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LIFE SCIENCE PAYLOADS PLANNING STUDY INTEGRATION FACILITY SURVEY RESULTS

NOVEMBER 1976

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PREFACE

This document was prepared by the McDonnell Douglas Astronautics Company for the NASA Johnson Space Center, Life Sciences Directorate, under Contract No. 9-14589, and presents the Integration Facility Survey Results of the Life Science Payload (LSP) Planning Study.

The LSP Planning Study develops planning data that covers overall acquisition, staging, and integration of elements, including program implementation, mission support and data disposition for Life Science Payloads.

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ABBREVIATIONS

TERM	EXPLANATION
ARC	Ames Research Center
BESS	Biomedical Experiments Scientific Satellite
CCAP	Control Center Applications Processor
CDMS	Command and Data Management System
CORE	Common Operational Research Equipment
DoD	Department of Defense
DOMSAT	Domestic Communications Satellite
DSM	Deep Space Network
EIA	Electronic Industries Association
EMI	Electromagnetic Interference
ESA	European Space Agency
FCT	Flight Control Team
FM	Frequency Modulation
FRR	Flight Readiness Review
GSE	Ground Support Equipment
GSFC	Goddard Space Flight Center
IF	Interface
JPL	Jet Propulsion Laboratory
JSC	Lyndon B. Johnson Space Center
KSC	John F. Kennedy Space Center
L/S	Launch Site
LS	Life Science
LSMA	Life Science Monitoring Area
LSP	Life Science Payloads
LSPF	Life Science Payloads Facility
MCC	Mission Control Center
MOPG	Master Operations Planning Group
MPSG	Multipurpose Support Group
MSI	Manned Systems Integration
MSS	Mission Specialist Station

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ABBREVIATIONS (Cont'd)

TERM	EXPLANATION
NASA	National Aeronautics and Space Administration
NOCC	Network Operations Control Center
ORR	Operational Readiness Review
PCM	Pulse Code Modulation
PE	Payload Engineer or Project Engineer
PI	Principal Investigator
PIP	POCCNET Interface Peripherals
POC	Payload Operations Center
POCC	Payload Operations Control Center
POCCNET	POCC Network
PRCB	Program Requirements Control Board
PSS	Payload Specialist Station
RAU	Remote Acquisition Unit
ROM	Rough Order of Magnitude
SMD	Spacelab Missions Development
SMS	Spacelab Mission Simulation
SRT	Supporting Research and Technology
STS	Space Transportation System
STDN	Spaceflight Tracking and Data Network
TDRS	Tracking Data Relay Satellite
TDRSS	Tracking Data Relay Satellite System
TIP	Telemeter Input Processor
VAFB	Vandenberg Air Force Base
VIP	Virtually Interfaced Peripheral
WTR	Western Test Range

Section 1
INTRODUCTION

1.1 PURPOSE

Ground based tests and studies of Life Science Shuttle era payload operations have indicated that plans to perform integration, checkout, test, and in-flight monitoring of Life Science payloads at NASA-JSC are feasible, and that scientific return will be cost effectively increased with this method of operation (see References 1 through 5).

The integration facility survey effort described in this report was structured to examine the facility resources needed to conduct Life Science Payload (LSP) integration and checkout activities at NASA-JSC. It is intended to provide reference information useful to JSC personnel in making programmatic decisions, to provide a guide for the preparation of detailed facility modification plans, and to identify rough order of magnitude facility and equipment costs necessary to implement the planned Life Science Program.

Additional Documents were produced which summarize and supplement this facility survey report. The documents are listed below:

DOCUMENT NUMBER	TITLE AND CONTENT
MDC G6579	Integration Facility Survey Executive Summary - Contains a brief overview of the major survey results including LSP Integration Facility and support equipment requirements, description of applicable JSC facilities, modification/equipment costs and LS facility implementation recommendations.
MDC G6578	Integration Facility Survey Data Sheets - Provides the detailed data on the facility physical and utilities characteristics including information concerning the LS applicable hardware/equipment controlled by the JSC Life Sciences Directorate.

1.2 OBJECTIVES

The primary objectives of the effort reported in this document are:

a) to define top level LSP Integration Facility Resource requirements for Life Science Shuttle Payloads,

b) to identify the resources currently available,

c) to compare the identified requirements with those already available, and

d) to specify methods to achieve any required new capabilities.

