (1)	Pot for plants. Values shown are for package of 16.
Holding Unit, Plants	101	1 1	27 (60)	140	188 (6.64)	- (10)	Basically a cage module. Dev. cost in E.I. 103.
Tank, Plant/Invert. Water	175	1 1	-	-	-	- -	For plant watering/fertilization. Part of organism ECS.
<u>E. U. 51 - Plant Research Support Unit</u>							
Cage Shelf, Plant Seedlings	30B	1 1	0.5 (1)	0	2.8 (0.1)	20 (0)	Shelf for holding unit to support plants. With required clamps and brackets.
Clinostat	50	1 1	10 (22)	10	89 (3.14)	50 (7)	Device to slowly rotate plants.
Kit, Plant Tool	111	1 1	9 (20)	0	113 (4.0)	25 (3)	Scissors, tweezers, knives, etc.
Motorized Plant Growth Monitor	131D	2 4	0.5 (1)	5	0.6 (0.02)	7 (1)	Motorized Device for monitoring plant growth and movement. Contact on plant makes or breaks switch to stepping motor device.
Pump, Gas Circulating	143C	2 2	0.5 (1)	5	0.6 (0.02)	3 (1)	Pump for sealed plant growth chamber, for radiobiology tests.
Squibs, Fixative	156B	4 8	0.05 (0.1)	0	0.03 (0.001)	0 (1)	Reactive device to stop plant growth.
Squib Firing Apparatus	156C	1 2	0.09 (0.2)	0	0.3 (0.01)	3 (1)	
<u>E. U. 70 - Invertebrate Holding Unit</u>							
Cage, Invertebrates	25	1 1	7.3 (16)	0	28 (1.0)	50 (1)	Containers for invertebrates. Values shown are estimates for package of 32.
Holding Unit, Incubator - Invertebrates	98C	1 1	36.4 (80)	50	188 (6.64)	- (10)	Holding Unit for Invertebrates. Basically a cage module. Dev. cost in E.I. 103, E. U. 40.
Kit, Tool - Insect Manipulation	113A	1 1	4.5 (10)	0	14 (0.5)	20 (3)	Tool kit for counting, sorting, examination, etc.

- \* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.
- \*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).
- \*\*\* Average power while equipment is operating.
- + The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

TABLE I.12-3 - EQUIPMENT VOLUME AND PLACEMENT  
SHARED AND DEDICATED LABORATORIES

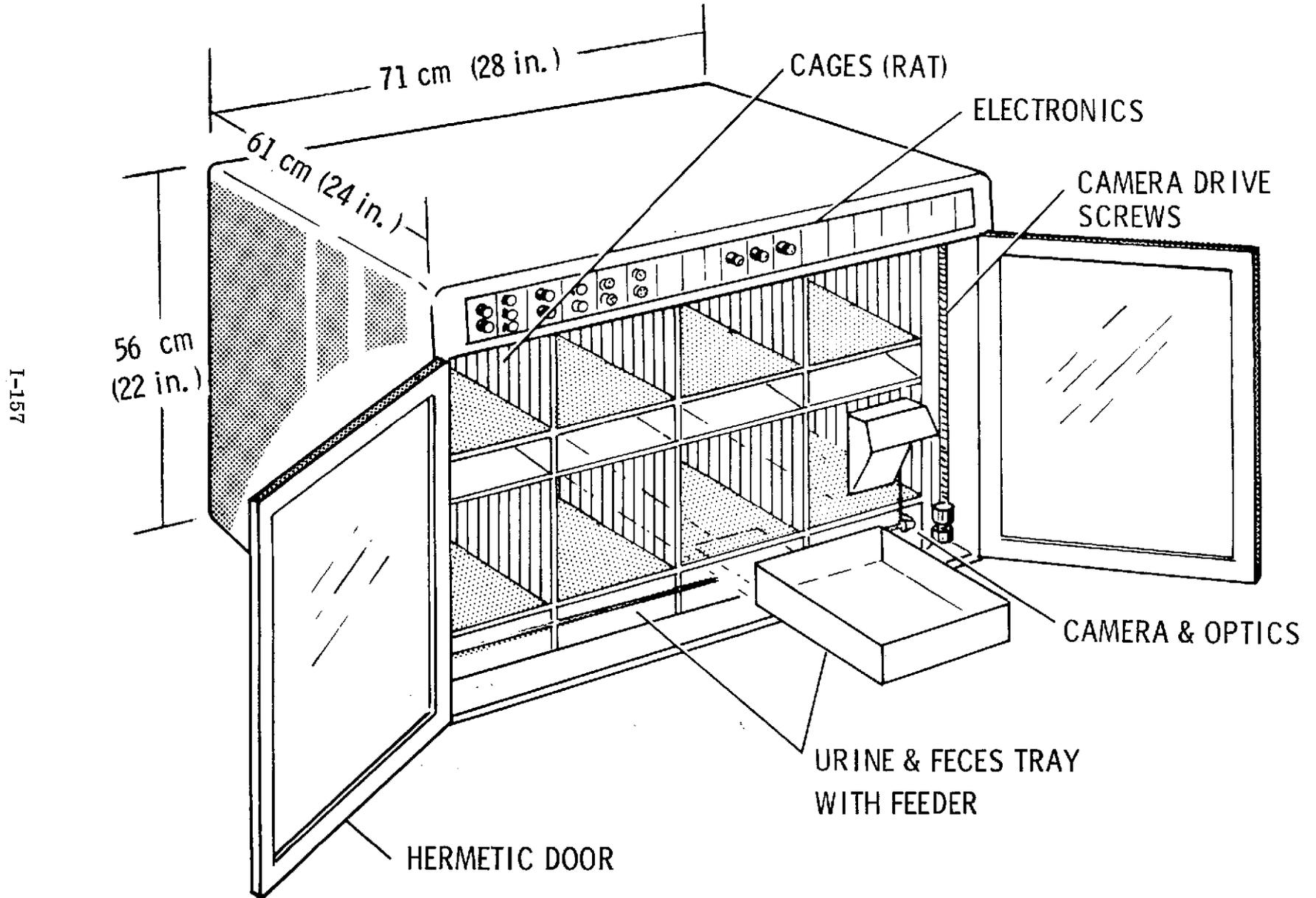
E.U. 50/51/70 - PLANT HOLDING UNIT (50), PLANT RESEARCH SUPPORT UNIT (51), &  
INVERTEBRATE HOLDING UNIT (70/

(NO RACK OR CONSOLE REQUIRED)

Items (E.I.s)		Volume, dm <sup>3</sup> (ft <sup>3</sup> )		
		Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>DISTRIBUTED OR EXTRA EQUIPMENT ITEMS</u>				
25	Cages for Invertebrates - in Holding Unit	0	0	0
26B	MMB Enclosure - in Cage Module	0	0	0
30B	Shelf - in Cage Module			
29	Pots - in Cage Module	0	0	0
98C	Invertebrate Holding Unit	188	188	188
101	Cage Module	188	188	188
131D	Plant Monitoring Device - in Cage Module	0	0	0
143C	Gas Circulating Pump - in Cage Module	<u>0</u>	<u>0</u>	<u>0</u>
	TOTALS	376 (13.3)	376 (13.3)	376 (13.3)
<u>SMALL STORAGE EQUIPMENT ITEMS</u>				
(Can be stored in miscellaneous small storage areas)				
50	Clinostat	89	89	89
111	Plant Tool Kit	113	113	113
113A	Tool Kit for Invertebrates	14	14	14
156B	Fixative Squibs	negl.	negl.	negl.
156C	Squib Firing Apparatus	<u>negl.</u>	<u>negl.</u>	<u>negl.</u>
	TOTALS	216 (7.6)	216 (7.6)	216 (7.6)

Figure I. 12-1

# CAGE MODULE



## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.12-4A. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 50. PLANT HOLDING UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
26B	CAGE MMB, PLANT 91A Plant radiochemistries (fixed) 91B " " (portable)	2	4/wk -	16.0 -	1.4 -	1	- 2/wk	- 8.0 8	- 0.3 0
29	CAGE, PLANT, POT 133A Holding unit plants	1	1/2 C	A 0	0 0	1	1/2 C	A 0	0 0
101	HOLDING UNIT PLANT 90A Histological staining 132A Housing - plant seedlings 133A Holding unit - plants	1	2/wk 1/2 C 1/2 C	1.4 A A	- - -	1	- 1/2 C 1/2 C	- A A 0	- - - 70
175	TANK, PLANT/INVERT WATER	1 <sup>4</sup>			70	1 <sup>4</sup>			
EU TOTALS					71/70 (71/70)				70/70

<sup>4</sup> Part of ECS.

TABLE I.12-4B. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 51. PLANT RESEARCH SUPPORT UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
30B	CAGE SHELF, PLANT SEEDLING 132A Housing - plant seedlings	1	1/2 C	$\frac{A}{0}$	$\frac{0}{0}$	1	1/2 C	$\frac{A}{0}$	$\frac{0}{0}$
50	CLINOSTAT 184A Clinostat environment	1	30 min/wk	$\frac{2.0}{2}$	$\frac{0.1}{0}$	1	30 min/wk	$\frac{2.0}{2}$	$\frac{0.1}{0}$
111	KIT, PLANT TOOLS 31B Biosampling	1	6/dy	$\frac{30.0}{30}$	$\frac{0}{0}$	1	3/dy	$\frac{15.0}{15}$	$\frac{0}{0}$
131D	MOTOR, PLANT GROWTH MONITOR 65D Plant activity	4	1 min/dy	$\frac{1.0}{1}$	$\frac{0.1}{0}$	2	1 min/dy	$\frac{1.0}{1}$	$\frac{0.1}{0}$
143C	PUMP, GAS CIRCULATING 91A Plant radiochemistries (fixed) 91B " " (portable)	2	4/wk --	16.0 $\frac{--}{16}$	10-c $\frac{--}{10}$	2	-- 2/wk	-- $\frac{3.0}{8}$	-- $\frac{10-c}{10}$
156B	SQUIBS, FIXATIVE 85A Starch granule assay	8	10 min/wk	$\frac{A}{0}$	$\frac{0}{0}$	4	5 min/wk	$\frac{A}{0}$	$\frac{0}{0}$
156C	SQUIB FIRING APPARATUS 85A Starch granule assay	2	10 min/wk	$\frac{A}{0}$	$\frac{0}{0}$	1	5 min/wk	$\frac{A}{0}$	$\frac{0}{0}$
EU TOTAL					$\frac{10}{10}$ (10/10)				$\frac{10}{10}$

TABLE I.12-4C. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 70. INVERTEBRATE HOLDING UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
25	CAGE, INVERTEBRATES (JARS) 136A Holding, invertebrates	1	C	$\frac{A}{0}$	$\frac{0}{0}$	1	C	$\frac{A}{0}$	$\frac{0}{0}$
98C	HOLDING UNIT INCUBATOR - INVERTEBRATES 136A Holding, invertebrates	1	C	$\frac{A}{0}$	$\frac{50}{50}$	1	C	$\frac{A}{0}$	$\frac{50}{50}$
113A	KIT, TOOL - INSECT MANIPULATION 78A Invertebrate counting and sorting	1	15 min/dy	$\frac{15.0}{15}$	$\frac{0}{0}$	1	5 min/dy	$\frac{5.0}{5}$	$\frac{0}{0}$
	EU TOTAL				$\frac{50}{50}$ (50/50)				$\frac{50}{50}$

TABLE I.12-5. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E. U. 50/51/70 - PLANT HOLDING UNIT/PLANT RESEARCH SUPPORT UNIT/INVERTEBRATE HOLDING UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Plant Cage Module (50/101), Invert. Cage Module (70/98C)</u>										
Temperature Monitor	20-30°C	0.5°C	Anal.	3	6	cont.	6/min	2	155K	
Temperature Control (On-Off)	2 positions	1 position	Disc.	3	1	cont.	6/min	negl.	26K	
ECS Flow Rate Monitor	0-5 V	0.1 V	Anal.	3	6	cont.	6/min	2	155K	
ECS Flow Rate Control	2 positions	1 position	Disc.	3	1	cont.	6/min	negl.	26K	
Relative Humidity Monitor	30-100	1%	Anal.	3	7	cont.	6/min	2	155K	
Relative Humidity Control	2 positions	1 position	Disc.	3	1	cont.	6/min	negl.	26K	
pCO2 Monitor	0-8 mm Hg	0.1 mm Hg	Anal.	3	7	cont.	6/min	2	181K	
Illumination (footcandles)	0-200 fc	1 fc	Anal.	4	8	cont.	6/min	3	276K	
Illumination Control	10 levels	1 level	Dig.	4	4	cont.	6/min	2	138K	
pO2 Monitor	140-180 mm Hg	1 mm Hg	Anal.	1	6	cont.	6/min	1	52K	
pO2 Control	2 positions	1 position	Disc.	1	1	cont.	6/min	negl.	9K	
Total Pressure Monitor	760±20 mm Hg	2 mm Hg	Anal.	1	5	cont.	6/min	1	43K	
Pressure Control	2 positions	1 position	Disc.	1	1	cont.	6/min	negl.	9K	
Water Flow Monitor	0-5 V	50 mV	Anal.	4	7	cont.	1/min	negl.	40K	
Water Flow Control	2 positions	1 position	Disc.	4	1	cont.	1/min	negl.	6K	
<u>Clinostat (51/50)</u>										
Tachometer Output	0-5 V	0.05 V	Anal.	1	7	cont.	1/min	negl.	10K	
<u>Plant Movement Sensor (51/131D)</u>										
Stepping Motor Encoder	0-100	1	Dig.	4	7	cont.	6/min	3	242K	
									1,549K	TOTAL

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TABLE I.12-6 - TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES

EU #	DESCRIPTION OF FUNCTIONAL INTERFACE WITH E.U. 50/51	CRITI- CALITY*
1	Video and photographic monitoring of plant movement, and experiment phenomena such as clinostat effects. Close-up photography studies and photomicrography of parasitic affinity for plant tissues on 0-g.	1
2	Handling and storage of incrementally acquired data from the clinostat and make-break motor assembly for assessment of plant adaptation to rotating environment and zero-g.	2
3	Air flow rate measurements into plant and invertebrate holding module. Acceleration measurements during clinostat operation.	2
4	Measuring soil pH and taking plant tissue samples with the aid of the Laminar Flow Bench (LFB). Dissection of plant tissue structures using the plant tool kit, LFB mass measurement device and dissecting microscope.	3
5	Determination of CO <sub>2</sub> concentration and humidity within the plant module using the CO <sub>2</sub> gas analyzer and water vapor meter.	3
6/7	Maintenance of plant specimens using the tool sterilizer, plant tool kit, and linear measurement kit. Storage of small items.	3
26	Determination of radioisotope uptake in plants using the clinostat, gas circulating pump, and radiation counter.	3

\*1 = Minimal, 2 = Nominal 3 = Maximal

TABLE I.12-7. COST SUMMARY -  
EQUIPMENT UNIT - 50 PLANT HOLDING UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
26B	CAGE MMB PLNT	REDESIGN	3	1000	10	1	1010	1000	10	2	1020	1000	10	2	1020		
29	CAGE, PLNT, POT	SRT	1	100	1	1	101	100	1	1	101	100	1	1	101		
101	HOLD UNIT, PLNT	SRT	3	-	10	1	10	-	10	1	10	-	10	1	10		R&D PART OF 103
	TOTAL COST ESTIMATE			1100	21		1121	1100	31		1131	1100	31		1131		

TABLE I.12-8. COST SUMMARY -  
EQUIPMENT UNIT - 51 PLANT RESEARCH SUPPORT UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
30B	CAGE SHELF, PLNT SEEDL	REDESIGN	1	20	0	1	20	20	0	1	20	20	0	1	20		
50	C LINGSTAT	REMPG	1	50	7	1	57	50	7	1	57	50	7	1	57		
111	KIT, PLNT TOOLS	REMPG	2	25	3	1	28	25	3	1	28	25	3	1	28		
131D	MOTOR, PLNT GRWTH MNTR	REPACK	1	7	1	2	9	7	1	4	11	7	1	4	11		
143C	PUMP, GAS CIRCULATNG	MINIMAL	1	3	1	2	5	3	1	2	5	3	1	2	5		
156B	SQUIBS, FIXATIVE	MINIMAL	1	0	1	4	4	0	1	8	8	0	1	8	8		
156C	SQUIBS FIRNG APPRTS	MINIMAL	1	3	1	1	4	3	1	2	5	3	1	2	5		
	TOTAL COST ESTIMATE			108	19		127	108	26		134	108	26		134		

TABLE I.12-9. COST SUMMARY -  
EQUIPMENT UNIT - 70 INVERTEBRATE HOLDING UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMERCIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
25	CAGE, INVERT, JARS	REDESIGN	2	50	1	1	51	50	1	1	51	50	1	1	51	R&D COST IN 103	
98C	HOLD UNIT INCBR-INVRTS	SRT	3	-	10	1	10	-	10	1	10	-	10	1	10		
113A	KIT, TOOL-INSECT MANIP	REMFG	2	20	3	1	23	20	3	1	23	20	3	1	23		
	TOTAL COST ESTIMATE			70	14		84	70	14		84	70	14		84		

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I.13 EQUIPMENT UNIT 60/61 - CELLS & TISSUES HOLDING UNIT (60), & CELLS & TISSUES RESEARCH SUPPORT UNIT (61)

I.13.1 FUNCTIONAL CAPABILITY & SUMMARY DATA. These equipment units provide for the housing of cells and tissues, as well as supporting research in these areas. Summary data is presented in Table I.13-1.

I.13.2 EQUIPMENT ITEMS. The major equipment includes 2 holding units (cage modules) for cells and tissues, see Table I.13-2. Equipment volume and placement are indicated in Table I.13-3. There are no racks or consoles required for these EUs; however, a drawing of a typical cage module (vertebrate configuration) is shown in Figure I.13-1 for completeness.

I.13.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.13-4.

Data Requirements - See Table I.13-5.

Launch and Reentry Operations - As with the other organisms, any cells and tissues which are being launched should be loaded as late as practical in the launch sequence and recovered as soon as possible upon Sortie Module return. DMS and ECS support may or may not be required during ascent and descent depending upon the particular experiment.

Electrical Power - Most of the power is used for heaters in the holding units for temperature control. These are on continuously and were assumed to be designed for d.c. power. The peak power for these EUs will be 105 watts.

Heat Rejection - Most of the heat supplied to the holding units is to maintain temperatures higher than ambient. Most of this heat is expected to be lost to the cabin air.

I.13.4 EQUIPMENT ITEM COST SUMMARY - See Tables I.13-6 & I.13-7.

TABLE I.13-1. E.U. 60/61 - CELLS & TISSUES HOLDING UNIT/  
 CELLS & TISSUES RESEARCH SUPPORT UNIT - SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	0	0	0
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>390 (13.8)</u>	<u>390 (13.8)</u>	<u>404 (14.3)</u>
Racks & Consoles	0	0	0
Distributed & Extra Items	376	376	376
Small Storage Items (Misc.)	14	14	28
<u>Fixed Weight, kg (lb)</u>	<u>74 (163)</u>	<u>74 (163)</u>	<u>78 (172)</u>
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>100</u>	<u>100</u>	<u>100</u>
Estimated d.c.	100	100	100
Estimated a.c.	0	0	0
<u>Off-Duty* Average Power, Total</u>	<u>100</u>	<u>100</u>	<u>100</u>
Estimated d.c.	100	100	100
Estimated a.c.	0	0	0
<u>Estimated On-Duty Peak Power</u>	105	105	105
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>100</u>	<u>100</u>	<u>100</u>
Estimated Air Cooled Load	100	100	100
Estimated Cold Plated Load	0	0	0
<u>Off Duty Load, Total</u>	<u>100</u>	<u>100</u>	<u>100</u>
Estimated Air Cooled Load	100	100	100
Estimated Cold Plated Load	0	0	0
<u>Development Cost, \$K</u>	328	328	328
<u>Unit Cost, \$K</u>	36	36	37
*12 Hours			

TABLE I.13-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT #60/61 -  
CELLS AND TISSUES HOLDING UNIT (60), CELLS AND TISSUES RESEARCH SUPPORT UNIT (61)

E.I. Name	E.I. No.*	No. of Units Req'd.** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
<u>E.U. 60 - Cells &amp; Tissues Holding Unit</u>							
Colony Chamber, Scalable	25B	2 2	0.9 (2.0)	0	2.8 (0.1)	200 (5) (1) <sup>+</sup>	Colony chamber for cells and tissues. Container for liquid media and organisms with oxygen lines, pumps, membranes, etc.
Cage, MMB, C/T	26A	1 1	0.5 (1)	5	0.8 (0.03)	100 (1)	"Cage" for metabolic mass balance measurements on cells and tissues.
Holding Unit, Incubator, C/T	98A	2 2	32 (70)	50	188 (6.64)	- (10)	Holding Unit for Cells and Tissues. Basically a cage module, a sealed ventilated enclosure for housing organisms. Dev. cost in E.I. 103 in E.U. 40.
<u>E.U. 61 - Cells and Tissues Research Support Unit</u>							
Air Particle Sample Collector	6	1 1	2.7 (6)	0	0.8 (0.03)	28 (4)	To measure airborne particles and microorganisms. Device where air is drawn through a slit impacts an agar substrate where particles and microorganisms stick.
Media, Prepared	124	1 1 (2)	4.5 (10)	0	14 (0.5)	0 (1)	In sealed disposable packages.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

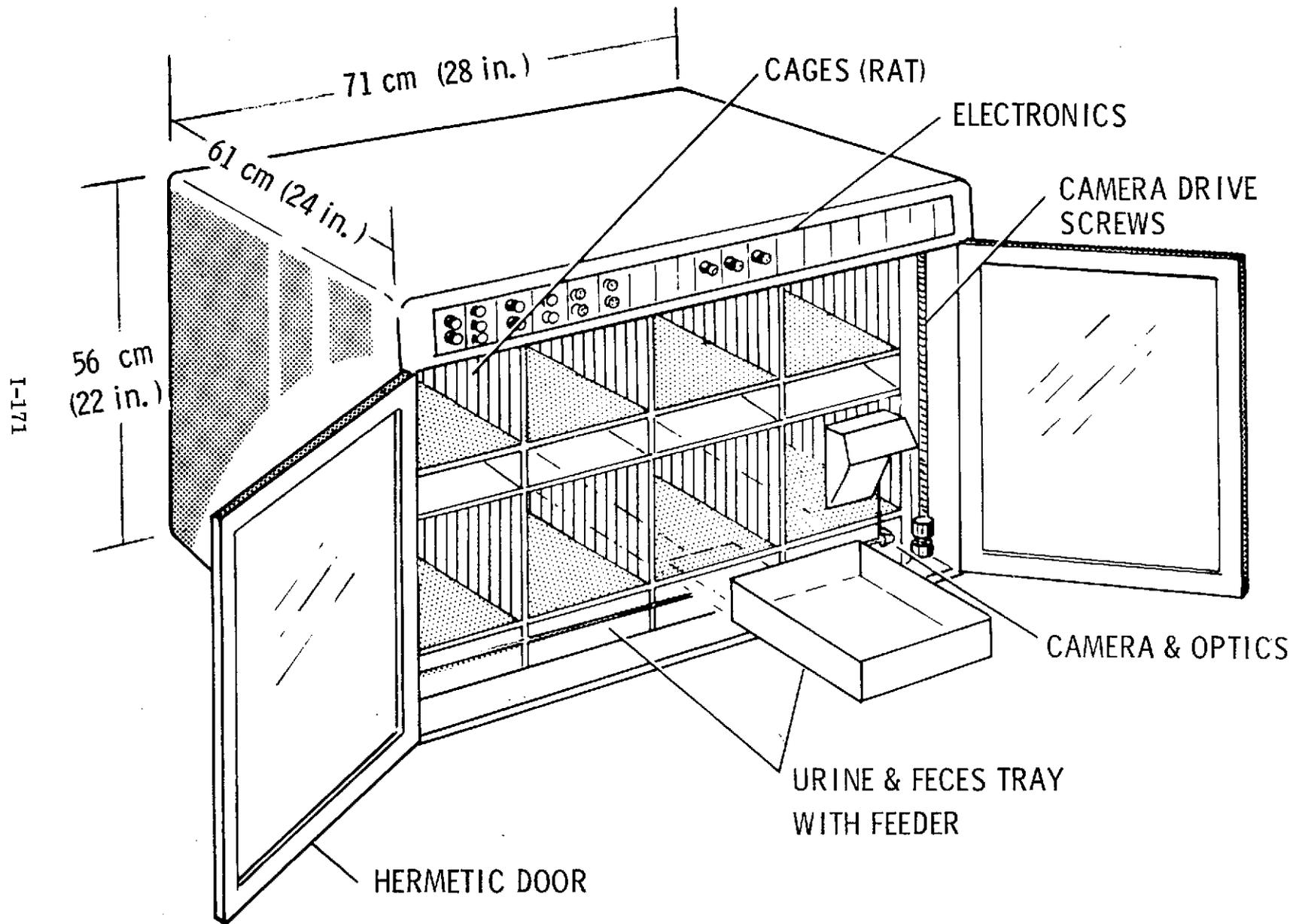
TABLE I.13-3 - EQUIPMENT VOLUME AND PLACEMENT  
 SHARED AND DEDICATED LABORATORIES

E.U. 60/61 - C/T HOLDING UNIT, C/T RESEARCH SUPPORT UNIT  
 (NO RACK OR CONSOLE REQUIRED)

Items (E.I.s)		Volume, dm <sup>3</sup> (ft <sup>3</sup> )		
		Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>DISTRIBUTED OR EXTRA EQUIPMENT ITEMS</u>				
6	Air Particle Sample Collector	negl.	negl.	negl.
25B	Colony Chambers - in Holding Unit	0	0	0
26A	MMB Cage - in Holding Unit	0	0	0
98A	C/T Holding Unit (2)	<u>376</u>	<u>376</u>	<u>376</u>
	TOTALS	376 (13.3)	376 (13.3)	376
<u>SMALL STORAGE EQUIPMENT ITEMS</u> (Can be stored in miscellaneous small storage areas)				
124	Prepared Media	<u>14</u>	<u>14</u>	<u>28</u>
	TOTALS	14 (1/2)	14 (1/2)	28 (1)

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Figure I. 13-1  
**CAGE MODULE**



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## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.13-4A. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 60. CELL AND TISSUE HOLDING UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
25B	COLONY CHAMBER, SEALABLE, C&T 94B Cell and tissue radiochemistries	2	4/wk	$\frac{16.0}{16}$	$\frac{0}{0}$	2	2/wk	$\frac{8.0}{8}$	$\frac{0}{0}$
26A	CAGE MMB, C&T	1*				1*			
98A	HOLDING UNIT INCUBATOR - CELLS & TISSUES	2				2			
	87A Microorganism identification		8/wk	16.0	↓		4/wk	8.0	↓
	135A Holding, cells and tissues		C	A	100		C	A	100
	353A Culture/sensitivity		1/wk	1.0	↑		-	-	-
	372A Fungal culturing		-	-	-		1/wk	$\frac{8.0}{14}$	↑
				$\frac{17}{17}$	$\frac{100}{100}$				$\frac{100}{100}$
	EU TOTAL				100/100 (100/100)				100/100

\*Use is experiment specific.

TABLE I.13-4B. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 61. CELL AND TISSUE RESEARCH SUPPORT UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
6	AIR PARTICLE SAMPLE COLLECTOR	1				1			
	141A Air particulate sampling & analysis		1/dy	15.0	0		-	-	-
	142A Microbiological sampling - air		2/dy	$\frac{10.0}{25}$	$\frac{0}{0}$		1/dy	$\frac{5.0}{5}$	$\frac{0}{0}$
124	MEDIA, PREPARED	1				0			
	81B Media preparation - C&T	(2)	30 min/wk	$\frac{6.0}{6}$	$\frac{0}{0}$				
	EU TOTAL				0/0 (0/0)				0/0

TABLE I.13-5. DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E.U. 60/61 - CELLS AND TISSUES HOLDING UNIT/CELLS AND TISSUES RESEARCH SUPPORT UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Cells and Tissues Cage Modules (2) (60/98A) and</u>										
Temperature Monitor	20-50°C	0.5°C	Anal.	2	5	cont.	6/min	1	86K	
Temperature Control (On-Off)	2 positions	1 position	Disc.	2	1	cont.	6/min	negl.	17K	
ECS Flow Rate Monitor	0-5 v	0.1 v	Anal.	2	6	cont.	6/min	1	104K	
ECS Flow Rate Control	2 positions	1 position	Disc.	2	1	cont.	6/min	negl.	17K	
Relative Humidity Monitor	30-95%	1%	Anal.	2	6	cont.	6/min	1	121K	
Relative Humidity Control	2 positions	1 position	Disc.	2	1	cont.	6/min	negl.	17K	
pCO2 Monitor	1-8 mm Hg	0.1 mm Hg	Anal.	2	7	cont.	6/min	1	121K	
pCO2 Control	2 position	1 position	Disc.	1	1	cont.	6/min	negl.	9K	
pO2 Monitor	140-180 mm Hg	1 mm Hg	Anal.	3	6	cont.	6/min	2	155K	
pO2 Control	2 position	1 position	Disc.	1	1	cont.	6/min	negl.	9K	
Total Pressure Monitor	760±20 mm Hg	2 mm Hg	Anal.	1	5	cont.	6/min	1	43K	
Pressure Control	2 position	1 position	Disc.	1	1	cont.	6/min	negl.	9K	
									708K	TOTAL

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TABLE I.13-6. COST SUMMARY -  
EQUIPMENT UNIT - 60 CELLS & TISSUES HOLDING UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
25B	COINY CHAMBER, SEALBL, CT	REDESIGN	2	200	5	2	210	200	5	2	210	200	5	2	210	980.00	
26A	CAGE MMB C/T	REDESIGN	4	100	1	1	101	100	1	1	101	100	1	1	101		
98A	HOLD UNIT INCUBER-CELLS	SRT	3	-	10	2	20	0	10	2	20	0	10	2	20		R&D COST IN 103
TOTAL COST ESTIMATE				300	31		331	300	31		331	300	31		331		

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TABLE I.13-7. COST SUMMARY -  
EQUIPMENT UNIT - 61 CELLS & TISSUES RESEARCH SUPPORT UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER-	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	CIAL COSTS	
6	AIR PARTCL SMPL COLCT	REPACK	1	28	4	1	32	28	4	1	32	28	4	1	32		
124	MEDIA PREPRED	MINIMAL	0	0	1	1	1	0	1	1	1	0	1	2	2		
	TOTAL COST ESTIMATE			28	5		33	28	5		33	28	6		34		

## I.14 EQUIPMENT UNIT 80 - LIFE SUPPORT SUBSYSTEM TEST UNIT

I.14.1 FUNCTIONAL CAPABILITY & SUMMARY DATA. This equipment unit provides the capability to perform tests on LSS prototype equipment. Summary data is shown in Table I.14-1.

I.14.2 EQUIPMENT ITEMS. Major equipment includes portable life support systems for EVA, and an LSS test bench. The latter is intended to provide support to a variety of experimental test apparatus. Such support would include electrical power connections, coolant fluid connections, structural support, vacuum connections, and general purpose instrumentation. The power of 200 watts for this item is primarily due to the estimated power consumption of a typical test item (a Bosch reactor prototype was used as an example in this study). The equipment list is shown in Table I.14-2, and the equipment volume and placement is shown in Figures I.14-1 and I.14-2.

### I.14.3 OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.14-3.

Data Requirements - See Table I.14-4.

Electrical Power - As mentioned above, the major electrical power consumer is likely to be the life support test apparatus. The power for this was assumed to be 200 watts continuous. It was assumed to be 75% d. c. and 25% a. c. for purposes of this study only. Actually, any ratio of a. c. to d. c. is possible for any one experiment.

Heat Rejection - Similar to the electrical power, the characteristics of the test apparatus heat rejection are quite variable. For purposes of this preliminary study, 50% was assumed to be rejected to the cabin air and 50% to the Sortie Module coolant.

Typical Equipment Unit Functional Interfaces - See Table I.14-5.

### I.14.4 EQUIPMENT ITEM COST SUMMARY - See Table I.14-6.

TABLE I.14-1. E.U. 80, LIFE SUPPORT SUBSYSTEM TEST UNIT -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	$\frac{1}{2}$	1	1
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>429 (15.1)</u>	<u>801 (28.3)</u>	<u>801 (28.3)</u>
Racks & Consoles	372	744	744
Distributed & Extra Items	57	57	57
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	54 (119)	114 (251)	114 (251)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>200</u>	<u>200</u>	<u>200</u>
Estimated d.c.	150	150	150
Estimated a.c.	50	50	50
<u>Off-Duty* Average Power, Total</u>	<u>200</u>	<u>200</u>	<u>200</u>
Estimated d.c.	150	150	150
Estimated a.c.	50	50	50
<u>Estimated On-Duty Peak Power</u>	200	200	200
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>200</u>	<u>200</u>	<u>200</u>
Estimated Air Cooled Load	100	100	100
Estimated Cold Plated Load	100	100	100
<u>Off Duty Load, Total</u>	<u>200</u>	<u>200</u>	<u>200</u>
Estimated Air Cooled Load	100	100	100
Estimated Cold Plated Load	100	100	100
<u>Development Cost, \$K</u>	1015	1015	1015
<u>Unit Cost, \$K</u>	102	902	902
*12 Hours			

TABLE I.14-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT #80,  
LIFE SUPPORT SUBSYSTEM TEST UNIT

E.I. Name	E.I. No.*	No. of Units Req'd,** Shared, Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
LSS Test Bench	115F	1 1	45 (100.0)	200	453 (16.0)	1000 (100)	To provide support to LSS experimental apparatus: electrical connections, fluids, structural support, etc. Power includes typical value for test apparatus.
Manifold, Vacuum	118I	1 1	9 (20)	0	57 (2.0)	15 (2)	To provide vacuum line connections to various test apparatus. Small tubing (about 3/8 inch) should be sufficient. Valves, etc.
Portable LSS	142	0 2	30 (67)	0	79 (2.8)	0 (400)	Portable Life Support System (PLSS). Backpack type units to be used for pressure suit tests.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

**FIGURE I.14-1 EQUIPMENT VOLUME AND PLACEMENT**

Shared 7-Day Laboratory

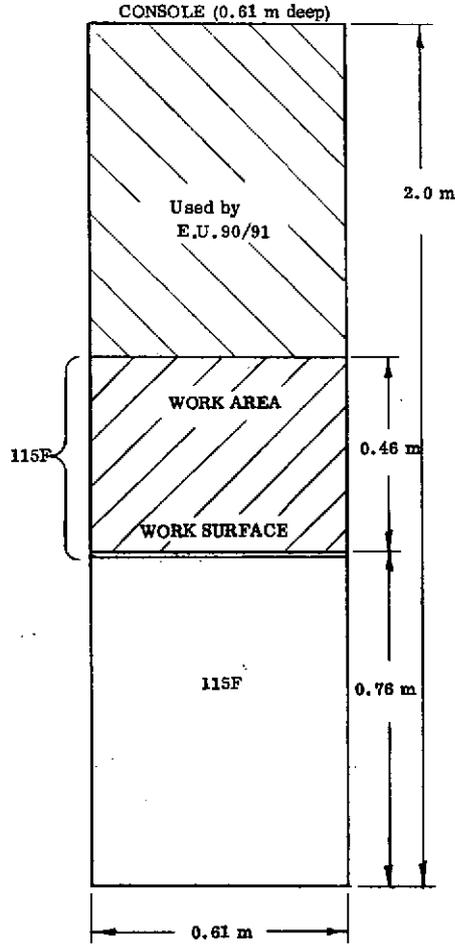
E.U. 80 Life Support Subsystem Test Unit

**EQUIPMENT ITEMS IN CONSOLE**

<u>E.I. Number &amp; Name</u>	<u>Vol.</u> <u>dm<sup>3</sup></u>
<u>In Bottom of Console:</u>	
115F LSS Test Bench	453
Total	453
<u>Excess Volume</u>	
Allowance	none

**DISTRIBUTED OR EXTRA EQUIPMENT ITEMS**  
(Not in Rack or Console)

<u>E.I. Number &amp; Name</u>	<u>Vol.</u> <u>dm<sup>3</sup></u>
118I Vacuum Manifold	57
Total	57



**FIGURE I.14-2 EQUIPMENT VOLUME AND PLACEMENT**

Dedicated 7 & 30 Day Laboratories

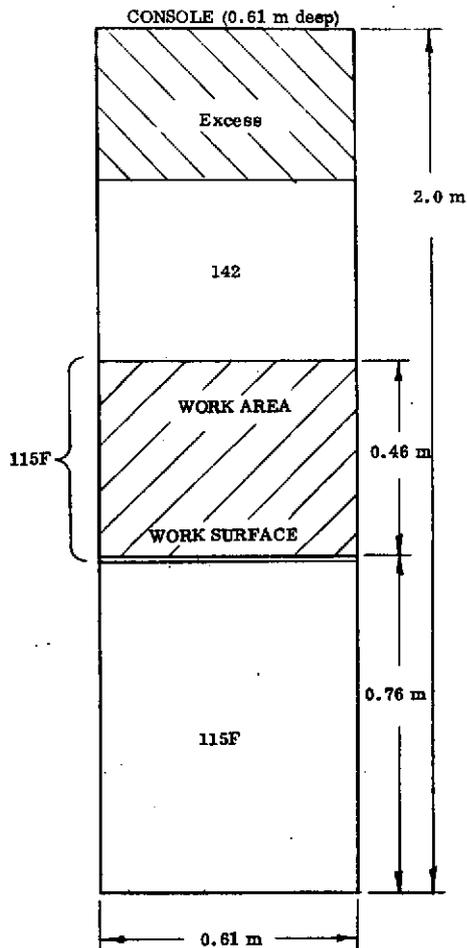
E.U. 80 Life Support Subsystem Test Unit

EQUIPMENT ITEMS IN CONSOLE

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
<u>In Top of Console:</u>	
142 PLSS	158
Total	158
Excess Volume Allowance	132
<u>In Bottom of Console:</u>	
115F LSS Test Bench	453
Total	453
Excess Volume Allowance	0

DISTRIBUTED OR EXTRA EQUIPMENT ITEMS  
(Not in Rack or Console)

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
118I Vacuum Manifold	57
Total	57



## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

- C continuous function
- A automatic function
- \* designates payload or experiment specific
- † high use frequency by crew
- ( ) bracket data is for the 30-Day Dedicated Laboratory only
- 1 included in EI 32A
- 2 part of the Sortie Module Data Management Subsystem
- 3 not used for coded information
- 4 part of organism ECS
- 5 same as No. 2 above

TABLE I.14-3. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 80. LIFE SUPPORT SUBSYSTEM TEST UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
115F	LSS TEST BENCH 500A Control of experiment parameters 508A Vacuum supply	1	5 min/4 hrs C	15.0 $\frac{A}{15}$	200 $\frac{1}{200}$	1			200 $\frac{1}{200}$
118I	MANIFOLD, VACUUM 508A Vacuum supply	1	C	$\frac{A}{0}$	$\frac{0}{0}$	1	C	$\frac{A}{0}$	$\frac{0}{0}$
142	PORTABLE LSS (PLSS) 521B Pressure suit ventilatn. & cooling	2	15 min/3 dy	$\frac{5.0}{5}$	$\frac{0}{0}$	0			
	EU TOTAL				200/200 (200/200)				200/200

TABLE I.14-4 DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E. U. 80 LIFE SUPPORT SUBSYSTEM TEST UNIT

EQUIPMENT ITEMS (E.U.#/E.I.#) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>LSS Test Bench (80/115F)</u>										Exemplary signals are indicated based on a flight test of a Bosch reactor.
Feed Gas Supply Pressures	0-5 V	50 mV	Anal.	2	7	cont.	0.1/min	negl.	2K	
Feed Section Pressure	0-2 psig	0.1 psig	Anal.	1	5	cont.	1/min	negl.	7K	
Compressor Discharge Press.	0-15 psig	0.1 psig	Anal.	1	8	cont.	1/min	negl.	12K	
Feed Gas Flow Rates	0-5 V	0.05 V	Anal.	2	7	cont.	1/sec	14	1.21M	
Re-cycle Gas Flow Rate	0-5 V	0.05 V	Anal.	1	7	cont.	1/sec	7	0.60M	
Re-cycle Mixture Conductivity	0-5 V	0.05 V	Anal.	1	7	cont.	1/min	negl.	10K	
Re-cycle Compressor Power	0-100 w	1 w	Anal.	1	7	cont.	1/min	negl.	10K	
Re-cycle Gas Temps.	0-5 V	0.05 V	Anal.	12	7	cont.	1/min	1	121K	
Heater Power	0-500 w	2 w	Anal.	1	8	cont.	0.2/min	negl.	2K	
Water Accumulation Counter	0-1000	1 count	Digital	1	10	cont.	5/min	1	72K	
Coolant Flow Rate	0-5 V	0.05 V	Anal.	1	7	cont.	1/min	negl.	10K	
									2.056M	

TABLE I.14-5 TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES

EU #	DESCRIPTION OF FUNCTIONAL INTERFACE WITH E.U. 80	CRITI- CALITY*
1	Video and photographic coverage of experimental apparatus phenomena such as a gas/liquid separation device.	3
2	Acquisition, processing and display of experimental apparatus performance parameters.	3
3	Restraint of the crew while attending to LSS research. Supply of gases such as CO <sub>2</sub> for LSS experiments.	2
4	Weighing quantities associated with LSS experiments.	1
5	Analysis of LSS apparatus gases to determine various constituent percentages (e.g., CO <sub>2</sub> , CH <sub>4</sub> , H <sub>2</sub> , CO trace gases, etc.).	3
6/7	General maintenance, clean-up, repair and storage.	1
11	Use of PLSS units in all EVA tests.	3

\*1 = Minimal, 2 = Nominal 3 = Maximal

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TABLE I.14-6. COST SUMMARY -  
EQUIPMENT UNIT - 80 LIFE SUPPORT SUBSYSTEM TEST UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER- CIAL COSTS	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K		
115F	LSS TEST BENCH	REDESIGN	1	1000	100	1	1100	1000	100	1	1100	1000	100	1	1100		
118I	LSPS MANIFOLD VACUUM	REPACK	1	15	2	1	17	15	2	1	17	12	2	1	17		
142	LSPS PORTABLE LSS PLSS	MINIMAL	1			0		0	400	2	800	0	400	2	800		
	TOTAL COST ESTIMATE			1015	102		1117	1015	902		1917	1015	902		1917		

## I.15 EQUIPMENT UNIT 91/93 - M.S.I. MEASUREMENTS UNIT (91), & MOBILITY UNIT (93)

I.15.1 FUNCTIONAL CAPABILITY AND SUMMARY DATA. These equipment units provide the capability to test man's behavior and performance in space and his interaction with various types of equipment. A summary of the properties for these E.U.s is given in Table I.15-1.