1.3 SCOPE

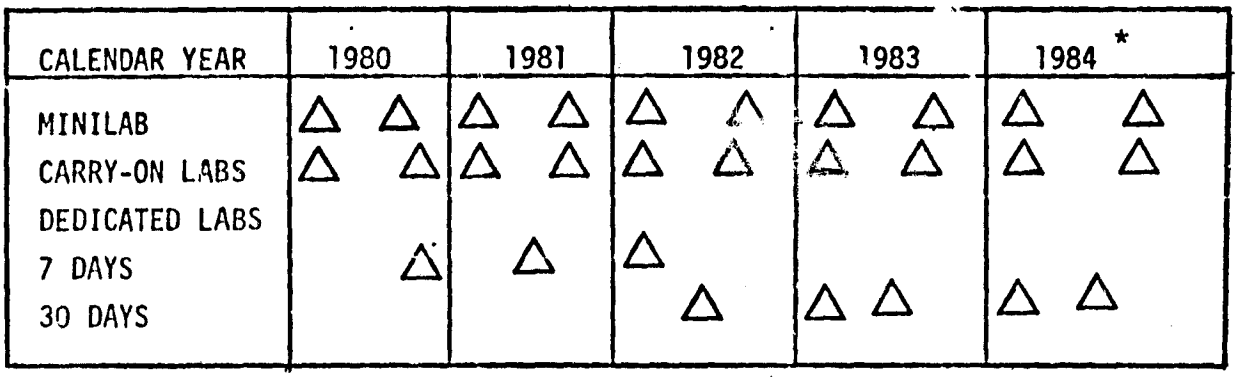
The Life Science Payload Integration Facility survey outlines accommodations needed in the development, test, integration, checkout and flight support of Life Sciences Carry-on labs, Spacelab Minilabs, and Spacelab Dedicated laboratories. Primary emphasis was placed on those integration and flight support activities to be conducted in NASA-JSC Building 36. However, the capabilities of additional JSC facilities identified as able to provide support to the Building 36 Life Science Payload activities were also examined and documented. Facilities in this group included Building 8 for medical support and Building 37 for general laboratory support.

1.4 GUIDELINES AND ASSUMPTIONS

The major guidelines and assumptions used in the integration facility survey are presented in the following paragraphs.

1.4.1 Dunning Flight Model

The integration facility requirements are based on the 30 November 1975 Dunning Life Science traffic model shown in Figure 1-1. It is assumed that two Carry-on labs, two Minilabs and two Dedicated labs will continue to be launched per year in the period 1985 through 1991. A parametric evaluation on the effect of a reduction in this traffic level on facility requirements was not performed.



* 1985 through 1991 same as 1984

FIGURE 1-1: LIFE SCIENCE PAYLOADS TRAFFIC MODEL (REFERENCE 7. BESS FLIGHTS NOT SHOWN)

1.4.2 Subfacility Operations

Space will be required at the Integration Facility, or within close proximity, to perform the following subfacility operations.

a) shipping and receiving
b) specimen examination, test, and holding
c) equipment storage
d) experiment test and checkout
e) experiment development
f) component integration
g) flight checkout test
h) data management
i) science data monitoring
j) facility maintenance
k) general purpose scientific laboratory testing
l) office and conference room space