I.15.2 EQUIPMENT ITEMS. Major equipment items are the psychomotor performance console, the force/torque measurement taskboard, the vision tester, protective corridor devices, and the EVA, M.S.I. task simulator (required only on the dedicated laboratories). The complete list of equipment items and their general descriptions are given in Table I.15-2. Equipment item placement is shown in Figures I.15-1 & I.15-2.

### I.15-3. OPERATIONS AND INTERFACES.

Equipment Operations Analysis - See Table I.15-3.

Data Requirements - See Table I.15-4.

Electrical Power - Peak power for these E.U.s will be approximately 105 watts, when the psychomotor performance console and the optiscan device are on simultaneously. All power was assumed to be d.c.

Heat Rejection - All equipment was assumed to be air cooled.

Typical Equipment Unit Functional Interfaces - See Table I.15-5.

### I.15.4 EQUIPMENT ITEM COST SUMMARY - See Tables I.15-6 & I.15-7.

TABLE I.15-1. E.U. 91/93 - MSI MEASUREMENT UNIT/MOBILITY UNIT -  
SUMMARY OF PROPERTIES

Property	Shared 7-Day Lab	Dedicated 7-Day Lab	Dedicated 30-Day Lab
<u>Number of Racks &amp; Consoles</u>	$\frac{1}{2}$	$\frac{1}{2}$	$\frac{1}{2}$
<u>Volume, dm<sup>3</sup> (ft<sup>3</sup>), Total</u>	<u>372 (13.1)</u>	<u>938 (33.1)</u>	<u>1051 (37.1)</u>
Racks & Consoles	372	372	372
Distributed & Extra Items	0	566	679
Small Storage Items (Misc.)	0	0	0
<u>Fixed Weight, kg (lb)</u>	72 (158)	118 (260)	142 (312)
<u>Electrical Power, w</u>			
<u>On Duty* Average Power, Total</u>	<u>0</u>	<u><math>\frac{2}{2}</math></u>	<u><math>\frac{4}{4}</math></u>
Estimated d.c.		2	4
Estimated a.c.		0	0
<u>Off-Duty* Average Power, Total</u>	0	0	0
Estimated d.c.			
Estimated a.c.			
<u>Estimated On-Duty Peak Power</u>	105	105	105
<u>Heat Rejection, w<sub>t</sub></u>			
<u>On Duty Load, Total</u>	<u>0</u>	<u><math>\frac{2}{2}</math></u>	<u><math>\frac{4}{4}</math></u>
Estimated Air Cooled Load		2	4
Estimated Cold Plated Load		0	0
<u>Off Duty Load, Total</u>	0	0	0
Estimated Air Cooled Load			
Estimated Cold Plated Load			
<u>Development Cost, \$K</u>	211	461	495
<u>Unit Cost, \$K</u>	56	71	98
*12 Hours			

TABLE I.15-2. EQUIPMENT ITEMS (EIs) CONTAINED IN EQUIPMENT UNIT #91/93,  
MSI MEASUREMENTS UNIT (91), MOBILITY UNIT (93)

E.I. Name	E.I. No.*	No. of Units Req'd,** Ded.	Unit Weight kg (lb.)	Unit Pwr*** watts	Unit Volume dm <sup>3</sup> (ft <sup>3</sup> )	Cost Develop. (Unit) <sup>+</sup> \$K	Comments
<u>E. U. 91 - MSI Measurements Unit</u>							
Audio Stereo Headset	(15D)	(1)	0.7 (1.5)	0	5.7 (0.2)	14 (2)	Earphones for various MSI hearing tests.
Console, Behav. Measurements	(50C)	- -	-	-	-	-	Behavioral Measurements Console CRT and response keyboard capable of alphanumeric and graphic displays, for tests of crew's sensory and mental capabilities. Can be provided by Data Management Subsystem Remote Control Station Module, E.I. 58A, E. U. 2.
MSI Task Simulator	119	0 1	23 (50)	5	566 (20)	200 (10)	For testing astronauts' ability to do maintenance, repair, assembly, etc. Experiment specific.
Optiscan - Field & Fixed	131H	1 1	2.3 (5.0)	5	8.5 (0.3)	21 (3)	For monitoring subject eye movement during MSI tests. Accurate to 2° arc. A head mounted camera device.
Psychomotor Performance Console	144	1 1	45 (100)	100	113 (4.0)	150 (50)	Provides multiple measurement devices of the crew's psychomotor performance.
Taskboard, Force/Torque	176H	0 1	23 (50)	5	57 (2.0)	50 (5)	Devices to determine man's capability to apply various torques and forces in various directions and orientations.
Vision Tester	(182K)	(1)	23 (50)	100	113 (4.0)	20 (25)	Hood and optical system with various images, computer controlled and monitored.
<u>E. U. 93 - Mobility Unit</u>							
Anthropometric Grid	15	1 1	1.8 (4)	0	2.8 (0.1)	10 (1)	Various sizes to allow measurement of size and movement of various organisms. Used together with various optical devices. Values are for package of 10 grids.
Mass, Test - Variable Size	122A	3 3	0	0	0	0 (0)	Various size existing masses aboard the vehicle for MSI mobility tests. Experiment specific.
Mobility Unit - Protective Corridor	126I	1 1	23 (50)	0	57 (2.0)	30 (2)	Protective corridor devices, for mobility and transport tests on man. For Sortie missions, this consists of covers, bumpers, rails, etc., which can be positioned in existing volume to allow mobility tests.

\* EI No. in parentheses in this column indicates that the item is needed only for the dedicated 30-day mission.

\*\* Number of units (EIs) required in shared laboratory is given by the upper number, and the number required in the dedicated laboratories is shown by the lower numbers. Parentheses indicate the number required for the 30-day laboratory (only if it is different from the number required for the dedicated 7-day laboratory).

\*\*\* Average power while equipment is operating.

+ The top number (unparenthesized) is development cost. The parenthesized numbers are unit costs, and a plus (+) indicates a unit cost value for a commercially available item intended for ground use.

**FIGURE I.15-1 EQUIPMENT VOLUME AND PLACEMENT**

**Shared 7-Day Laboratory**

**E.U. 91/93 MSI Measurements Unit and Mobility Unit**

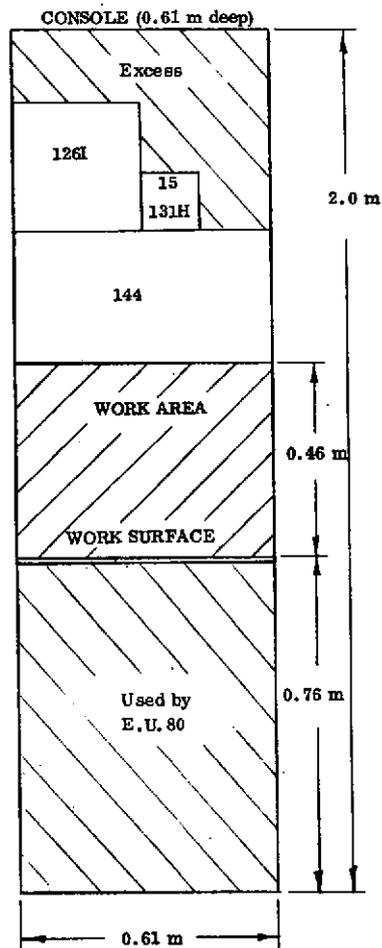
**EQUIPMENT ITEMS IN CONSOLE**

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
<b>In Top of Console:</b>	
15 Anthropometric Grid	2.8
126I Protective Devices	57
131H Optiscan	8.5
144 Psychomotor Perf. Console	113
<b>Total</b>	<b>181.3</b>
<b>Excess Volume</b>	
<b>Allowance</b>	<b>109</b>

**DISTRIBUTED OR EXTRA EQUIPMENT ITEMS**

(Not in Rack or Console)

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
None	



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**FIGURE I.15-2 EQUIPMENT VOLUME AND PLACEMENT**

**Dedicated 7-Day & 30-Day Laboratories**

**E.U. 91/93 MSI Measurements Unit and Mobility Unit**

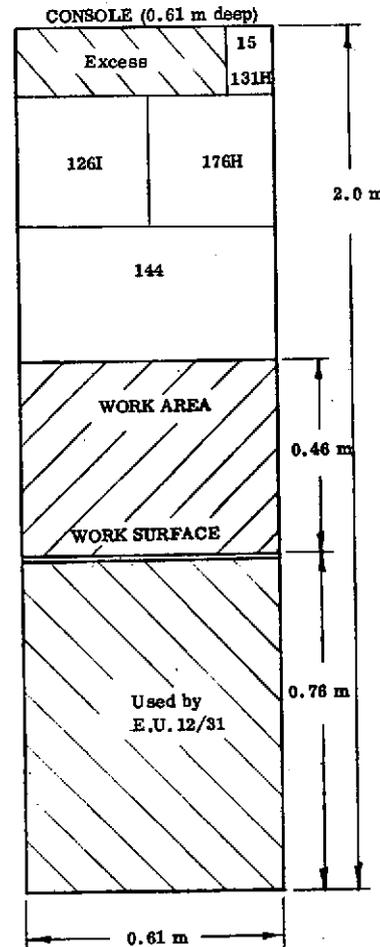
**EQUIPMENT ITEMS IN CONSOLE**

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
<b>In Top of Console:</b>	
15 Anthropometric Grid	2.8
150 Audio Headset*	5.7
126I Protective Corridor Devices	57
131H Optiscan	8.5
144 Psychomotor Perf. Console	113
176H Taskboard	57
<b>Total</b>	<b>244.0</b>
Excess Volume Allowance	46

**In Bottom of Console:**

Used by E.U. 12/31 for E.I. 125D  
Metabolic Analyzer

\*Required only for 30-Day Mission



**DISTRIBUTED OR EXTRA EQUIPMENT ITEMS**  
(Not In Rack or Console)

<u>E.I. Number &amp; Name</u>	<u>Vol. dm<sup>3</sup></u>
119 MSI Task Simulator	566
<b>Dedicated 7-Day Laboratory Total</b>	<b>566</b>
Extra Item for Dedicated 30-Day Lab.	
182K Vision Tester	113*
<b>Dedicated 30-Day Laboratory Total</b>	<b>679</b>

## EQUIPMENT OPERATIONS ANALYSIS TABLE

### Code Explanations

C	continuous function
A	automatic function
*	designates payload or experiment specific
†	high use frequency by crew
( )	bracket data is for the 30-Day Dedicated Laboratory only
1	included in EI 32A
2	part of the Sortie Module Data Management Subsystem
3	not used for coded information
4	part of organism ECS
5	same as No. 2 above

TABLE I.15-3A. EQUIPMENT OPERATIONS ANALYSIS.- EQUIPMENT UNIT 91 - BEHAVIORAL MEASUREMENTS UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
15D	AUDIO STEREO HEADSET	0				0			
	715A Auditory - absolute threshold	(1)	2/3 dy	1.3	0				
	716A " - pitch discrimination		"	1.7	0				
	717A " - temporal acuity		"	1.7	0				
	730A Cognitive/complex perceptual-speech intel.		"	<u>3.3</u>	<u>0</u>				
				(8)	0				
50C	CONSOLE, BEHAVIORAL MEASMTS.-CRT + KYBD	0				0			
	734A Cognitive/complex perceptual-perceptl. spd.	(1) <sup>F</sup>							
	740A Cognitive/conceptual & thinking ability								
	752A Cognitive/memory-memory span, etc.								
119	MSI TASK SIMULATOR (see below)								
131H	OPTISCAN	1				1			
	825A Eye movement measurements - optical		15 min/wk	<u>3.0</u>	<u>0.1</u>		10 min/wk	<u>2.0</u>	<u>0.1</u>
				3	0			2	0
144	PSYCHOMOTOR PERFORMANCE CONSOLE	1				1			
	416A Tracking measurements		2/wk	1.2	0.2		-	-	-
	760A Fine psychomotor - manipulative ability		2/3 dy	3.3	0.5		-	-	-
	766A " " - tracking		"	2.0	0.3		2/wk	1.2	0.2
	768A " " - multilimb coord.		"	2.7	0.4		-	-	-
	770A " " - reaction time, simple		"	1.7	0.2		-	-	-
	771A " " - " " , complex		"	<u>1.0</u>	<u>0.1</u>		-	-	-
				12	2			1	0
176H	TASKBOARD, FORCE/TORQUE	1				0			
	776B Gross psychomotor - muscle strength		2/3 dy	<u>6.7</u>	<u>0.1</u>				
				7	0				
182K	VISION TESTER	0				0			
	700A Visual - acuity, static	(1)	2/3 dy	1.3	0.2				
	702A " - stereopsis (depth perception)		"	1.3	0.2				
	704A " - brightness threshold		"	1.3	0.2				
	706A " - color perception		"	0.7	0.1				
	707A " - critical flicker fusion freq.		"	1.3	0.2				
	708A " - phorias lateral & vertical		"	1.3	0.2				

<sup>F</sup>Part of DMS.

TABLE I.15-3A. EU 91 (cont'd)

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
182K	VISION TESTER (Cont'd)								
	709A Visual - glare recovery (photo stress)		2/3 dy	1.3	0.2				
	710A " - dark adaptation		"	1.3	0.2				
	713A " - peripheral field		"	<u>2.0</u> (12)	<u>0.3</u> (2)				
119	MSI TASK SIMULATOR	1				0			
	524A Maintenance task simulation		15 min/wk	<u>3.0</u> 3	<u>0.1</u> 0				
	EU TOTAL				2/0 (4/0)				0/0

TABLE I.15-3B. EQUIPMENT OPERATIONS ANALYSIS - EQUIPMENT UNIT 93 - MOBILITY UNIT

EQUIP. ITEM	EQUIPMENT NAME AND USING FUNCTION	DEDICATED LAB				SHARED LAB			
		NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS	NO. OF ITEMS REQ'D	FUNCT. FREQ.	CREW TIME, MIN/DAY	AVE. POWER, WATTS
15	ANTHROPOMETRIC GRID 822B Crew body position measurements 823B Crew body motion measurements	1	30 min/dy " "	30.0 " <u>30</u>	0 0 0	1	15 min/dy " "	15.0 " <u>15</u>	0 0 0
122A	MASS, TEST 840A Max. mass transportable - SS 840B " " " - PS 841A " volume " - SS 841B " " " - PS 842A " MOI " - SS 842B " " " - PS 843A " mass alignable - SS 843B " " " - PS 844A " volume " - SS 844B " " " - PS 845A " MOI " - SS 845B " " " - PS	3*				3*			
126I	MOBILITY UNIT - PROTECTIVE CORRIDOR 840A Max. mass transportable 841A " volume " 842A " MOI " 843A " mass alignable 844A " volume " 845A " MOI "	1	5 min/wk " " " " "	1.0 " " " " <u>0</u> 6	0 0 0 0 0 0	1	3 min/wk " " " " "	0.6 " " " " <u>4</u>	0 0 0 0 0
	EU TOTAL				0/0 (0/0)				0/0

\*Use is experiment specific.

TABLE I.15-4 DEDICATED 7-DAY LABORATORY SAMPLED DATA REQUIREMENTS

E. U. 91/93, BEHAVIORAL MEASUREMENTS UNIT/MOBILITY UNIT

EQUIPMENT ITEMS (E. U. #/E. I. #) AND SIGNAL IDENTITY	SENSOR/SIGNAL CHARACTERISTICS					PROCESSING				COMMENTS
	Range	Resolution	Signal Type	No. of Chan.	Bits per Sample	Sampling Duration min/day	Sampling Rate per Channel	Total Bit Rate, BPS	Total Bits per Day	
<u>Psychomotor Performance Console (91/144)</u>										
Joystick Pickup	0-5 V	50 mV	Anal.	4	7	12	50/sec	1400	1.0M	
Reaction Timelights	2 position	1 position	Disc.	12	1	12	1/sec	12	9K	
Steadiness Tester	2 position	1 position	Disc.	4	1	12	1/min	negl.	negl.	
Pattern Perception Display	2 position	1 position	Disc.	2	1	12	1/min	negl.	negl.	
Response Keys Monitor	2 position	1 position	Dig.	48	1	12	5/sec	240	173K	
Tracking Display Generation	2 position	1 position	Disc.	1	1	12	1/min	negl.	negl.	
Digital Insert Monitor	2 position	1 position	Disc.	6	1	12	1/min	negl.	negl.	
Tracking Hand Controller	0-5 V	50 mV	Anal.	2	7	12	50/sec	700	504K	
Numerical Display Control	2 position	1 position	Disc.	4	1	12	1/min	negl.	negl.	
Console On/Off	2 position	1 position	Disc.	1	1	cont.	1/min	negl.	9K	
Initiation Control	2 position	1 position	Disc.	1	1	12	1/min	negl.	negl.	
Power Supply Monitor	12	12	Anal.	1	7	12	0.1/sec	1	1K	
<u>Vision Tester (91/182K)</u>										
Brightness Control	10 level	1 level	Dig.	1	4	12	6/min	negl.	negl.	
Focus Control	10 level	1 level	Dig.	1	4	12	6/min	negl.	negl.	
Tester On/Off	2 position	1 position	Disc.	1	1	cont.	1/sec	1	86K	
Initiation Control	2 position	1 position	Disc.	1	1	12	1/min	negl.	negl.	
Response Key Monitor	2 position	1 position	Disc.	48	1	12	1/sec	48	35K	
									1.817M	TOTAL

TABLE I.15-5 - TYPICAL EQUIPMENT UNIT FUNCTIONAL INTERFACES

EU #	DESCRIPTION OF FUNCTIONAL INTERFACE WITH E.U. 91/93	CRITI- CALITY*
1	Video and photographic analytical studies of psychomotor performance levels, sensory acuity and 0-g performance decrement.	3
2	Processing of instrumentation signals. The data management control and display console is used to perform MSI tests on crew's sensing and mental capabilities	3
5	Use of audiometer, sound level meter and headset for determining aural acuity and frequency discrimination among crew members.	3
6/7	General maintenance, clean-up, repair, and storage.	2
11	Behavioral observations, visual acuity, and aural acuity measurements during EVA tasks.	3
12/31	Monitoring of electrophysiological phenomena (ECG, EEG, EMG) during various psychomotor performance tests. Measurement of cardiopulmonary function (i.e., respiration rates, pulse, etc.) during performance testing.	3

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\*1 = Minimal, 2 = Nominal 3 = Maximal

TABLE I.15-8. COST SUMMARY -  
EQUIPMENT UNIT - 91 MSI MEASUREMENT UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER-	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	CIAL COSTS	
15D	AUDIO STEREO HEADSET	REMPG	1			0				0		14	2	1	16		
50C	CONSL, BEHAV, MSMTS-CRT																SAME AS EI63B,EU-2
119	MSI TASK SIMULATOR	REDESIGN	3			0		200	10	1	210	200	10	1	210		
131H	OPTISCAN-FIELD AND FIXT	REMPG	1	21	3	1	24	21	3	1	24	21	3	1	24		
144	PSYCHOMTR PERF CONSL	REDESIGN	2	150	50	1	200	150	50	1	200	150	50	1	200		IMBLMS DEVELOPED
176H	TASKBRD, FORCE/TORQUE	REPACK	1			0		50	5	1	55	50	5	1	55		
182K	VISION TESTER	REMPG	1			0						20	25	1	25		IMBLMS DEVELOPED
	TOTAL COST ESTIMATE			171	53		224	421	68		489	455	95		550		

TABLE I.15-7. COST SUMMARY -  
EQUIPMENT UNIT - 93 - MOBILITY UNIT

EQUIPMENT IDENTIFICATION		DEVELOPMENT		SHARED SORTIE (7 DAYS)				DEDICATED SORTIE (7 DAYS)				DEDICATED SORTIE (30 DAYS)				COMMER-	REMARKS
No.	Title	Type	Time (Yrs)	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	Dev. Cost \$K	Unit Cost \$K	No. Req.	Total Cost \$K	CIAL COSTS	
15	ANTHROPOMETRIC GRID	REPACK	0	10	1	1	11	10	1	1	11	10	1	1	11		
122A	MASS, TEST-VAR SIZE WT SHP	U	1	0	0	3	0	0	0	3	0	0	0	3	0		
126I	MOBILITY PROTCT CORR	SRT	2	30	2	1	32	30	2	1	32	30	2	1	32		
	TOTAL COST ESTIMATE			40	3		43	40	3		43	40	3		43		

APPENDIX II  
OPERATIONS MODEL

An operations model was developed based upon the functions to be performed within the laboratories (see Section 6.0, Volume II). The model is documented in Table II-1. The functions and their selected methods are listed in the left-hand column. The estimated time to complete the function - method is listed in the next two columns; the first column is the time estimate if the function-method is performed just once; the second column is the time estimate for each additional repetition (it generally is smaller as the unstow, setup, restow type of activities are included in the first time estimate). The next three columns are the estimated frequency of occurrence of the function-method for the Dedicated and Shared laboratories and an explanatory note column. The estimated frequencies are stated as the number of repetitions of a given function or method per time period (or where a time estimate was not provided in the functions inventory, an activity time estimate per time period).

The final columns in Table II-1 are crew time estimates used in the manning analysis.

TABLE II-1  
OPERATIONS MODEL

OPERATIONS MODEL

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY *			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
3 Vertebrate feeding - solid pellets are supplied adlib or regulated A Pellets attached to belt	0	0	C <sup>1</sup>	C		A <sup>2</sup>	A
4 Vertebrate watering - req dripless animal actuated dispenser tips A Manifold low pressure to tips	0	0	C	C		A	A
5 Urine mgmt at cage - urine must be removed quickly (minutes) Air flow thru cage moves urine to collection pad. A Lam air flow system as appo	0	0	C	C		A	A
6 Urine mgmt from cage collector to storage or disposal A Urine pad exchanged	20	2	1/wk	1/wk		20/wk	20/wk
8 Feces mgmt - cage to disposal liquid to solid consistency B Feces collected through LFB	20	1	1/wk	1/wk		20/wk	20/wk
9 Organism mass measurements A Oscillating mass measurements	5	5	1/3 dys	1/wk		5/3 dys	5/wk
10 Holding primates MMB - measures basic metabolism at work/rest C Modified primate holding cylinder	60 <sup>2</sup>		1/2C	-		A	-
11 Holding rat and rat size animals for metabolic msmts A Special cage with many xdcrs	20		1/2C	-		A	-
12 Holding mouse MMB - same as for rat A Special cage with many xdcrs	20		1/2C	-		A	-
13 Holding cage MMB - rabbits/marmots, etc. A Special cage with many xdcrs	20		1/2C	-		A	-
14 Biotelectic xdcr installation and setup - beware emi B Crt check/precalib comptr cal C Preinstal	15 1	5 1	2/2 dys 1/dy	- 1/dy	Crew checkout	20/2 dys 1/dy	- 1/dy
15 Camera setup A Mount, function ck and calib	20	10	1/dy	-		30/dys	-
16 Setup camera optical commutation-organism to organism C X-Y camera drive	1/5C	-	1/5 C	-		A	-
17 Monitor ECG (for bioresearch - ecg signal mgmt from cage to cage Mod to data mgmt.) B Hardware multiplex data to dm	5	0	C	-	3/wk crew checkout	9/wk	-

\* Or minutes/time period where appropriate.  
\*\* Data in parenthesis are for 30-day lab only.  
1 "C" indicates a continuous function.

2 "A" indicates an automatic function with no crew time required except for initial equipment setup. This time is estimated in the "First Repetition" column but not used in the manning analysis.

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
17 (cont.) All data available at dm continuously							
C Xntr on organm/recvr at cg mod mod to dm as in mode A or B - this technique req for free orgnsm	10	10	2/wk	2/wk		20/wk	20/wk
F Electrophysiology backpack - man	U <sup>4</sup>	U	30 min/wk	15 min/wk		30/wk <sup>3</sup>	15/wk <sup>3</sup>
18 Monitor EEG (for bioresearch - EEG signal mgmt from cage to cage mod to Data Mgmt.)							
B Hardwire multiplex data to IM All data available at IM continuously	5	2	C	-	2/wk crew checkout	7/wk	-
F Electrophysiology backpack - man -	U	U	5 min/3 dys	-		5/3 dys <sup>3</sup>	-
19 Monitor EMG-EMG signal mgmt cage to cage mod to data mgmt							
B Hardwire multiplex data to IM All data available at IM continuously	5	2	C	-	2/wk crew checkout	7/wk	-
F Electrophysiology backpack - man -	U	U	5 min/wk	-		5/wk <sup>3</sup>	-
20 Respiratory rate monitoring - does not include resp volume							
A Extract from resp CO2 data	0	0	1/6C	-		A	-
21 Cardiac output - implanted flow xdcr-signal xfr to IM as Func 17							
A Catheterized semirestrained	10	10	2/wk	-		20/wk	-
B Ultrasonic flowmeter	30	10	1/wk	-		10/wk	-
22 Temperature msmts							
A Thermocouples	5	0	10 min/wk	5 min/wk		10/wk	5/wk
B Thermisters	5	0	10/min/wk	5 min/wk		10/wk	5/wk
23 Nutrient Consumption - a count of the number of pellets consumed							
A Trigger bar against pellet	2	0	30/min/wk	-		A	-
24 Water consumption - water consumed or water delivered							
A Flowmtr in manifold	10	0	30/min/wk	-		A	-
C Water dispenser/trigger bar	2	U	30 min/wk	-		A	-
26 Liquid volume msmts - micro volumes .001 ml to 1 ml							
B Microsyringes and needles	2	2	4/day	2/day		8/day	4/day
27 Liquid volume msmts - Macro 1 ml to 1000 ml							
A Macrosyringes	2	2	8/day	4/day		16/day	8/day
28 Mass measurements of contained liquids and solids							
A Piezoelectric sensor oscillator	3	3	3/day	2/day		9/day	6/day

<sup>3</sup> A two-man function

<sup>4</sup> "U" means "Unknown"

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
29 Mass measurements - contained liquids and solids A Oscillating mass msmt sys	3	3	4/dy	2/dy		12/dy	6/dy
31 Biosampling-obtaining blood whole organism leaves etc for analysis B Work through LFB at QM C Subject on RLC	5 10	5 5	6/dy 2/3 dys	3/dy -		30/dy 15/3 dy <sup>3</sup>	15/dy -
32 Specimen status observation-periodic look at organisms in cages A Video monitor	1	1	20/dy	10/dy		20/dy	10/dy
33 Blood preparation - syringe-tube/capillary with NAF EDTA etc A Clot/cent for serum cntrige	10	5	4/dy	2/dy		25/dy	15/dy
34 Blood electrolytes C Preserve for ground analysis	5	2	10/wk	5/wk		23/wk	13/wk
35 Blood PH PCO2 O2 Msur conc of dissolved gs in blood A Specific ion sensors	2	2	10/wk	-		20/wk	-
36 Blood total protein msur conc in serum or whole blood C Preserve for ground analysis	5	2	5/wk	-		13/wk	-
40 Blood morphology and cell counts D Stain for ground analysis	10	5	(10/wk)	-		(55/wk)	-
41 Hematocrit msur of packed cell vol to total vol A Microhematocrit B Electronic hematocrit inst	5 1	1	- 2/wk	1/wk -		- A	5/wk -
42 Hemoglobin-msur conc oxyhgb or carboxyhgb A Cyanmethemoglobin mthd	15	3	2/wk	1/wk		18/wk	15/wk
43 Digital records-recording of instrument data A Inst data direct to IM-CRT B Std meters and recrdr on inst	0 5	0 5	C 1/dy	C 1/dy		A 5/dy	A 5/dy
44 Analog records - recording of inst data A Inst data direct to IM-CRT B Strip Chart recorders-paper	0 5	0 5	C 1/dy	C 1/dy		A 5/dy	A 5/dy
49 Pressure monitoring A Meters visual readout B Pressure xdcr electronic sig	3 0	1 0	1/dy C	- C		3/dy A	- A

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
50 Gas sampling - obtain gas from site xfer to instmt							
A Manual syringe samples	10	10	1/dy	1/2		10/dy	10/2 dys
B Micromanifold system	0	0	C	C		A	A
51 Trace gas analysis hydrocarbons-specific compound/predeterm list							
A Gas chromatography	0	0	15 min/dy	-		A	-
B Mass spectroscopy	0	0	10 min/dy	10 min/dy		A	A
52 Trace gas analysis inorganics							
A Mass spectroscopy	10	0	5 min/dy	5 min/dy		A	A
B Atomic Absorption spectrophoto	10	0	10 min/wk	-		A	-
53 Oxygen monitoring							
B Mass spectrometry	10	0	1/4C	1/4C		A	A
54 Carbon dioxide monitoring							
B Mass spectrometry	10	0	1/4C	1/4C		A	A
55 Nitrogen monitoring							
B Mass spectrometry	10	0	1/4C	1/4C		A	A
C Total pressure difference	0	0	C	C		A	A
56 Carbon monoxide monitoring							
C Mass spectrometer	10	0	1/4C	1/4C		A	A
57 Water vapor monitoring							
A Mass spectrometry	10	0	1/4C	1/4C		A	A
C Specific sensors	5	5	1/dy	1/dy		5/dy	5/day
58 Ammonia monitoring							
C Mass spectrometry	10	0	1/4C	1/4C		A	A
59 Atmospheric ethylene monitoring sens to soppb							
A Gas chromatography	20	0	1/4C	1/4C		A	A
61 Vibration monitoring							
A Accelerometers	5	0	C	C		A	A
62 Acceleration monitoring 10-5 to 1G 0-100HZ							
A Accelerometers	0	0	C	C		A	A
63 Radiation monitoring at orgnsm holding and throughout lab							
A Film sensors	1	0	C	-		A	-
B Plastic dosimetry	2	2	2/wk	2/wk		4/wk	4/wk
C Rate monitoring	2	2	2/wk	2/wk		4/wk	4/wk

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
64 Noise monitoring A Miniature microphone	3	0	C	C		A	A
65 Plant activity-msur growth and movement of plants A Time lapse video-short storage D Make/break incremental motor	30 U	0 U	1 min/dy 1 min/dy	1 min/dy 1 min/dy		1/dy 1/dy	1/dy 1/dy
66 Animal activity - msur animal activity in std. and mmb cages A Video - time lapse	10	0	1 min/dy	1 min/dy		A	A
68 Organism identification film A ID tags and solid state time	5	0	C	C		A	A
70 Air movement A Thermal couple anamoters	5	0	C	C		A	A
71 Light monitoring-on/off and intensity-assume no freq data req A Photocells B Phototransistors	5 5	0 0	C C	C C		A A	A A
72 Organism identification video records A Number ID on org or cage-time	5	0	C	C		A	A
73 Data storage A Computer-magnetic tape or disc B Computer memory core	0 0	0 0	C C	C C		A A	A A
75 Crew guidance - provide desired information to crew on demand A Semifixed information sys	1	1	30 min/dy	15 min/dy		30/dy	15/dy
76 Experiment management system A Programmed 15 devoted computer	5	0	C	C		A	A
77 Microscopy general A Standard light microscope B Disecting microscopy	10 10	10 10	(4/2 days) 4/2 dys	- 4/2 dys		(40/2 dys) 40/2 dys	- 40/2 dys
78 Invertebrate counting and sorting (insects) A Manual ops at PP workbench	U	U	15 min/dy	5 min/dy		15/dy	5/dy
79 Organism subculture-substrate preparation B Logistic supply prepard media	U	U	C	-		A	-
80 Organism subculture-plants B Logstc supply preprd substrtes	U	U	15 min/wk	-		15/wk	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
81 Media preparation-cells and tissue B Logistic supply preprd media	U	U	30/min/wk	-		30/wk	-
82 Work bench cleanup - deactivat equip, recage or dispose of specimen(s), cleanup and stow equip, dispose of waste, clean bench surface, stow and/or dispose of cleaning material A	15	5	3/dy	2/dy		20/dy	20/dy
83 Workbench sterilization A Alcohol or quad ammonia wash C Work bnch autoclavabl liners	10 5	10 5	1/dy 4/dy	1/dy 2/dy		10/dy 20/dy	10/dy 10/dy
84 Organism subculturing-cells and tissue A Standard ground techniques	5	2	8/dy	-		19/dy	-
85 Starch granule assay A Fix starch grans in situ	U	U	10 min/wk	5 min/wk		A	A
86 Bacterial colony counting A Automatic colony counting B Manual counting	3 10	3 10	5/wk -	- 3/wk		15/wk -	- 30/wk
87 Microorganism identification A Preservation of isol colonies	10	10	8/wk	4/wk		80/wk	40/wk
88 Bacterial smear staining A Manual smears auto staining	5	5	25/wk	-		125/wk	-
89 Histological sectioning-wax and plastic empedment B Imbedment for ground analysis	10	10	(2/wk)	-		(20/wk)	-
90 Histological staining A Automatic flowthrough stain	5	2	2/wk	-		7/wk	-
91 Plant Radiochemistries A Adminstrn of gas/liquid (fixed work site) B Adminstrn of gas/liquid (LFB)	20 20	20 20	4/wk -	- 2/wk		80/wk -	- 40/wk
92 Vertebrate radiochemistries B Adminstrn of gas/liquid (LFB)	20	20	4/wk	2/wk		80/wk	40/wk
93 Invertebrate radiochemistries B Adminstrn of gas/liquid (LFB)	20	20	4/wk	2/wk		80/wk	40/wk

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab	Shared Lab
						(7 & 30 Day)	(7 Day)
94 Cells and tissue radiochemistries B Adminstrn of gas/liquid (LFB)	20	20	4/wk	2/wk		80/wk	40/wk
95 Radio isotope methodology-preparation and mgmt C LFB special radiochem insert	U	U	15 min/wk	10 min/wk		15/wk	10/wk
96 Radiochem waste mgmt - radiochems, orgnsm, and parts A Waste container in PE or W box	U	U	15 min/wk	10 min/wk		15/wk	10/wk
97 Experiment waste mgmt A Pkg-sterilize/store intervehic	U	U	10 min/dy	10 min/dy		10/dy	10/dy
98 Distilled/sterile water preparation B Prepare in space	10		C	-		A	-
102 Sterilizn of atm gases C Filtration	10	0	C	-		A	-
105 Organism or sample presvn with gas or liquid chemicals A Manual fill of containers	2	2	2/dy	-		4/dy	-
106 Organism/sample pres thermal A Low temperature	2	2	4/dy	2/dy		8/dy	4/dy
107 Organism/sample presvn lyophil A Freeze dry	10	5	4/dy	2/dy		25/dy	15/dy
108 Bacterial cell counting A Automatic cell counters	10	3	3/wk	-		16/wk	-
D Light absorcion	10	2	-	2/wk		-	12/wk
112 Oxygen msmts mmb B Manifold to common analyzer	20	0	1/6C	-		A	-
113 Carbon dioxide msmts mmb B Manifold to common analyzer	10	0	1/6C	-		A	-
124 Crew/organism isolation - reqmt TBD A Shroud with gloves and window	3	0	1/4 hrs	1/dy		3/4 hrs	3/dy
125 Crew/ehemical isolation A Shroud with gloves and window	3	0	1/4 hrs	1/dy		3/4 hrs	3/dy
126 Crew radiation isolation B Glove box-radiochems only	20	5	1/wk	-		20/wk	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
127 Crew mobility/transfer - crew access to any lab area, walls, etc. H Combination of apro mob aids	U	U	45 min/wk	30 min/wk		45/wk	30/wk
128 Materials transfer - move cargo, tools, specimen in/out around lab H Combination of apro xfer aids	U	U	90 min/wk	60 min/wk		90/wk	60/wk
129 Holding-primates-large macaque to chimpanzees C Cylinders 30DX60H-common ECS/data D Metabolic mass balance inserts	0 60	0 0	1/2C 1/2C	- -		A A	- -
130 Holding-mice and mice size animals A Divider in std rat cage	5	0	1/2C	-		A	-
131 Holding, rats quail, etc. A Cage holding in comm cage mod	5	0	1/2C	1/2C		A	A
132 Housing-plant seedlings A Incubator-cage module	5	0	1/2C	1/2C		A	A
133 Holding unit plants A Incubator-cage module	2	0	1/2C	1/2C		A	A
134 Holding-rabbits cats marmots, etc. A Cage 4xRat for cage module	5	0	1/2C	-		A	-
135 Holding-cells and tissue A Constant temp holding facility	5	0	C	C		A	A
136 Holding invertebrates A Constant temp holding units	5	0	C	C		A	A
137 Holding-colony mice, hamsters, etc. A Rabbit cage with inserts in	5	0	1/2C	-		A	-
141 Airparticulate sampling and analysis A Particle impingment	15	10	1/dy	-		15/dy	-
142 Microbiological sampling, air, surfaces and large organisms A Air sampling	5	5	2/dy	1/dy		10/dy	5/dy
145 Centrifugation A Std. item-various speeds	U	U	60 min/dy	60 min/dy	10 min/dy crew time	10/dy	10/dy
149 Urine Analysis A Automatic urine analysis	20	0	1/wk	-		20/wk	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
149 (cont.)							
B Manual analysis	20	5	1/wk	-		20/wk	-
C Preserve for ground analysis	5	3	3/wk	2/wk		11/wk	8/wk
155 Urinary phosphates							
B Preserve for ground analysis	5	1	8/wk	-		12/wk	-
156 Urine creatinine and creatine							
B Preserve for ground analysis	5	1	8/wk	-		12/wk	-
161 Arterial blood pressure							
A Pressurecuff and microphone	5	5	2/dy	-		10/dy	-
164 Peripheral venous blood pressure							
A Miniature hypodermic probe	20	10	2/wk	-		30/wk	-
165 Event monitoring							
A Computer function-meas v/a	U	U	C	C		A	A
B Specific sensors	U	U	C	-		A	-
167 Anesthesiology - invertebrates							
A Pentobarbital or derivatives	20	20	2/wk	1/wk		40/wk	20/wk
168 Anesthesiology - invertebrates							
A Carbon-dioxide	3	3	5 bottles/dy	2 bottles/dy		15/dy	6/dy
169 Television monitoring routine and for data B/W high resolution							
A TV cameras-data type-specimen commutation	U	U	1/50	1/50		A	A
170 TV monitoring ad hoc - commercial grade color							
A Transportable hand held TV	U	U	30 min/dy	-		30/dy	-
174 Enzyme assay-recommend assays possible on crude hemogenates and one step partial purification only for space anal							
B Preserve for ground analysis	10	5	1/wk	-		10/wk	-
177 Protein assay							
B Preserve for ground analysis	10	5	4/wk	-		25/wk	-
180 Plant hormones							
B Preserve for ground analysis	10	5	2/wk	-		15/wk	-
184 Clinostat environment							
A Std. clinostat	U	U	30 min/wk	30 min/wk	10 min/wk crew time	10/wk	10/wk