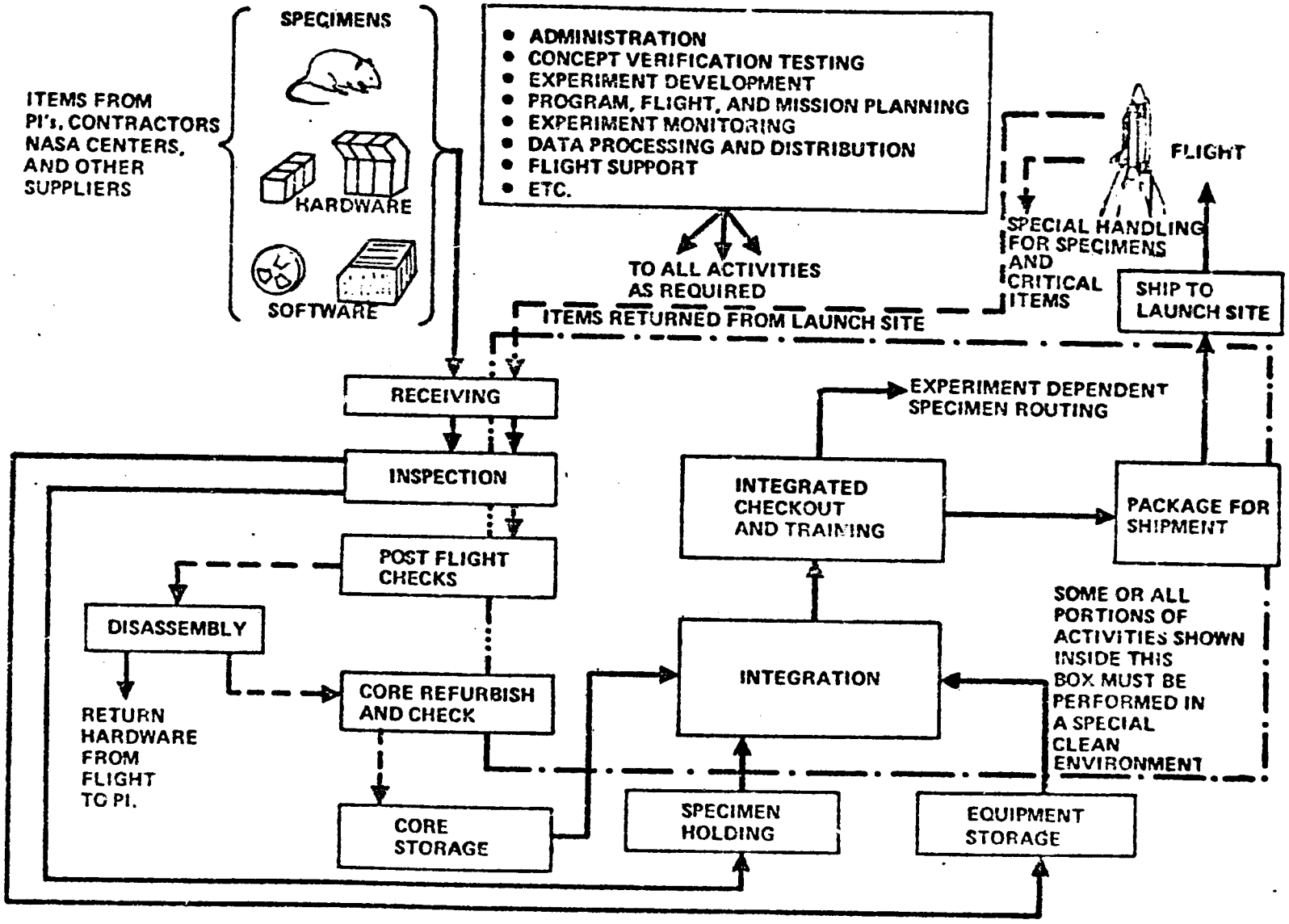
A simplified composite of Integration Facility activities is indicated in Figure 1-2.

1.4.3 Integration Activities

The Integration Facility must be capable of integrating individual experiments or filled racks provided from other sites (e.g., NASA-JSC) into flight ready packages up to complete rack/floor sets. All individually received experiments and components of dedicated and shared Life Science Payloads will be integrated with other necessary experiment support elements and given integrated tests and

FIGURE 1-2

TOP LEVEL JSC LIFE SCIENCE PAYLOADS INTEGRATION FACILITY ACTIVITIES



mission checkouts at the Integration Facility. The components will be shipped to the launch site for final integration and checkout with other Space Shuttle elements.

It is assumed that BESS payloads will not be processed by the JSC LSP Integration Facility.

It is assumed that Spacelab experiment interfaces connected for simulations will remain connected, whenever practical, through flight. Since interface plumbing and wiring between components in different racks will normally be routed under the Spacelab floor, it is desirable operationally to integrate Dedicated Lab floor segments along with experiments, racks, and other equipment at the LSP Integration Facility. This method of operation was assumed for this survey, although final selection of this procedure is dependent on floor segment cost and availability data that is not yet available.