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	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
185 Cytochemical staining plants C Preserve for ground analysis	5	2	8/wk	-		19/wk	-
186 Cytochemical staining - animal systems - hematoxalin/eosin C Preserve for ground analysis	5	2	8/wk	-		19/wk	-
201 Crew restraint - stabilize the crew for max safty and efficiency L Using combinations of above	U	U	30 min/wk	15 min/wk		30/wk	15/wk
218 Deep body temperature - implantable sensor B Implnt sensor/hardwire to coup	15	U	C	-		A	-
226 Cells and Tissue population density A Turbidometric	5	2	2/ay	1/ay		7/ay	5/ay
302 Sweat sample collection A Standard sponge system	10	2	3/wk	-		14/wk	-
303 Sweat preservation and storage A Extract from sponge and freeze	3	3	3/wk	-		9/wk	-
306 Ear canal caloric stimulation A liquid (water) stimulation. (ear)	60	15	2/wk	1/wk		75/wk <sup>1</sup>	60/wk <sup>3</sup>
307 Spatial localization A Graviceptors response monitoring	60	45	2/wk	-		105/wk <sup>3</sup>	-
308 Electro-oculogram (Eog) 0.14-100Hz A-D at least 500 samp/sec B Electrophysiology backpack - man	U	U	10 min/ay	5 min/ay		10/ay <sup>3</sup>	5/ay <sup>3</sup>
309 Routine metabolic gas monitoring A Metabolic unit fixed B Metabolic backpack	30 30	20 20	2/3 dya -	- 2/wk		50/3 dya <sup>3</sup> -	- 50/wk <sup>3</sup>
310 Bicycle ergometry A Bicycle ergometry at fixed consol B Bicycle egometry with backpack	60 U	50 U	2/3 dya -	- 2/wk		110/3 dya <sup>3</sup> -	- 110/wk <sup>3</sup>
312 Electronic equipment calibration A Computer calibration	U	U	20/min/wk	-		20/wk	-
313 Atmospheric monitor calibration B Bottled stds manual calib	U	U	10 min/wk	10 min/wk		10/wk	10/wk
314 Biochemanalytical equipment calibration A Standard filters and solutions	U	U	10 min/wk	10 min/wk		10/wk	10/wk

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
315 Total body water A Medical doctor physical exam	60	60	1/wk	-		60/wk <sup>3</sup>	-
316 Agravic perception A Controlled body or head movements	45	30	2/wk	1/wk		75/wk <sup>3</sup>	45/wk <sup>3</sup>
317 Ocular counter-rolling A Iris photography	60	60	2/wk	1/wk		120/wk <sup>3</sup>	60/wk <sup>3</sup>
318 Oculogyral illusion A Vestibular rotational sensitivity	10	10	2/wk	1/wk		20/wk <sup>3</sup>	10/wk <sup>3</sup>
319 Vectorcardiogram (VCG) 0.05-500HZ A-D at least 2500 samp/sec B Electrophysiology backpack - man -	U	U	15 min/3 dys	10 min/3 dys		15/3 dys <sup>3</sup>	10/3 dys <sup>3</sup>
320 Phono/vibrocardiogram (PCG/VBCG) 0.1-20HZ 10-30HZ 30-500HZ and 0.1-1000HZ selectable - A-D at least 100,150,2500,5000 samples/sec respectively B Electrophysiology backpack - man -	U	U	15 min/3dys	10 min/3dys		15/3 dys <sup>3</sup>	10/3 dys <sup>3</sup>
321 Impedance cardiography (ZCG) A-D 100 samples/sec B Electrophysiology backpack - man -	U	U	15 min/3dys	-		15/3dys <sup>3</sup>	15/3dys <sup>3</sup>
322 Venous blood pressure - invasive during venipuncture A Hypodermic needle transducer	20	15	2/wk	-		35/wk <sup>3</sup>	-
324 Pulse wave velocity A ECG VS flowmeter	45	30	1/wk	-		45/wk <sup>3</sup>	-
325 Pulse wave contour A ECG VS flowmeter	45	30	1/wk	-		45/wk <sup>3</sup>	-
326 Ballistocardiography (BCG) at least 800 samples per sec B Electrophysiology backpack - man -	U	U	15 min/wk	-		15/wk <sup>3</sup>	-
327 Respiratory vital capacity (VC), timed vital capacity (VC1, VC3) Inspiratory capacity (IC), expiratory reserve volume (ERV) Tidal volume (TV), minute tidal volume (MTV) max inspiratory flow (MIF), Max expiratory flow (MEF) max. breathing capacity (MBC) A-D at least 200 samples/sec A Pulmonary flowmeter	30	20	2/wk	1/wk		50/wk <sup>3</sup>	30/wk <sup>3</sup>
330 Respiratory dead space (VD) alveolar ventilation (VA) residual vol (VR) A Rapid response CO2 monitor	10	5	2/wk	1/wk		15/wk <sup>3</sup>	10/wk <sup>3</sup>

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	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
331 Respiratory Airway resistance (RA) A Pulmonary resistance	10	5	2/wk	1/wk		15/wk <sup>3</sup>	10/wk <sup>3</sup>
332 Lung compliance A-D at least 100 samp/sec A Lung compliance	10	5	2/wk	1/wk		15/wk <sup>3</sup>	10/wk <sup>3</sup>
333 Bleeding time A Ear or finger prick B Ivy method	5 15	5 15	1/wk -	- 1/wk		5/wk <sup>3</sup> -	- 15/wk <sup>3</sup>
334 Clotting time A Tube clot formation	10	5	1/wk	-		10/wk <sup>3</sup>	-
335 Erythrocyte survival A Radioisotope	60	45	1/wk	-		60/wk	-
336 Plasma glucose A Automatic biochemical analyzer	7	1	3/wk	-		9/wk	-
337 Plasma phosphate B Prepare/preserve for ground anal	7	1	10 min/wk	-		10/wk	-
338 Plasma alkaline phosphatase A Automatic biochemical analyzer	7	1	3/wk	-		9/wk	-
339 Plasma bilirubin A Automatic biochemical analyzer	7	1	3/wk	-		9/wk	-
340 Plasma globulins A Electrophoresis	20	5	3/wk	-		30/wk	-
341 Plasma Immunoglobins A Electrophoresis	20	5	3/wk	-		30/wk	-
342 Plasma coagulation A Time clot formation	10	5	3/wk	-		15/wk	-
343 Body mass measurement device (BMD) for man A Oscillatory mass balance	2	2	2/day	2/day		4/day <sup>3</sup>	4/day <sup>3</sup>
344 Electronystagmogram (Eng) B Electrophysiology backpack - man -	U	U	30 min/3 dys	20 min/3 dys		30/3dys <sup>3</sup>	20/3dys <sup>3</sup>
345 Angular acceleration threshold A Vestibular threshold	45	30	2/wk	1/wk		75/wk	45/wk

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
346 Subject histories							
A Voice recording	5	5	2/dy	2/dy		10/dy	10/dy
347 Intraocular pressures							
A Tonometry	15	10	1/wk	-		15/wk <sup>3</sup>	-
350 Crew metabolic records - food/water consumption-urine/feces production							
A Laboratory notebook	U	U	5 min/dy	5 min/dy		5/dy	5/dy
B Voice records	U	U	5 min/dy	-		5/dy	-
351 Bone densitometry - photon absorption							
A Photon absorption	10	10	1/wk	-		10/wk	-
352 Radioisotope counting-whole body							
A Radioisotope counting	60	45	1/wk	-		60/wk	-
353 Culture/sensitivity-microorganism growth capability in presence of various antibiotics							
A Sensidisk exposure	5	3	1/wk	-		5/wk	-
354 Ear canal temperature							
A Temperature probe	5	5	2/wk	1/wk		10/wk <sup>3</sup>	5/wk <sup>3</sup>
355 Muscle strength and size							
A Standard measurements	20	15	2/wk	1/wk		35/wk	20/wk
356 Subject instrumentation and cleanup							
B Common use restraint chair	U	U	20 min/dy	10 min/dy		20/dy <sup>3</sup>	10/dy <sup>3</sup>
358 Biomedical equipment cleanup/disposal							
B Common use restraint chair	U	U	10 min/dy	-		10/dy	-
359 Heart rate							
A Computer function	U	U	5 min/dy	3 min/dy		5/dy	3/dy
364 Visual task with head rotation							
A Response analysis tester	75	60	-	1/wk		-	75/wk <sup>3</sup>
B Response analysis testing	75	60	2/wk	-		135/wk <sup>3</sup>	-
365 Venous compliance (LVMS)							
A Limb volum measurements	10	5	3/wk	-		20/wk <sup>3</sup>	-
366 Arteriolar reactivity							
A Analyze pulse wave contour/velocity	U	U	15 min/wk	-		15/wk <sup>3</sup>	-

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	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
368 Stool preservation A Thermal	10	5	3/wk	2/wk		20/wk	15/wk
369 Urine preservation A Thermal	10	5	3/wk	2/wk		20/wk	15/wk
372 Fungal culturing A Preprepared media	30	20		1/wk		-	30/wk
373 Fungal identification A Prepare for ground identifi	30	20	-	1/wk		-	30/wk
400 Galavanic skin response (GSR) A Psychogalvanometer	10	5	2/wk	1/wk		15/wk <sup>3</sup>	10/wk <sup>3</sup>
401 Alveolar ventilation A Rapid response respiratory monitor	1	1	4/wk	2/wk		4/wk <sup>3</sup>	2/wk <sup>3</sup>
402 Lung diffusion capacity A O2/CO2 isotope inhalation	60	45	2/wk	-		105/wk <sup>3</sup>	-
403 Average skin temperature A Thermisters	5	5	4/wk	-		20/wk <sup>3</sup>	-
404 Red blood cell mass (RBC MASS) A Standard blood indecies	10	5	2/wk	-		15/wk	-
405 Blood plasma volume A Radiochemistry (invasive)	30	20	2/wk	-		50/wk	-
406 Urine, microscopic analysis A Prepare/preserve for ground anal	5	2	2/dy	1/dy		7/dy	5/dy
407 Urine chemical analysis (bile, acetone, CA, NA, K, Cl and blood) A Prepare/preserve for ground anal B Analyze in space	3 30	2 10	2/dy 2/dy	2/dy -		5/dy 40/dy	5/dy -
408 SGOT (serum glutamic oxalacetic transaminase) A Prepare/preserve for ground anal B Automatic biochemical analyzer	10 7	5 1	2/wk 2/wk	2/wk -		15/wk 8/wk	15/wk -
409 SGPT (serum glutamic-pyruvic transaminase) A Prepare/preserve for ground anal B Automatic biochemical analyzer	10 7	3 1	2/wk 2/wk	2/wk -		13/wk 8/wk	13/wk -

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
411 Mineral balance							
A Special foods and urine/feces anal	2	1	4/dy	2/dy		5/dy	3/dy
412 Fecal mass/net weight measurement							
A Prepare/preserve for ground anal	10	10	2/dy	-		20/dy	-
414 Impedance pneumogram for man							
B Electrophysiology bodypack	20	10	2/wk	-		30/wk	-
415 Lung volumes							
A Respiratory flowmeter	10	5	2/wk	-		15/wk	-
416 Tracking measurements							
A Computerized psychomtr perf mod	4	2	2/wk	-		6/wk	-
417 Plasma cholesterol							
A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
418 Urine volume							
A Prepare/preserve for ground anal	10	10	-	2/dy		-	20/dy
B Measure in space	4	2	4/dy	-		10/dy	-
419 Nitrogen balance							
A Special premeasured foods msure	2	1	4/dy	-		5/dy	-
420 Caloric intake							
A Special premeasured foods msure	2	1	2/dy	-		3/dy	-
B Premeasurd food preserve/pkg waste	5	1	2/dy	-		6/dy	-
421 Water consumption for man							
A Metering water dispenser	2	1	4/dy	-		5/dy	-
424 Carotid body stimulation response measurement							
A ECG/blood pressure response to stimuli	30	25	2/wk	-		55/wk <sup>3</sup>	-
425 Blood rheology/encephar orheogram (ERG)							
A Radiochemical tracers	60	45	2/wk	-		105/wk <sup>3</sup>	-
426 Prothrombin consumption							
A Clot formation time	15	5	2/wk	-		20/wk	-
427 Platelet adhesiveness							
A Microscopic evaluation in space	20	10	2/wk	-		30/wk	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
429 Serum antidiuretic hormone (ADH)							
A Prepare/preserve for ground anal	10	3	2/wk	2/wk		13/wk	13/wk
B Analyze in space-autoanalyzer	5	3	2/wk	-		8/wk	-
430 Blood, 17 hydroxycorticosteroids							
A Prepare/preserve for ground anal	10	3	2/wk	2/wk		13/wk	13/wk
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
431 Blood urea nitrogen (BUN)							
A Prepare/preserve for ground anal	10	3	2/wk	2/wk		13/wk	13/wk
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
432 Blood uric acid							
A Prepare/preserve for ground anal	10	3	2/wk	2/wk		13/wk	13/wk
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
433 Blood bicarbonate							
A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
434 Creatinine phosphokinase (CPK) blood							
A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
435 Serum lactic acid dehydrogenase (LDH) and LDH isoenzymes							
A Prepare/preserve for ground anal	10	3	2/wk	2/wk		13/wk	13/wk
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
436 Blood adrenocorticotrophic hormone (ACTH)							
A Prepare/preserve for ground anal	10	3	2/wk	2/wk		13/wk	13/wk
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
437 Blood TEPA							
A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
438 Blood histamin							
A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
439 Lymphocyte karyotyping							
A Prepare/preserve for ground anal	10	3	4/wk	-		19/wk	-
440 Transferrins, blood							
A Prepare/preserve for ground anal	15	10	2/wk	-		25/wk	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
	440 (cont.) B Analyze in space - autoanalyzer	5	3	2/wk	-		8/wk
441 Whole blood methemoglobin A Prepare/preserve for ground anal	10	3	-	2/wk		-	13/wk
B Automatic Biochemical analyzer	7	1	4/wk	-		10/wk	-
442 RBC enzyme measurement A Prepare/preserve for ground anal	10	3	2/wk	2/wk		13/wk	13/wk
B Analyze in space-autoanalyzer	5	3	2/wk	-		8/wk	-
443 Complement titration, blood A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Analyze in space - autoanalyzer	5	3	2/wk	-		8/wk	-
444 Thyroid stimulating hormone A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Analyze in space-autoanalyzer	5	3	2/wk	-		8/wk	-
445 Blood growth hormone A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
446 Serum parathyroid hormone A Prepare/preserve for ground anal	10	3	2/wk	-		13/wk	-
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
447 Serum calcitonin A Prepare/preserve for ground anal	5	2	2/wk	-		7/wk	-
B Automatic biochemical analyzer	7	1	2/wk	-		8/wk	-
448 Insulin assay A Prepare/preserve for ground anal	10	2	4/wk	-		16/wk	-
449 Glucagon assay A Prepare/preserve for ground anal	10	2	2/wk	-		12/wk	-
B Analyze in space - bench chemistry	30	10	2/wk	-		40/wk	-
450 Blood serotonin (5HTAA) A Prepare/preserve for ground anal	5	2	2/wk	2/wk		7/wk	7/wk
B Analyze in space - autoanalyzer	5	3	2/wk	-		8/wk	-
451 Angiotension II A Radiochemistry	30	10	4/wk	-		60/wk	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
452 Membrane assay and cytogenic analysis, blood cells A Measure RBC fragility, sphering, etc.	30	15	4/wk	-		75/wk	-
453 Urine, calcium A Prepare/preserve for ground anal	5	2	2/wk	2/wk		7/wk	7/wk
B Analyze in space - autourine analzr	5	3	2/wk	-		8/wk	-
454 Urine, Mucoproteins A Prepare/preserve for ground anal	5	2	2/wk	-		7/wk	-
B Analyze in space - autourine analzr	5	3	2/wk	-		8/wk	-
455 Urine, pyrophosphates A Prepare/preserve for ground anal	5	2	2/wk	-		7/wk	-
B Analyze in space-autourine analzr	5	3	2/wk	-		8/wk	-
456 Urine, Hydoxyprolines A Prepare/preserva for ground anal	5	2	2/wk	-		7/wk	-
B Analyze in space - autourine analzr	5	3	2/wk	-		8/wk	-
457 Urine, total amino acid A Prepare/preserve for ground anal	5	2	2/wk	-		7/wk	-
B Analyze in space - autourine analzr	5	3	2/wk	-		8/wk	-
458 Urine, Aldosterone A Prepare/preserve for ground anal	5	2	2/wk	-		7/wk	-
B Analyze in space - autourine analzr	5	3	2/wk	-		8/wk	-
459 Urine, Antidiuretic hormone (ADH) A Prepare/preserve for ground anal	10	3	2/wk	2/wk		13/wk	13/wk
B Analyze in space - autourine analzr	5	3	2/wk	-		8/wk	-
460 Urine, 17, hydroxycorticosteroids A Prepare/preserve for ground anal	5	2	2/wk	2/wk		7/wk	7/wk
B Analyze in space - autourine analzr	5	3	2/wk	-		8/wk	-
461 Urine, 17, Ketosteroids A Prepare/preserve for ground anal	5	2	2/wk	2/wk		7/wk	7/wk
B Analyze in space - autourine analzr	5	3	2/wk	-		8/wk	-
462 Urine, vinyl mendelic acid (VMA) A Prepare/preserve for ground anal	5	2	2/wk	2/wk		7/wk	7/wk
B Analyze in space-autourine analzr	5	3	2/wk	-		8/wk	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab	Shared Lab
						(7 & 30 Day)	(7 Day)
463 Urine, metanephrines							
A Prepare/preserve for ground anal	5	2	2/wk	2/wk		7/wk	7/wk
B Analyze in space-autourine analzr	5	3	2/wk	-		8/wk	-
464 Urine, catacholoamines							
A Prepare/preserve for ground anal	5	2	2/wk	2/wk		7/wk	7/wk
B Analyze in space-autourine analzr	5	3	2/wk	-		8/wk	-
465 Urine, histamines							
A Prepare/preserve for ground anal	5	2	2/wk	-		7/wk	-
B Analyze in space-autourine analzr	5	3	2/wk	-		8/wk	-
466 Urine, serotonine (5HTAA)							
A Prepare/preserve for ground anal	5	2	1/dy	1/dy		5/dy	5/dy
B Analyze in space-autourine analzr	5	3	1/dy	-		5/dy	-
467 Urine, sulfate							
A Prepare/preserve for ground anal	5	2	2/wk	-		7/wk	-
B Analyze in space-autourine analzr	5	3	2/wk	-		8/wk	-
468 Electromagnetic field monitoring							
A Antennas-receivers	30		c	-		A	-
469 Rotating litter chair (RLC)							
A Rotating litter chair	10	8	2/wk	1/wk		18/wk	10/wk
500 Control of exper parameters - T,P,Flow,Power,etc.							
A Meas/display and manual control	1		5 min/4 hrs	-		5/4 hrs	-
501 Analysis of gas mixtures for O2, N2, CO2, CO, CH4, H2O, H2, NH3, etc.							
A Chromatography	5		5 min/dy	3 min/dy		5/dy	3/dy
E Individual constituent sensors	2		5 min/dy	2 min/dy		5/dy	2/dy
507 Liquid transfer							
A Syringe transfer	3		10 min/dy	-		10/dy	-
508 Vacuum supply							
A Use space vacuum	2		c	-		A	-
510 Electrical power system for experiment support							
A Sortie Module supply - lab distrib. and control	2		2 min/dy	2 min/dy	Making electrical connections, etc.	2/dy	2/dy
511 Electrical continuity and voltage measurements							
A Individual meter measurements	3		5 min/dy	5 min/dy		5/dy	5/dy

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
512 Electrical amperage measurements							
A Individual meter measurements	2		5 min/dy	5 min/dy		5/dy	5/dy
515 Supply of coolant							
A SM supply-lab dist/control	2		5 min/dy	5 min/dy	Making coolant connections, etc.	5/dy	5/dy
517 Clean-up, liquid and solid							
A Manual	5		5 min/dy	5 min/dy		5/dy	5/dy
518 Trash disposal							
A Manual transfer, ncompaction, stor.	2		2 min/dy	-		2 dy	-
520 Pressure suit donning and doffing (experimental)							
A Manual, using mechanical aids	30		30 min/3 dy	-		30/3 days	-
521 Pressure suit ventilation and cooling (experimental)							
A Umbilical	5		15 min/3 dy	-		15/3 dys	-
B PLSS (portable life support syst)	15		15 min/3 dy	-		15/3 dys	-
523 Ingress/egress (laboratory to EVA)							
A Airlock	30		30 min/wk	-		30/wk	-
524 EVA maintenance task simulation							
A Simulate maintenance tasks (EVA)	60		15 min/wk	-		15/wk	-
525 Data management							
A Digital computer managed data			C	C		A	A
700 Visual - acuity, static - near and far							
A Computerized vision monitor	2	2	2/3 dy	-		4/3 dys	-
702 Visual - stereopsis (depth perception), static							
A Computerized vision monitor	2	2	2/3 dy	-		4/3 dys	-
704 Visual - brightness threshold, absolute							
A Computerized vision monitor	2	2	2/3 dy	-		4/3 dys	-
706 Visual - color perception							
A Computerized vision monitor	1	1	2/3 dy	-		2/3 dys	-
707 Visual - critical flicker fusion frequency							
A Computerized vision monitor	2	2	2/3 dy	-		4/3 dys	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min. /Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
708 Visual - phorias, lateral and vertical - near and far A Computerized vision monitor	2	2	2/3 dy	-		4/3 dys	-
709 Visual - glare recovery (photo stress) A Computerized vision monitor	2	2	2/3 dy	-		4/3 dys	-
710 Visual - dark adaptation A Computerized vision monitor	2	2	2/3 dy	-	20 min/man crew time	40/3 dys	-
713 Visual - peripheral field A Computerized vision monitor	3	3	2/3 dy	-		6/3 dys	-
715 Auditory - absolute threshold A Computerized audiometer	2	2	2/3 dy	-		4/3 dy	-
716 Auditory - pitch discrimination A Computerized audiometer	3	2	2/3 dy	-		5/3 dys	-
717 Auditory - temporal acuity A Computerized audiometer	3	2	2/3 dy	-		5/3 dys	-
730 Cognitive/complex perceptual - speech intelligibility A Monosyllabic word/sentence tests	5	5	2/3 dy	-		10/3 dys	-
734 Cognitive/complex perceptual - perceptual speed A CRT displayed speed of ID test	6	5	2/3 dy	-		11/3 dys	-
740 Cognitive/conceptual and thinking abil.-verbal knowledge, word fluency numerical ability, concept fluency, discovery of principles, general reasoning, seeing implications and consequences (foresight), logical evaluation, etc. A CRT displayed questns, problms, etc.	10	10	2/3 dy	-		20/3 dys	-
752 Cognitive/memory - memory span-immediate recall A CRT displayed tests	5	5	2/3 dy	-		10/3 dy	-
760 Fine psychomotor - manipulative ability-arm/hand steadiness A Computerized psychcmtr perf mod	5	5	2/3 dy	-		10/3 dy	-
766 Fine psychomotor - gross positioning ability-control prec(TRK) A Computerized psychcmtr perf mod	4	2	2/3 dy	2/wk		6/3 dys	6/wk
768 Fine psychomotor - gross positioning ability-multilimb coord. A Simultaneous performance of 2 tasks	5	3	2/3 dy	-		8/3 dys	-

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
770 Fine psychomotor - reaction time - simple A Comprzd psychmtr perf mod	3	2	2/3 dy	-		5/3 dys	-
771 Fine Psychomotor - reaction time - complex(resp orientatn) A Comprzd psymtr perf mod	2	1	2/3 dy	-		3/3 dys	-
776 Gross Psychomotor - muscle strength-impulsive-hand/shldr B Force application test (M508 type)	10	10	2/3 dy	-		20/3 dys	-
780 Gross Psychomotor - gross body coordination A Coordination test	6	5	2/3 dy	-		11/3 dys	-
820 Task completion times (E.G. time to complete a specified maintenance task, to assemble an antenna rib, to move from point A to B by a maneuvering unit, to align an object with a remote manipulator, to complete a proficiency assessment task, etc.) A Subject or experimtr-actuated timer C Video coverage	U U	U U	10/min/dy 60 min/dy	5 min/dy 30 min/dy	Same time period for crew	10/dy <sup>3</sup> 60/dy <sup>3</sup>	5/dy <sup>3</sup> 30/dy <sup>3</sup>
821 Task accuracy and errors A Method is experiment specific			60 min/dy	30 min/dy	"		
822 Crew body position measurements B Motion picture photography	U	U	30 min/dy	15 min/dy	"		
823 Crew body motion measurements B Motion picture photography C Body mounted sensors	U U	U U	30 min/dy 60 min/dy	15 min/dy 30 min/dy	"		
825 Eye movement measurements - optical A Recording of visual field and point	U	U	15 min/wk	10 min/wk		15/wk	10/wk
830 Frequency of equipment/facility utilization A Video coverage	U	U	(1/10C)	-		(A)	-
831 Length of use of equipment/facility A Video coverage	U	U	(1/10C)	-		(A)	-
832 Sequence of use of equipment/facilities A video coverage	U	U	(1/10C)	-		(A)	-
833 Crew subjective comments on equipment/facility/procedures/sched. B Crew logs-unstructured response	10	10	5 min/dy	5 min/dy		5/dy	5/dy

FUNCTION	TIME REQUIRED PER REPETITION, MIN.		FREQUENCY			CREW TIME REQUIRED (Min./Time Period)	
	First Repetition	Succeeding Repetitions	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)	Notes	Dedicated Lab (7 & 30 Day)	Shared Lab (7 Day)
834 Facility Traffic patterns							
A Video coverage	U	U	(1/100)	-		(A)	-
840 Max mass transportable - function of type of mobility aid.							
A Shirtsleeve (IVA) limits	U	U	30 min/wk	20 min/wk		30/wk <sup>3</sup>	20/wk <sup>3</sup>
B Suited (pressurized) limits	U	U	30 min/wk	-		30/wk <sup>3</sup>	-
846 Remote manipulation							
A Bilateral electric master/slave manip	U	U	30 min/wk	-		30/wk	-
950 Routine equipment maintenance							
A Periodic completion of checklist req	U	U	10 min/dy	-		10/dy	-

## APPENDIX III

### COST STUDIES

This appendix documents the basic working data used to develop the cost distribution estimates for the Life Sciences Laboratories discussed in Section 8.0 of Volume II.

The data presented is a computer printout of the cost distribution curves based upon the NASA idealized cost distribution shown in curve 3 of Figure 8-5 in Volume II.

The data format includes:

1. Three Cost Summary Sections

Table III-1	Shared 7-Day Laboratory
Table III-2	Dedicated 7-Day Laboratory
Table III-3	Dedicated 30-Day Laboratory

2. A cost Data Sheet for each EU of each Laboratory.

The individual EU cost data sheets provide three types of cost information. The funding rate in thousand dollars per year is shown in the upper tabulation of each sheet. This was used to develop the subsequent tabulations of total cumulative funding and quarterly funding. The cumulative research equipment funding tabulation (center table of each sheet) provides the research equipment cost data presented in the various cost tables of Volumes I and II.

At the end of each laboratory cost summary section, the total cost for all the EUs within the payload is presented. These summary tabulations present the same three categories of cost data as discussed above; namely, yearly funding rate, cumulative costs, and quarterly funding.

TABLE III-1

COST DISTRIBUTION DATA  
FOR INDEPENDENT DEVELOPMENT  
OF THE SHARED 7-DAY LABORATORY

FUNDING REQUIREMENTS FOR EL 1

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	175.1	578.7	896.2	1481.5	1772.3	1875.0	1772.3	1481.5	1031.2	924.4	612.6	345.7	411.6	276.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.2	207.4	562.9	803.7	0.0
TOTAL	0.0	175.1	578.7	896.2	1481.5	1772.3	1875.0	1772.3	1481.5	1031.2	924.4	612.6	437.8	618.9	839.5	803.7	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	15.3	106.5	310.5	629.6	1039.9	1500.0	1960.1	2370.4	2701.9	2967.0	3159.7	3276.5	3367.0	3460.6	3490.0	3490.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	47.6	140.2	328.0	419.0
TOTAL	0.0	15.3	106.5	310.5	629.6	1039.9	1500.0	1960.1	2370.4	2701.9	2967.0	3159.7	3285.2	3414.6	3600.8	3818.0	3909.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	15.7	91.2	204.1	319.1	410.2	460.1	460.1	410.2	331.5	255.1	192.8	116.8	90.4	93.7	29.4	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	38.9	92.5	187.9	91.0
TOTAL	0.0	15.7	91.2	204.1	319.1	410.2	460.1	460.1	410.2	331.5	255.1	192.8	125.5	129.3	186.2	217.3	91.0

FUNDING REQUIREMENTS FOR EL 2

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	14.8	18.7	14.8	148.0	142.2	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	142.2	522.2	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	14.8	18.7	14.8	148.0	284.4	522.2	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.5	3.1	7.5	11.9	29.6	71.9	87.0	87.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.1	104.4	167.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.5	3.1	7.5	11.9	29.6	87.0	191.4	254.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.5	2.6	4.4	4.4	17.7	42.3	15.1	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.1	89.3	62.6
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.5	2.6	4.4	4.4	17.7	57.4	104.4	62.6	

FUNDING REQUIREMENTS FOR EL 3

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	2.6	8.0	13.2	16.3	16.3	13.2	8.0	2.6	811.9	811.9	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	18.7	374.5	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	2.6	8.0	13.2	16.3	16.3	13.2	8.0	2.6	822.4	830.6	374.5	0.0

9-III

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	.2	1.5	4.2	7.9	12.1	15.8	18.5	19.8	106.3	344.7	431.0	431.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.0	54.5	101.0
TOTAL	0.0	0.0	0.0	0.0	0.0	.2	1.5	4.2	7.9	12.1	15.8	18.5	19.8	107.3	349.7	485.5	532.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	.2	1.3	2.7	3.7	4.1	3.7	2.7	1.3	86.5	238.5	86.3	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.0	49.5	46.5
TOTAL	0.0	0.0	0.0	0.0	0.0	.2	1.3	2.7	3.7	4.1	3.7	2.7	1.3	87.5	242.4	135.7	46.5

FUNDING REQUIREMENTS FOR EU 4

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	116.7	385.8	597.5	987.7	1467.7	2126.3	2630.1	2776.0	2669.4	2560.3	1911.7	1012.1	712.2	428.6	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.4	108.4	341.6	461.0	0.0
TOTAL	0.0	116.7	385.8	597.5	987.7	1467.7	2126.3	2630.1	2776.0	2669.4	2560.3	1911.7	1027.4	820.6	770.3	461.0	0.0

III

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	10.2	71.0	207.0	419.8	718.6	1168.1	1768.5	2453.0	3146.3	3821.5	4389.2	4755.4	4954.5	5106.5	5152.0	5152.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	15.2	70.7	181.1	233.0
TOTAL	0.0	10.2	71.0	207.0	419.8	718.6	1168.1	1768.5	2453.0	3146.3	3821.5	4389.2	4756.8	4969.6	5177.2	5333.1	5385.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	10.2	60.8	136.0	212.7	298.9	449.5	600.4	684.5	693.4	675.2	567.7	366.1	199.1	152.0	45.5	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.4	13.7	55.6	110.4	51.9
TOTAL	0.0	10.2	60.8	136.0	212.7	298.9	449.5	600.4	684.5	693.4	675.2	567.7	367.6	212.8	207.6	155.9	51.9

FUNDING REQUIREMENTS FOR EU 5

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	2.6	8.0	13.2	16.3	515.9	1292.2	1626.7	1281.6	1272.0	772.3	0.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.2	568.5	801.2	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	2.6	8.0	13.2	16.3	515.9	1292.2	1626.7	1281.6	1276.2	1340.8	801.2	0.0	0.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	.2	1.5	4.2	7.9	58.0	287.6	666.0	1043.0	1351.1	1623.9	1706.0	1706.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.4	61.6	257.5	347.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	.2	1.5	4.2	7.9	58.0	287.6	666.0	1043.0	1351.5	1685.5	1963.5	2053.0	0.0	0.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	.2	1.3	2.7	3.7	50.1	229.6	378.4	377.0	308.1	272.8	82.1	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.4	61.2	195.9	89.5	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	.2	1.3	2.7	3.7	50.1	229.6	378.4	377.0	308.5	334.0	277.9	89.5	0.0	0.0

FUNDING REQUIREMENTS FOR EU 6

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.9	148.1	187.5	148.1	190.2	132.3	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	69.1	101.1	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.9	148.1	187.5	148.1	190.2	201.5	101.1	0.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

8-III

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	31.5	75.0	118.5	158.7	202.9	217.0	217.0	217.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	31.7	43.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	31.5	75.0	118.5	158.7	210.3	248.7	260.0	0.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	26.2	43.5	43.5	40.2	44.2	14.1	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	7.3	24.3	11.3	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	26.2	43.5	43.5	40.2	51.5	38.4	11.3	0.0

FUNDING REQUIREMENTS FOR EU 7

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.5	41.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	44.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	41.5	41.5	44.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

6-III

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	16.6	21.0	21.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	11.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	16.6	26.5	32.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	12.2	4.4	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.5	5.5
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.4	12.2	9.9	5.5

FUNDING REQUIREMENTS FOR EL 12

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.6	98.8	125.0	98.8	556.1	517.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	49.4	825.4	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	38.6	98.8	125.0	98.8	556.1	566.9	825.4	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

01-III

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	21.0	50.0	79.0	151.4	307.0	362.0	362.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	116.8	219.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	21.0	50.0	79.0	151.4	312.3	478.8	581.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	17.4	29.0	29.0	72.4	155.6	55.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	111.5	102.2
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.5	17.4	29.0	29.0	72.4	160.8	166.5	102.2

FUNDING REQUIREMENTS FOR EU 26

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.0	345.7	437.5	345.7	856.0	721.0	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.8	306.8	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.0	345.7	437.5	345.7	856.0	819.8	306.8	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	73.5	175.0	276.5	414.2	638.4	715.0	715.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	65.5	102.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	73.5	175.0	276.5	414.2	648.9	780.5	817.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	61.0	101.5	101.5	137.6	224.2	76.6	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	55.0	36.5	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	61.0	101.5	101.5	137.6	234.7	131.6	36.5	

FUNDING REQUIREMENTS FOR EU 31

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.7	158.0	260.0	158.0	170.4	108.6	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	227.2	383.2	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.7	158.0	260.0	158.0	170.4	335.8	383.2	0.0

III-12

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	33.6	80.0	126.4	165.9	203.5	215.0	215.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	110.4	154.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	33.6	80.0	126.4	165.9	227.6	325.4	369.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	27.9	46.4	46.4	39.4	37.6	11.5	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	86.2	43.6
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	27.9	46.4	46.4	39.4	61.7	97.8	43.6

FUNDING REQUIREMENTS FOR EU 40

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	58.4	192.9	298.7	493.8	1254.1	2656.4	3948.3	4639.5	4444.4	3550.9	2089.7	663.3	0.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	51.8	81.3	64.1	0.0
TOTAL	0.0	58.4	192.9	298.7	493.8	1254.1	2656.4	3948.3	4639.5	4444.4	3550.9	2089.7	669.5	51.8	81.3	64.1	0.0

SI-13

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.1	35.5	103.5	209.9	405.4	889.7	1723.8	2813.2	3973.4	4994.1	5705.2	6041.2	6100.0	6100.0	6100.0	6100.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	6.9	24.9	44.2	51.0
TOTAL	0.0	5.1	35.5	103.5	209.9	405.4	889.7	1723.8	2813.2	3973.4	4994.1	5705.2	6041.8	6106.9	6124.3	6144.2	6151.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.1	30.4	68.0	106.4	195.6	484.3	834.1	1089.5	1160.2	1020.8	711.1	336.0	58.8	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	6.3	17.9	19.4	6.8
TOTAL	0.0	5.1	30.4	68.0	106.4	195.6	484.3	834.1	1089.5	1160.2	1020.8	711.1	336.5	65.1	17.9	19.4	6.8

FUNDING REQUIREMENTS FOR EU 42

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	52.0	159.3	263.4	325.2	325.2	263.4	159.3	52.0	150.1	150.1	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.1	37.5	93.1	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	52.0	159.3	263.4	325.2	325.2	263.4	159.3	52.0	171.2	187.6	93.1	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	4.6	30.6	84.0	158.7	241.3	316.0	369.4	395.4	416.0	460.0	476.0	476.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	10.0	26.9	38.0
TOTAL	0.0	0.0	0.0	0.0	0.0	4.6	30.6	84.0	158.7	241.3	316.0	369.4	395.4	418.0	470.0	502.9	514.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	4.6	26.0	53.4	74.7	82.7	74.7	53.4	26.0	20.6	44.1	16.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	7.9	16.9	11.1
TOTAL	0.0	0.0	0.0	0.0	0.0	4.6	26.0	53.4	74.7	82.7	74.7	53.4	26.0	22.6	52.0	32.9	11.1

FUNDING REQUIREMENTS FOR EL 50

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	197.5	197.5	0.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	21.1	37.5	25.1	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	218.6	235.0	25.1	0.0	0.0	0.0

SI-15

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1021.0	1079.0	1100.0	1100.0	1100.0	1100.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	10.0	18.4	21.0	21.0	21.0
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1023.1	1089.0	1118.4	1121.0	1121.0	1121.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	196.8	133.5	64.9	32.5	58.0	21.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.1	7.3	8.4	2.6	2.6	2.6
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	196.8	133.5	64.9	34.6	66.0	29.4	2.6	2.6	2.6

FUNDING REQUIREMENTS FOR EU 51

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	24.7	31.3	24.7	173.6	164.0	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	69.9	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	24.7	31.3	24.7	173.6	169.9	69.9	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	5.2	12.5	19.8	41.5	90.6	108.0	108.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	10.4	19.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	5.2	12.5	19.8	41.5	91.2	118.4	127.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	4.4	7.3	7.3	21.8	49.0	17.4	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	9.7	8.6	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	4.4	7.3	7.3	21.8	49.7	27.2	8.6	

III-11

FUNDING REQUIREMENTS FOR EU 60

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	5.8	19.3	29.9	49.4	59.1	62.5	59.1	49.4	107.0	216.8	255.8	197.5	77.2	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	22.5	58.6	41.5	0.0
TOTAL	0.0	5.8	19.3	29.9	49.4	59.1	62.5	59.1	49.4	107.0	216.8	255.8	198.1	99.6	58.6	41.5	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	.5	3.5	10.4	21.0	34.7	50.0	65.3	79.0	96.7	138.4	199.5	258.0	292.9	300.0	300.0	300.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.1	2.4	12.8	26.8	31.0
TOTAL	0.0	.5	3.5	10.4	21.0	34.7	50.0	65.3	79.0	96.7	138.4	199.5	258.1	295.3	312.8	326.8	331.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	.5	3.0	6.8	10.6	13.7	15.3	15.3	13.7	17.7	41.7	61.1	58.5	34.9	7.1	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.1	2.3	10.4	14.0	4.2
TOTAL	0.0	.5	3.0	6.8	10.6	13.7	15.3	15.3	13.7	17.7	41.7	61.1	58.6	37.2	17.5	14.0	4.2

FUNDING REQUIREMENTS FOR EU 61

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3	55.3	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3	55.3	20.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	22.1	28.0	28.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	22.1	30.5	33.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	16.2	5.9	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	16.2	8.4	2.5

FUNDING REQUIREMENTS FOR EL 70

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	69.1	87.5	69.1	27.0	0.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	26.7	18.4	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	69.1	87.5	69.1	37.6	26.7	18.4	0.0	

61-III

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	14.7	35.0	55.3	67.5	70.0	70.0	70.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.8	12.1
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	14.7	35.0	55.3	68.6	75.8	82.1	84.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.2	20.3	20.3	12.2	2.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.8	6.3	1.9
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.2	20.3	20.3	13.2	7.3	6.3	1.9

FUNDING REQUIREMENTS FOR EL #0

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0									
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2004.9	2004.9	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	408.0	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2004.9	2004.9	408.0	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0									
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	802.0	1015.0	1015.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.0	102.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	802.0	1066.0	1117.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0									
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	588.9	213.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.0	51.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	588.9	264.0	51.0	

FUNDING REQUIREMENTS FOR EL 91

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	337.8	337.8	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	212.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	337.8	337.8	212.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9	135.1	171.0	171.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.5	53.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9	135.1	197.5	224.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9	99.2	35.9	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.5	26.5
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	35.9	99.2	62.4	26.5