1.4.4 Experiment Modifications

The majority of experiments received by the Integration Facility will be ready to fly or will require only minor modifications to bring them to flight ready status. More extensive fabrication efforts will not be performed at the Integration Facility, but will be performed at Contractor or JSC Technical Services Division facilities.

1.4.5 Integration and Transport Dollies

Integration of Spacelab racks and floors will occur on GSE dollies which will serve as in-building transporters. The dollies (similar to those used for SMS II) will also allow positioning of the integrated rack/floor sets for installation into the checkout structure. Rack and floor sets returned from the landing site will be placed on the GSE dollies for post flight checks and disassembly.

1.4.6 Shipping/Receiving Methods

The Integration Facility must accommodate shipping/receiving of assembled rack/floor sets as well as individual equipment items. Large items received or shipped from the facility will be unloaded or loaded on over-the-road transporters inside the building high bay area. Other items will be unloaded

or loaded at an outside covered dock area. Provisions for removing gross external contamination from incoming shipments and transporters outside the building will be provided.

1.4.7 Orbiter and Spacelab Mock-Up Fidelity

The level of fidelity with which the Spacelab interfaces are simulated by the Spacelab Mock-Ups used for checkout/test in the Integration Facility will be high.

Actual Spacelab subsystem functions, however, will be performed for the most part by lower cost non-flight hardware. Extensive Spacelab subsystem hardware and subsystem GSE will not be required.

An Orbiter aft flight deck and mid deck mockup will also be required. The Orbiter mid deck area will be equipped with habitability accommodations to enable participating crewmembers to remain in the mockup for the duration of the preflight checkout.

1.4.8 Contamination/Outgassing

Contamination and outgassing measurements will be conducted on individual experiments in an off-line vacuum chamber. Fully integrated racks or rack/floors sets will not be subjected to outgassing measurements.

1.4.9 Utility Usage Profiles

The capability to monitor thermal, electrical, and other utility usage profiles will be required during integrated tests and checkout acitivities.

1.4.10 Cleanliness Levels in Integration Areas

The Integration Facility will be operated such that flight components undergoing final integration, tests and checkout:

a) have surface cleanliness maintained at level 300A according to MIL-STD-1246A (Reference 7)

b) are exposed to an environment with an airborne particle content meeting class 100,000 requirements as specified in FED-STD-209B (References 7 and 8)

c) are exposed to a controlled ambient temperature of 18 to 26°C (65 to 78°F (Reference 7)

d) are exposed to a controlled relative humidity between 30 and 50 percent (Reference 7).

1.4.1i Additional Cleanliness Provisions

Clean rooms having an airborne contaminant level of less than class 100K will not be necessary in the Integration Facility. Individual components requiring a more contaminant-free environment for assembly or checkout will be processed in the facility at a laminar flow bench capable of providing class 10K conditions, or at outside facilities.

1.5 APPROACH

Based on the major guidelines and assumptions described in the preceeding text, the Integration Facility survey was carried out in a nine step process. Those nine tasks are shown in the flow diagram of Figure 1-3.

Task 1, definition of the operations and functions which are required to be carried out in the Integration Facility, and Task 4, the survey of existing JSC facilities, were initiated concurrently. On completion of Task 1, a determination of the requirements which would drive the LSP facility design was made (Task 2). Task 1 and 2 results were then used in Task 3 to identify facility requirements of the Integration Facility.