FUNDING REQUIREMENTS FOR EU 93

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	29.6	37.5	29.6	31.3	19.8	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	29.6	37.5	29.6	31.3	23.7	8.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	6.3	15.0	23.7	31.0	37.9	40.0	40.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.4	2.1	3.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	6.3	15.0	23.7	31.0	38.3	42.1	43.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.2	8.7	8.7	7.3	6.9	2.1	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.4	1.7	.9
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.2	8.7	8.7	7.3	7.3	3.8	.9

PAYLOAD TOTALS

YEAR	73	.	.	.	74	.	.	.	75	.	.
DEVELOPMENT FUNDING RATE	0.0	194.2	610.5	1284.6	2335.4	5805.4	8281.0	8742.4	9935.4	10426.2	9394.9
PRODUCTION FUNDING RATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	408.0	142.2	765.9	162.9
TOTAL FUNDING RATE	0.0	194.2	610.5	1284.6	2335.4	5805.4	8281.0	9150.4	10077.6	11192.1	9557.9
CUMULATIVE DEVELOPMENT COSTS	0.0	17.1	115.5	349.7	808.2	1796.4	3681.2	5769.5	8149.3	10696.9	13248.3
CUMULATIVE PRODUCTION COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.0	117.1	236.0	348.3
TOTAL CUMULATIVE COSTS	0.0	17.1	115.5	349.7	808.2	1796.4	3681.2	5820.5	8266.4	10932.9	13596.7
QUARTERLY DEVELOPMENT COSTS	0.0	17.1	98.3	234.3	458.5	988.3	1884.8	2088.3	2379.8	2547.6	2551.5
QUARTERLY PRODUCTION COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.0	66.1	118.9	112.3
TOTAL QUARTERLY COSTS	0.0	17.1	98.3	234.3	458.5	988.3	1884.8	2139.3	2445.9	2666.4	2663.8

PAYLOAD TOTALS (CONTINUED)

YR	.	76	.	.	.	77	.	.	.	78
DEVELOPMENT FUNDING RATE	7252.5	6370.2	4752.5	3162.9	3308.6	2197.8	1193.7	1135.8	0.0	0.0
PRODUCTION FUNDING RATE	370.3	243.8	535.3	247.5	425.5	1522.4	2922.9	125.4	612.8	0.0
TOTAL FUNDING RATE	7622.8	6614.0	5287.8	3410.3	3732.2	3720.2	4116.6	1261.2	612.8	0.0
CUMULATIVE DEVELOPMENT COSTS	15327.1	17080.9	18465.5	19466.2	20235.9	20980.7	21344.4	21683.3	21804.0	21804.0
CUMULATIVE PRODUCTION COSTS	420.6	489.8	596.1	887.7	774.2	999.0	1608.5	1962.3	2058.5	2133.0
TOTAL CUMULATIVE COSTS	15747.6	17570.7	19061.6	20154.0	21010.0	21980.5	22952.9	23645.7	23862.5	23937.0
QUARTERLY DEVELOPMENT COSTS	2078.8	1753.8	1384.7	1000.7	769.6	744.8	363.7	339.0	120.7	0.0
QUARTERLY PRODUCTION COSTS	72.2	69.3	106.3	91.6	86.4	225.6	608.7	353.8	96.2	74.5
TOTAL QUARTERLY COSTS	2151.0	1823.0	1491.0	1092.3	856.1	970.4	972.4	692.8	216.9	74.5

TABLE III-2

COST DISTRIBUTION DATA FOR  
THE INDEPENDENT DEVELOPMENT  
OF THE DEDICATED 7-DAY LABORATORY

FUNDING REQUIREMENTS FOR EU 1

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	175.1	578.7	896.2	1481.5	1811.3	1994.5	1969.8	1725.3	1275.1	1121.9	732.1	384.7	413.5	278.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.2	312.8	829.4	1164.2	0.0
TOTAL	0.0	175.1	578.7	896.2	1481.5	1811.3	1994.5	1969.8	1725.3	1275.1	1121.9	732.1	476.9	726.4	1107.9	1164.2	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	15.3	106.5	310.5	629.6	1043.3	1522.9	2023.1	2489.4	2882.9	3204.0	3436.8	3573.1	3667.2	3761.4	3791.0	3791.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	58.0	198.6	471.3	603.0
TOTAL	0.0	15.3	106.5	310.5	629.6	1043.3	1522.9	2023.1	2489.4	2882.9	3204.0	3436.8	3581.8	3725.1	3960.0	4262.3	4394.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	15.3	91.2	204.1	319.1	413.7	479.6	500.2	466.3	393.5	321.1	232.8	136.3	94.1	94.2	29.6	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	49.3	140.6	272.7	131.7
TOTAL	0.0	15.3	91.2	204.1	319.1	413.7	479.6	500.2	466.3	393.5	321.1	232.8	145.0	143.4	234.8	302.3	131.7

FUNDING REQUIREMENTS FOR EU 2

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.7	163.0	206.3	163.0	472.5	408.9	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	246.9	886.9	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.7	163.0	206.3	163.0	472.5	655.8	886.9	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	34.6	82.5	130.4	202.6	328.6	372.0	372.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.2	178.8	285.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	34.6	82.5	130.4	202.6	354.8	550.8	657.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	28.8	47.9	47.9	72.2	126.9	43.4	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.2	152.5	106.2
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	28.8	47.9	47.9	72.2	152.2	196.0	106.2

FUNDING REQUIREMENTS FOR EU 3

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	31.2	95.6	158.0	195.1	195.1	158.0	95.6	31.2	813.8	813.8	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.8	60.0	525.8	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	31.2	95.6	158.0	195.1	195.1	158.0	95.6	31.2	847.6	873.8	525.8	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	2.8	18.3	50.4	95.2	144.8	189.6	221.7	237.2	326.5	565.5	652.0	652.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	16.0	90.2	155.0
TOTAL	0.0	0.0	0.0	0.0	0.0	2.8	18.3	50.4	95.2	144.8	189.6	221.7	237.2	329.8	581.5	742.2	807.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	2.8	15.6	32.0	44.8	49.6	44.8	32.0	15.6	89.2	239.1	86.5	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	12.7	74.2	64.8
TOTAL	0.0	0.0	0.0	0.0	0.0	2.8	15.6	32.0	44.8	49.6	44.8	32.0	15.6	92.5	251.7	160.7	64.8

FUNDING REQUIREMENTS FOR EU 4

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	140.0	463.0	717.0	1185.2	1782.0	2615.3	3261.4	3461.3	3295.9	3081.9	2236.6	1139.5	816.4	513.6	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.6	178.2	454.1	609.3	0.0
TOTAL	0.0	140.0	463.0	717.0	1185.2	1782.0	2615.3	3261.4	3461.3	3295.9	3081.9	2236.6	1167.1	994.7	967.7	609.3	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	12.2	85.2	248.4	503.7	864.2	1414.0	2155.8	3007.0	3868.7	4691.9	5366.3	5788.0	6011.7	6190.4	6245.0	6245.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	25.7	105.4	250.3	319.0
TOTAL	0.0	12.2	85.2	248.4	503.7	864.2	1414.0	2155.8	3007.0	3868.7	4691.9	5366.3	5790.6	6037.4	6295.9	6495.3	6564.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	12.2	73.0	163.3	255.3	360.5	549.8	741.3	851.2	861.7	823.2	674.4	421.6	223.8	178.7	54.6	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	23.1	79.8	144.8	68.7
TOTAL	0.0	12.2	73.0	163.3	255.3	360.5	549.8	741.3	851.2	861.7	823.2	674.4	424.2	246.8	258.5	199.4	68.7

FUNDING REQUIREMENTS FOR EU 5

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	58.4	192.9	298.7	493.8	729.9	1051.2	1295.3	1363.6	1976.8	2966.6	3103.3	2208.3	2672.9	1864.7	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.4	294.3	1233.5	1679.3	0.0
TOTAL	0.0	58.4	192.9	298.7	493.8	729.9	1051.2	1295.3	1363.6	1976.8	2966.6	3103.3	2269.7	2967.3	3098.2	1679.3	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.1	35.5	103.5	209.9	359.0	581.8	877.9	1214.6	1616.4	2249.6	3030.7	3713.0	4288.8	4910.9	5109.0	5109.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	47.1	229.1	634.5	823.0
TOTAL	0.0	5.1	35.5	103.5	209.9	359.0	581.8	877.9	1214.6	1616.4	2249.6	3030.7	3718.8	4335.8	5140.0	5743.5	5932.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.1	30.4	68.0	106.4	149.1	222.8	296.2	336.6	401.8	633.2	781.0	682.3	575.8	622.1	198.1	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	41.3	182.1	405.4	188.5
TOTAL	0.0	5.1	30.4	68.0	106.4	149.1	222.8	296.2	336.6	401.8	633.2	781.0	688.1	617.1	804.2	603.5	188.5

FUNDING REQUIREMENTS FOR EU 6

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.9	148.1	187.5	148.1	316.6	258.8	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.8	176.8	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.9	148.1	187.5	148.1	316.6	351.6	176.8	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	31.5	75.0	118.5	172.2	253.5	281.0	281.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9	47.6	68.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	31.5	75.0	118.5	172.2	263.4	328.6	349.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	26.2	43.5	43.5	53.7	81.3	27.5	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.9	37.8	20.4
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	26.2	43.5	43.5	53.7	91.2	65.3	20.4

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FUNDING REQUIRMENTS FOR EU 7

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELCW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.5	43.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.5	43.5	52.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	17.4	22.0	22.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	13.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	17.4	28.5	35.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	12.8	4.6	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.5	6.5
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	12.8	11.1	6.5

FUNDING REQUIREMENTS FOR EU 11

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	0.0	0.0	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.7	93.8	84.7	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	52.7	93.8	84.7	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

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	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1000.0	1000.0	1000.0	1000.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	25.0	48.8	58.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1005.2	1025.0	1048.8	1058.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	186.8	133.5	64.9	11.5	0.0	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	19.8	23.8	9.2	
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	186.8	133.5	64.9	16.7	19.8	23.8	9.2	

FUNDING REQUIREMENTS FOR EL 12

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.5	246.9	312.5	246.9	697.1	590.6	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	148.1	956.1	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.5	246.9	312.5	246.9	697.1	738.3	956.1	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	52.5	125.0	197.5	303.9	486.2	549.0	549.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.0	15.7	160.3	277.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	52.5	125.0	197.5	303.9	502.0	709.3	826.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	8.9	43.6	72.5	72.5	106.3	182.4	62.8	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.7	144.5	116.7	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	8.9	43.6	72.5	72.5	106.3	198.1	207.3	116.7	

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FUNDING REQUIREMENTS FOR EU 26

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.0	345.7	437.5	345.7	856.0	721.3	0.0	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.0	345.7	437.5	345.7	856.0	919.9	306.8	0.0	0.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	73.5	175.0	276.5	414.2	638.4	715.0	715.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	73.5	175.0	276.5	414.2	648.3	780.5	817.0	0.0	0.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	61.0	101.5	101.5	137.6	224.2	76.6	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	1.0	3.0	0.0	0.0	0.0	12.4	61.0	101.5	101.5	137.6	234.7	171.6	36.5	0.0	0.0

FUNDING REQUIREMENTS FOR EL 31

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.7	158.0	200.0	158.0	229.6	167.9	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	227.2	443.2	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.7	158.0	200.0	158.0	229.6	395.1	443.2	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	33.6	80.0	126.4	172.2	227.2	245.0	245.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	117.9	169.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	33.6	80.0	126.4	172.2	251.3	362.9	414.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	27.9	46.4	46.4	45.7	55.0	17.8	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	93.7	51.1	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	27.9	46.4	46.4	45.7	79.1	111.6	51.1	

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FUNDING REQUIREMENTS FOR EL 40

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	58.4	192.9	298.7	493.8	1254.1	2656.4	3948.8	4639.5	4444.4	3550.9	2089.7	663.3	0.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	51.8	81.3	64.1	0.0
TOTAL	0.0	58.4	192.9	298.7	493.8	1254.1	2656.4	3948.8	4639.5	4444.4	3550.9	2089.7	669.5	51.8	81.3	64.1	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.1	35.5	103.5	209.9	405.4	889.7	1723.8	2813.2	3973.4	4994.1	5705.2	6041.2	6100.0	6100.0	6100.0	6100.0
PRODUCTION	0.0	8.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	6.9	24.8	44.2	51.0
TOTAL	0.0	5.1	35.5	103.5	209.9	405.4	889.7	1723.8	2813.2	3973.4	4994.1	5705.2	6041.8	6106.9	6124.8	6144.2	6151.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.1	30.4	68.0	106.4	195.6	484.3	834.1	1089.5	1160.2	1020.8	711.1	336.0	58.8	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	6.3	17.9	19.4	6.8
TOTAL	0.0	5.1	30.4	68.0	106.4	195.6	484.3	834.1	1089.5	1160.2	1020.8	711.1	336.5	65.1	17.9	19.4	6.8

FUNDING REQUIREMENTS FOR EU 41

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	790.1	790.1	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	200.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	790.1	790.1	200.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.0	316.0	400.0	400.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	50.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.0	316.0	425.0	450.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.0	232.1	84.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	25.0	25.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	84.0	232.1	109.0	25.0

FUNDING REQUIREMENTS FOR EU 42

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	52.0	159.3	263.4	325.2	325.2	263.4	159.3	52.0	268.6	268.6	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.2	75.0	414.2	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	52.0	159.3	263.4	325.2	325.2	263.4	159.3	52.0	310.8	343.6	414.2	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	4.6	30.6	84.0	158.7	241.3	316.0	369.4	395.4	428.5	507.5	536.0	536.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	20.0	82.4	133.0
TOTAL	0.0	0.0	0.0	0.0	0.0	4.6	30.6	84.0	158.7	241.3	316.0	369.4	395.4	432.7	527.5	618.4	669.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	4.6	26.0	53.4	74.7	82.7	74.7	53.4	26.0	33.2	78.9	28.5	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	15.9	62.4	50.6
TOTAL	0.0	0.0	0.0	0.0	0.0	4.6	26.0	53.4	74.7	82.7	74.7	53.4	26.0	37.3	94.8	90.9	50.6

FUNDING REQUIREMENTS FOR EU 50

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	197.5	197.5	0.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.6	56.3	35.6	0.0	0.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	229.2	253.8	35.6	0.0	0.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1021.0	1079.0	1100.0	1100.0	1100.0	1100.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	15.0	27.4	31.0	31.0	31.0
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1024.1	1094.0	1127.4	1131.0	1131.0	1131.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	186.8	133.5	64.9	32.5	58.0	21.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	11.9	12.4	3.6	3.6	3.6
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	186.8	133.5	64.9	35.6	69.9	33.4	3.6	3.6	3.6

FUNDING REQUIREMENTS FOR EU 51

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	24.7	31.3	24.7	173.6	164.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	97.9	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	24.7	31.3	24.7	173.6	169.9	97.9	0.0

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THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	5.2	12.5	19.8	41.5	90.6	108.0	108.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	13.9	26.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	5.2	12.5	19.8	41.5	91.2	121.9	134.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	4.4	7.3	7.3	21.8	49.0	17.4	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	13.2	12.1
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	4.4	7.3	7.3	21.8	49.7	30.7	12.1

FUNDING REQUIREMENTS FOR EU 60

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.8	19.3	29.9	49.4	59.1	62.5	59.1	49.4	107.0	216.8	255.8	197.5	77.2	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	22.5	58.6	41.5	0.0
TOTAL	0.0	5.8	19.3	29.9	49.4	59.1	62.5	59.1	49.4	107.0	216.8	255.8	198.1	99.6	58.6	41.5	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	.5	3.5	10.4	21.0	34.7	50.0	65.3	79.0	96.7	138.4	199.5	258.0	292.9	300.0	300.0	300.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.1	2.4	12.8	26.8	31.0
TOTAL	0.0	.5	3.5	10.4	21.0	34.7	50.0	65.3	79.0	96.7	138.4	199.5	258.1	295.3	312.8	326.8	331.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	.5	3.0	6.8	10.6	13.7	15.3	15.3	13.7	17.7	41.7	61.1	58.5	34.9	7.1	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.1	2.3	10.4	14.0	4.2
TOTAL	0.0	.5	3.0	6.8	10.6	13.7	15.3	15.3	13.7	17.7	41.7	61.1	58.6	37.2	17.5	14.0	4.2

FUNDING REQUIREMENTS FOR EU 61

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3	55.3	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	20.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3	55.3	20.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	22.1	28.0	28.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	5.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	22.1	30.5	33.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	16.2	5.9	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	2.5
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	16.2	8.4	2.5

FUNDING REQUIREMENTS FOR EU 70

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	69.1	87.5	69.1	27.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	26.7	18.4	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	69.1	87.5	69.1	37.6	26.7	18.4	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	14.7	35.0	55.3	67.5	70.0	70.0	70.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.8	12.1	14.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	14.7	35.0	55.3	68.6	75.8	82.1	84.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.2	20.3	20.3	12.2	2.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.8	6.3	1.9
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.2	20.3	20.3	13.2	7.3	6.3	1.9

FUNDING REQUIREMENTS FOR EL 80

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2004.9	2004.9	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3608.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2004.9	2004.9	3608.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	802.0	1015.0	1015.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	451.0	902.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	802.0	1466.0	1917.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	588.9	213.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	451.0	451.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	588.9	664.0	451.0

FUNDING REQUIREMENTS FOR EU 91

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	831.6	831.6	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	272.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	831.6	831.6	272.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

III-45

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.4	332.6	421.0	421.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.0	68.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.4	332.6	455.0	489.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.4	244.3	88.4	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	34.0	34.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	88.4	244.3	122.4	34.0

FUNDING REQUIREMENTS FOR EU 93

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	29.6	37.5	29.6	31.3	19.3	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	29.6	37.5	29.6	31.3	23.7	8.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	6.3	15.0	23.7	31.0	37.9	40.0	40.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.4	2.1	3.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	6.3	15.0	23.7	31.0	38.3	42.1	43.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.2	8.7	8.7	7.3	6.9	2.1	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.4	1.7	.9
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.2	8.7	8.7	7.3	7.3	3.8	.9

PAYLOAD TOTALS

YEAR	73	.	.	.	74	.	.	.	75	.	.
DEVELOPMENT FUNDING RATE	0.0	194.2	610.5	1424.2	2753.6	7331.7	10309.0	11299.9	13160.5	13378.8	12417.5
PRODUCTION FUNDING RATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3808.0	246.9	1201.1	181.7
TOTAL FUNDING RATE	0.0	194.2	610.5	1424.2	2753.6	7331.7	10309.0	15107.9	13407.4	14579.9	12599.2
CUMULATIVE DEVELOPMENT COSTS	0.0	17.1	115.5	362.2	889.3	2111.7	4486.0	7112.6	10249.2	13561.7	16870.0
CUMULATIVE PRODUCTION COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	476.0	978.2	1168.9	1336.3
TOTAL CUMULATIVE COSTS	0.0	17.1	115.5	362.2	889.3	2111.7	4486.0	7588.6	11227.4	14730.6	18206.3
QUARTERLY DEVELOPMENT COSTS	0.0	17.1	98.3	246.7	527.2	1222.5	2374.2	2626.6	3136.6	3312.5	3308.3
QUARTERLY PRODUCTION COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	476.0	502.2	190.7	167.4
TOTAL QUARTERLY COSTS	0.0	17.1	98.3	246.7	527.2	1222.5	2374.2	3102.6	3638.8	3503.2	3475.7

PAYLOAD TOTALS (CONTINUED)

YR	.	76	.	.	.	77	.	.	.	78
DEVELOPMENT FUNDING RATE	10244.1	9280.9	7039.7	4548.9	5032.4	3478.8	1442.6	1384.7	0.0	0.0
PRODUCTION FUNDING RATE	380.9	243.8	676.0	415.0	975.7	2665.2	4484.9	227.8	1168.8	0.0
TOTAL FUNDING RATE	10624.9	9523.8	7715.7	4963.9	6008.1	6144.0	5927.5	1612.5	1168.8	0.0
CUMULATIVE DEVELOPMENT COSTS	19705.2	22216.2	24257.1	25722.7	26851.6	28014.1	28539.8	28951.9	29099.0	29099.0
CUMULATIVE PRODUCTION COSTS	1412.5	1482.8	1605.3	1734.7	1905.5	2343.9	3318.8	3862.9	4043.7	4186.0
TOTAL CUMULATIVE COSTS	21117.7	23699.0	25862.4	27457.4	28757.1	30358.0	31858.6	32814.7	33142.7	33285.0
QUARTERLY DEVELOPMENT COSTS	2835.2	2511.0	2040.9	1465.5	1128.9	1162.5	525.7	412.1	147.1	0.0
QUARTERLY PRODUCTION COSTS	76.2	70.3	122.5	129.4	170.8	438.4	974.9	544.1	180.8	142.3
TOTAL QUARTERLY COSTS	2911.4	2581.3	2163.4	1595.0	1299.7	1600.9	1500.6	956.2	327.9	142.3

**TABLE 3**

**COST DISTRIBUTION DATA FOR  
THE INDEPENDENT DEVELOPMENT  
OF THE DEDICATED 30-DAY LABORATORY**

FUNDING REQUIREMENTS FOR EU 2

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.7	163.0	206.3	163.0	472.5	408.9	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	246.9	886.9	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	63.7	163.0	206.3	163.0	472.5	655.8	886.9	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

III-50

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	34.6	82.5	130.4	202.6	328.6	372.0	372.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.2	178.8	285.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	34.6	82.5	130.4	202.6	354.8	550.8	657.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	28.8	47.9	47.9	72.2	126.0	43.4	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	26.2	152.5	106.2
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	28.8	47.9	47.9	72.2	152.2	196.0	106.2

FUNDING REQUIREMENTS FOR EL 1

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	175.1	578.7	896.2	1481.5	1811.3	1994.5	1969.8	1725.3	1275.1	1121.9	732.1	384.7	413.5	278.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	92.2	312.8	829.4	1324.2	0.0
TOTAL	0.0	175.1	578.7	896.2	1481.5	1811.3	1994.5	1969.8	1725.3	1275.1	1121.9	732.1	476.9	726.4	1107.9	1324.2	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	15.3	106.5	310.5	629.6	1043.3	1522.9	2023.1	2489.4	2882.9	3204.0	3436.8	3573.1	3667.2	3761.4	3791.0	3791.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	58.0	198.6	491.3	643.0
TOTAL	0.0	15.3	106.5	310.5	629.6	1043.3	1522.9	2023.1	2489.4	2882.9	3204.0	3436.8	3581.8	3725.1	3960.0	4282.3	4434.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	15.3	91.2	204.1	319.1	413.7	479.6	500.2	466.3	393.5	321.1	232.8	136.3	94.1	94.2	29.6	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.7	49.3	140.6	292.7	151.7
TOTAL	0.0	15.3	91.2	204.1	319.1	413.7	479.6	500.2	466.3	393.5	321.1	232.8	145.0	143.4	234.8	322.3	151.7

FUNDING REQUIREMENTS FOR EL 3

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	31.2	95.6	158.0	195.1	195.1	158.0	95.6	31.2	813.8	813.8	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	33.8	60.0	733.8	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	31.2	95.6	158.0	195.1	195.1	158.0	95.6	31.2	847.6	873.8	733.8	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

III-51

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	2.8	18.3	50.4	95.2	144.8	189.6	221.7	237.2	326.5	565.5	652.0	652.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	16.0	116.2	207.0
TOTAL	0.0	0.0	0.0	0.0	0.0	2.8	18.3	50.4	95.2	144.8	189.6	221.7	237.2	329.8	581.5	768.2	859.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	2.6	15.6	32.0	44.8	49.6	44.8	32.0	15.6	89.2	239.1	86.5	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.3	12.7	100.2	90.3
TOTAL	0.0	0.0	0.0	0.0	0.0	2.6	15.6	32.0	44.8	49.6	44.8	32.0	15.6	92.5	251.7	186.7	90.3

FUNDING REQUIREMENTS FOR FU 4

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	140.0	463.0	717.0	1185.2	1782.0	2615.3	3261.4	3461.3	3440.6	3452.3	2705.3	1509.9	1059.9	612.3	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.6	204.6	629.4	1064.1	0.0
TOTAL	0.0	140.0	463.0	717.0	1185.2	1782.0	2615.3	3261.4	3461.3	3440.6	3452.3	2705.3	1537.5	1264.5	1241.8	1064.1	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

III-52

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	12.2	85.2	248.4	503.7	864.2	1414.0	2155.8	3007.0	3882.0	4770.6	5553.8	6084.3	6383.9	6604.9	6670.0	6670.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	28.3	131.6	361.5	484.0
TOTAL	0.0	12.2	85.2	248.4	503.7	864.2	1414.0	2155.8	3007.0	3882.0	4770.6	5553.8	6086.9	6412.1	6736.5	7031.5	7154.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	12.2	73.0	163.3	255.3	360.5	549.8	741.8	851.2	875.0	888.6	783.2	530.4	299.6	221.0	65.1	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.6	25.7	103.3	230.0	122.5
TOTAL	0.0	12.2	73.0	163.3	255.3	360.5	549.8	741.8	851.2	875.0	888.6	783.2	533.0	325.3	324.4	295.0	122.5

FUNDING REQUIREMENTS FOR EU 5

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

		TIME (YEARS)															
		0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0							
DEVELOPMENT	0.0	58.4	192.9	298.7	493.8	899.0	1569.0	2151.3	2420.4	3066.3	3906.5	3727.4	2461.3	2705.7	1864.7	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	51.4	368.2	1433.9	1822.7	0.0
TOTAL	0.0	58.4	192.9	298.7	493.8	899.0	1569.0	2151.3	2420.4	3066.3	3906.5	3727.4	2522.8	3073.9	3298.6	1822.3	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

ES-III

		TIME (YEARS)															
		0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0							
DEVELOPMENT	0.0	5.1	35.5	103.5	209.9	374.0	681.1	1150.9	1730.3	2403.7	3294.6	4273.8	5065.1	5670.7	6295.9	6494.0	6494.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	54.3	271.5	724.9	928.0
TOTAL	0.0	5.1	35.5	103.5	209.9	374.0	681.1	1150.8	1730.3	2403.7	3294.6	4273.8	5070.9	5725.1	6567.4	7218.9	7422.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

		TIME (YEARS)															
		0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0							
DEVELOPMENT	0.0	5.1	30.4	68.0	106.4	164.1	307.1	469.7	579.5	673.4	890.9	979.2	791.3	605.6	625.1	198.1	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.8	48.5	217.2	453.4	203.1
TOTAL	0.0	5.1	30.4	68.0	106.4	164.1	307.1	469.7	579.5	673.4	890.9	979.2	797.1	654.1	842.3	651.5	203.1

FUNDING REQUIREMENTS FOR EU 6

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.9	148.1	187.5	148.1	316.6	258.9	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	108.6	252.6	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	57.9	148.1	187.5	148.1	316.6	367.4	252.6	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	31.5	75.0	118.5	172.2	253.5	281.0	281.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	61.5	91.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	31.5	75.0	118.5	172.2	265.0	342.5	372.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	26.2	43.5	43.5	53.7	81.3	27.5	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.5	49.9	29.5	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.3	26.2	43.5	43.5	53.7	92.9	77.4	29.5	

FUNDING REQUIREMENTS FOR EU 7

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.5	43.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	64.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	43.5	43.5	64.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

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	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	17.4	22.0	22.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.0	16.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	17.4	30.0	38.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	12.8	4.6	0.0
PRODUCTION	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.0	0.0
TOTAL	0.0	0.0	0.3	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.6	12.8	12.6	0.0

FUNDING REQUIREMENTS FOR EU 11

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	0.0	0.0	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	52.7	93.3	84.7	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	52.7	93.3	84.7	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1000.0	1000.0	1000.0	1000.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	25.0	48.8	58.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1005.2	1025.0	1048.8	1058.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	186.8	133.5	64.9	11.5	0.0	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.2	19.8	23.8	9.2	
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	186.8	133.5	64.9	16.7	19.8	23.8	9.2	

FUNDING REQUIREMENTS FOR EU 12

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.5	246.9	312.5	246.9	687.1	590.6	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	148.1	956.1	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	96.5	246.9	312.5	246.9	687.1	738.8	956.1	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	52.5	125.0	197.5	303.9	486.2	549.0	549.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.7	160.3	277.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	52.5	125.0	197.5	303.9	502.0	709.3	826.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	43.6	72.5	72.5	106.3	182.4	62.8	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	15.7	144.5	116.7	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	8.9	43.6	72.5	72.5	106.3	198.1	207.3	116.7	

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FUNDING REQUIREMENTS FOR EU 26

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.0	345.7	437.5	345.7	1843.7	1708.6	0.0	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	98.8	706.8	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	135.0	345.7	437.5	345.7	1843.7	1807.4	706.8	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

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	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	73.5	175.0	276.5	519.1	1033.5	1215.0	1215.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	115.5	202.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	73.5	175.0	276.5	519.1	1044.0	1330.5	1417.0	

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																	
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0		
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	61.0	101.5	101.5	242.6	514.3	181.5	0.0	
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	105.0	86.5	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	12.4	61.0	101.5	101.5	242.6	524.8	286.6	86.5	

FUNDING REQUIREMENTS FOR EU 31

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.7	158.0	200.0	158.0	229.6	167.9	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	227.2	443.2	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	61.7	158.0	200.0	158.0	229.6	395.1	443.2	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

85-III

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	33.6	80.0	126.4	172.2	227.2	245.0	245.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	117.9	169.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	33.6	80.0	126.4	172.2	251.3	362.9	414.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	27.9	46.4	46.4	45.7	55.0	17.8	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.1	93.7	51.1
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.7	27.9	46.4	46.4	45.7	79.1	111.6	51.1

FUNDING REQUIREMENTS FOR EU 40

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	58.4	192.9	298.7	493.8	1254.1	2656.4	3948.8	4639.5	4444.4	3580.9	2089.7	663.3	0.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	6.1	51.8	81.3	64.1	0.0
TOTAL	0.0	58.4	192.9	298.7	493.8	1254.1	2656.4	3948.8	4639.5	4444.4	3580.9	2089.7	669.5	51.8	81.3	64.1	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.1	35.5	103.5	209.9	405.4	889.7	1723.8	2813.2	3973.4	4994.1	5705.2	6041.2	6100.0	6100.0	6100.0	6100.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	6.9	24.8	44.2	51.0
TOTAL	0.0	5.1	35.5	103.5	209.9	405.4	889.7	1723.8	2813.2	3973.4	4994.1	5705.2	6041.8	6106.9	6124.8	6144.2	6151.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	5.1	30.4	68.0	106.4	195.6	484.3	834.1	1089.5	1160.2	1020.8	711.1	336.0	58.8	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	6.3	17.9	19.4	6.8
TOTAL	0.0	5.1	30.4	68.0	106.4	195.6	484.3	834.1	1089.5	1160.2	1020.8	711.1	336.5	65.1	17.9	19.4	6.8

FUNDING REQUIREMENTS FOR EU 41

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2765.4	2765.4	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	600.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2765.4	2765.4	600.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	293.8	1106.2	1400.0	1400.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	150.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	293.8	1106.2	1475.0	1550.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	293.8	812.3	293.8	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	75.0	75.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	293.8	812.3	368.8	75.0

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FUNDING REQUIREMENTS FOR EU 42

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	52.0	159.3	263.4	325.2	325.2	263.4	159.3	52.0	268.6	268.6	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	42.2	75.0	406.2	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	52.0	159.3	263.4	325.2	325.2	263.4	159.3	52.0	310.8	343.6	406.2	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	4.6	30.6	84.0	158.7	241.3	316.0	369.4	395.4	428.5	507.5	536.0	536.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	20.0	81.4	131.0
TOTAL	0.0	0.0	0.0	0.0	0.0	4.6	30.6	84.0	158.7	241.3	316.0	369.4	395.4	432.7	527.5	617.4	667.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	4.6	26.0	53.4	74.7	82.7	74.7	53.4	26.0	33.2	78.9	28.5	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.1	15.9	61.4	49.6
TOTAL	0.0	0.0	0.0	0.0	0.0	4.6	26.0	53.4	74.7	82.7	74.7	53.4	26.0	37.3	94.8	89.9	49.6

FUNDING REQUIREMENTS FOR EL 50

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	197.5	197.5	0.0	0.0		
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	31.6	56.3	35.6	0.0		
TOTAL	0.0	0.0	0.0	0.0	0.0	130.1	398.3	658.4	812.9	812.9	658.4	398.3	130.1	229.2	253.8	35.6	0.0		

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1021.0	1079.0	1100.0	1100.0		
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	15.0	27.4	31.0		
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	76.4	209.9	396.7	603.3	790.1	923.6	988.5	1024.1	1094.0	1127.4	1131.0		

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	186.8	133.5	64.9	32.5	58.0	21.0	0.0		
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.1	11.9	12.4	3.6		
TOTAL	0.0	0.0	0.0	0.0	0.0	11.5	64.9	133.5	186.8	206.6	186.8	133.5	64.9	35.6	69.9	33.4	3.6		

FUNDING REQUIREMENTS FOR EU 51

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	24.7	31.3	24.7	173.6	164.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	97.9	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	9.6	24.7	31.3	24.7	173.6	169.9	97.9	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

III-64

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	5.2	12.5	19.8	41.5	90.6	108.0	108.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	13.9	26.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	5.2	12.5	19.8	41.5	91.2	121.9	134.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	4.4	7.3	7.3	21.8	49.0	17.4	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	13.2	12.1
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.9	4.4	7.3	7.3	21.8	49.7	30.7	12.1

FUNDING REQUIREMENTS FOR EU 60

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	5.8	19.3	29.9	49.4	59.1	62.5	59.1	49.4	107.0	216.8	255.8	197.5	77.2	0.0	0.0	0.0		
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.6	22.5	58.6	41.5	0.0	0.0	
TOTAL	0.0	5.8	19.3	29.9	49.4	59.1	62.5	59.1	49.4	107.0	216.8	255.8	198.1	99.6	58.6	41.5	0.0		

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

99-III

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	.5	3.5	10.4	21.0	34.7	50.0	65.3	79.0	96.7	138.4	199.5	258.0	292.9	300.0	300.0	300.0		
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.1	2.4	12.8	26.8	31.0		
TOTAL	0.0	.5	3.5	10.4	21.0	34.7	50.0	65.3	79.0	96.7	138.4	199.5	258.1	295.3	312.8	326.8	331.0		

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																		
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	
DEVELOPMENT	0.0	.5	3.0	6.8	10.6	13.7	15.3	15.3	13.7	17.7	41.7	61.1	58.5	34.9	7.1	0.0	0.0		
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.1	2.3	10.4	14.0	4.2		
TOTAL	0.0	.5	3.0	6.8	10.6	13.7	15.3	15.3	13.7	17.7	41.7	61.1	58.6	37.2	17.5	14.0	4.2		

FUNDING REQUIREMENTS FOR EU 61

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	3.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3	55.3	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	24.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	55.3	55.3	24.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

99-III

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	22.1	28.0	28.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	6.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	22.1	31.0	34.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	16.2	5.9	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3.0	3.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	5.9	16.2	8.9	3.0

FUNDING REQUIREMENTS FOR EU 70

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																	
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	69.1	87.5	69.1	27.0	0.0	0.0	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	10.5	26.7	18.4	0.0	
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	27.0	69.1	87.5	69.1	37.6	26.7	18.4	0.0	

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	14.7	35.0	55.3	67.5	70.0	70.0	70.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	5.8	12.1	14.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	14.7	35.0	55.3	68.6	75.8	82.1	84.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.2	20.3	20.3	12.2	2.5	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.0	4.3	6.3	1.9
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2.5	12.2	20.3	20.3	13.2	7.3	6.3	1.9

FUNDING REQUIREMENTS FOR EL 80

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2004.9	2004.9	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	3608.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	2004.9	2004.9	3608.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

III-68

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	802.0	1015.0	1015.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	451.0	902.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	802.0	1466.0	1917.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	588.9	213.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	451.0	451.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	213.0	588.9	664.0	451.0

FUNDING REQUIREMENTS FOR EL 91

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	898.8	898.8	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	380.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	898.8	898.8	380.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95.5	359.5	455.0	455.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.5	95.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95.5	359.5	502.5	550.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5	1.0	1.5	2.0	2.5	3.0	3.5	4.0								
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95.5	264.0	95.5	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	47.5	47.5
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	95.5	264.0	143.0	47.5

FUNDING REQUIREMENTS FOR EL 93

THE FUNDING RATE (K\$/YEAR) VARIES AS SHOWN BELOW. THE NUMBERS REPRESENT THE FUNDING RATE REQUIRED AT THE INDICATED TIME (SLOPE OF THE CUMULATIVE COST CURVE).

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	29.6	37.5	29.6	31.3	19.8	0.0	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4.0	8.0	0.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	11.6	29.6	37.5	29.6	31.3	23.7	8.0	0.0

THE TOTAL FUNDING REQUIRED (CUMULATIVE COSTS IN K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE CUMULATIVE COSTS AT THE INDICATED TIME.

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	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	8.0	0.0	0.0	0.0	0.0	0.0	1.1	6.3	15.0	23.7	31.0	37.9	40.0	40.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.4	2.1	3.0
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	6.3	15.0	23.7	31.0	38.3	42.1	43.0

THE QUARTERLY FUNDING REQUIRED (K\$) IS SHOWN BELOW. THE NUMBERS REPRESENT THE DOLLARS SPENT IN THE PRECEDING THREE MONTH PERIOD.

	TIME (YEARS)																
	0	0.5		1.0		1.5		2.0		2.5		3.0		3.5		4.0	
DEVELOPMENT	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.2	8.7	8.7	7.3	6.9	2.1	0.0
PRODUCTION	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	.4	1.7	.9
TOTAL	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	1.1	5.2	8.7	8.7	7.3	7.3	3.8	.9

PAYLOAD TOTALS

YEAR	73	.	.	.	74	.	.	.	75	.	.
DEVELOPMENT FUNDING RATE	0.0	194.2	610.5	1424.2	2753.6	9306.7	12284.3	11536.2	13745.5	15222.4	14461.9
PRODUCTION FUNDING RATE	0.0	0.0	0.0	0.0	0.0	0.0	0.0	4208.0	246.9	1309.1	181.7
TOTAL FUNDING RATE	0.0	194.2	610.5	1424.2	2753.6	9306.7	12284.3	15744.2	13992.4	16531.5	14643.6
CUMULATIVE DEVELOPMENT COSTS	0.0	17.1	115.5	362.2	889.3	2321.7	5276.1	8134.7	11375.4	14973.5	18814.7
CUMULATIVE PRODUCTION COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	526.0	1076.2	1282.4	1463.3
TOTAL CUMULATIVE COSTS	0.0	17.1	115.5	362.2	889.3	2321.7	5276.1	8660.7	12453.6	16255.9	20278.1
QUARTERLY DEVELOPMENT COSTS	0.0	17.1	98.3	246.7	527.2	1432.4	2954.4	2858.6	3240.7	3598.1	3841.2
QUARTERLY PRODUCTION COSTS	0.0	0.0	0.0	0.0	0.0	0.0	0.0	526.0	552.2	204.2	180.9
TOTAL QUARTERLY COSTS	0.0	17.1	98.3	246.7	527.2	1432.4	2954.4	3384.6	3792.9	3802.3	4022.2

PAYLOAD TOTALS (CONTINUED)

YR	.	76	.	.	.	77	.	.	.	78
DEVELOPMENT FUNDING RATE	11478.3	10590.3	8132.5	5172.3	5308.7	3577.6	1442.6	1384.7	0.0	0.0
PRODUCTION FUNDING RATE	784.9	243.8	676.0	415.0	1075.9	3040.9	5242.7	243.6	1456.6	0.0
TOTAL FUNDING RATE	12263.1	10834.1	8808.5	5587.3	6384.5	6618.4	6685.2	1628.3	1456.6	0.0
CUMULATIVE DEVELOPMENT COSTS	22039.8	24873.9	27221.8	28905.2	30139.6	31347.6	31883.8	32295.9	32443.0	32443.0
CUMULATIVE PRODUCTION COSTS	1590.0	1710.8	1833.3	1962.7	2143.3	2640.4	3768.5	4482.5	4622.0	4800.0
TOTAL CUMULATIVE COSTS	23629.8	26584.7	29055.1	30867.9	32283.1	33988.0	35652.3	36698.4	37065.0	37243.0
QUARTERLY DEVELOPMENT COSTS	3225.1	2834.1	2347.9	1683.3	1234.6	1207.8	536.2	412.1	147.1	0.0
QUARTERLY PRODUCTION COSTS	126.7	120.8	122.5	129.4	180.6	497.0	1128.1	634.1	219.5	178.0
TOTAL QUARTERLY COSTS	3351.8	2954.9	2470.3	1812.8	1415.3	1704.8	1664.3	1046.2	366.6	178.0

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