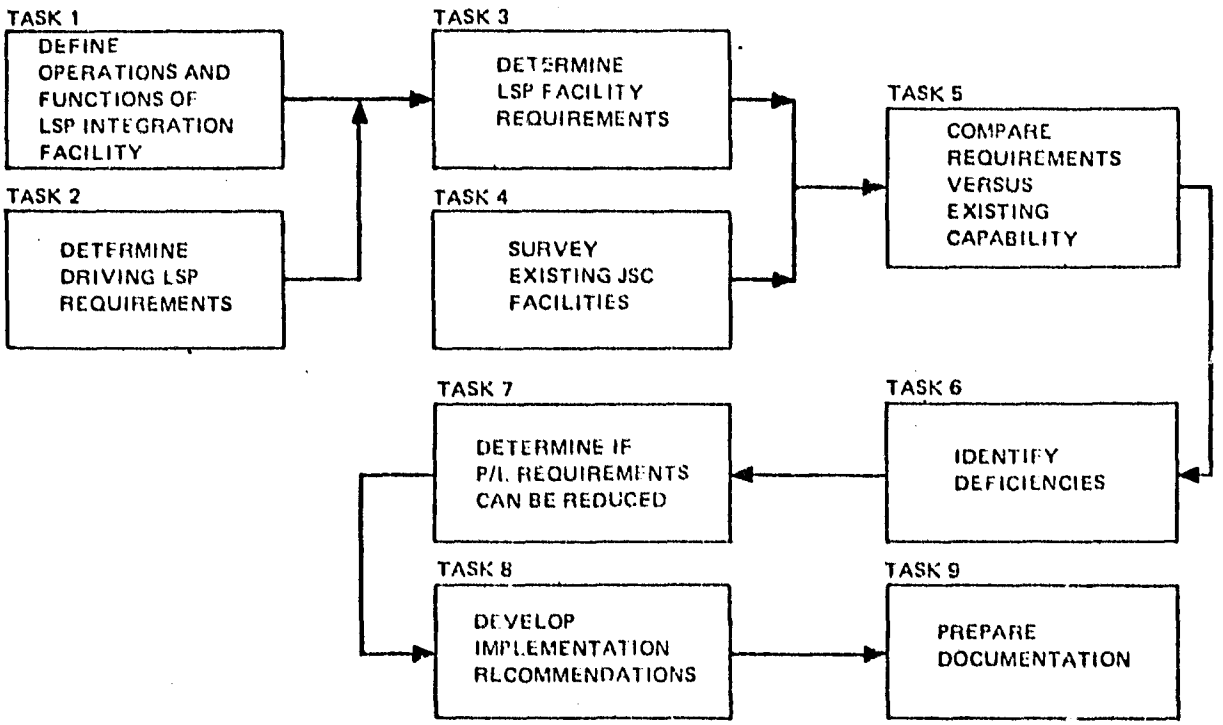


FIGURE 1-3 INTEGRATION FACILITY SURVEY TASK FLOW DIAGRAM

The JSC facilities surveyed in Task 4 included Building 36, which will be the center of the LSP integration efforts for the Shuttle time period, and two additional facilities which have unique existing capabilities for the support of planned Building 36 operations. The facilities surveyed in addition to Building 36 were Building 8 (medical support capability), and Building 37 (general Life Science laboratories).

The LSP facility requirements determined in Task 3 were compared with the existing JSC accommodations identified in Task 4. This activity consisted of Task 5. Deficiencies in the existing capabilities were determined in Task 6, and methods to reduce the identified deficiencies in a cost effective manner were examined in Task 7.

Implementation recommendations for the remaining firmly needed facility changes were developed in Task 8, and the Integration Facility documentation was compiled, published and distributed in Task 9.

1.6 SUMMARY

The initial efforts of the LSP Integration Facility survey were conducted to determine the top level operations to be performed in the JSC Life Science Payload processing area. As a result, twelve major subfacilities were identified in which operations required of the Integration Facility would be accomplished. The major subfacilities were composed of 30 lower level areas in which payload related activities were carried out.

An assessment of the major facility characteristic requirements of each of the 30 processing areas was made, based on the assumptions described in Section 1.4. Facility requirements of each area were then identified, based on assumed processing loads derived with the aid of information contained in Reference 2 and 3. Summation of the individual processing area requirements indicated that an overall area of slightly over 2,044 M^2 (22,000 ft^2) was required to support laboratory activities of the Integration Facility 86M^2 (925 ft^2) were needed for special requirements/items holding, and 418M^2 (4,500 ft^2)

were required for outside dock and storage activities. It was projected that additional activities of the Integration Facility would require slightly over 2,500M^2 (27,000 ft^2), of which about 697M^2 (7,500 ft^2) were required to be environmentally controlled to the class 100K level. A total of 5080M^2 (54,650 ft^2) was estimated to be required for all Integration Facility activities.

In addition to facility space requirements, the support equipment requirements were identified in the same survey phase. GSE items necessary to process flight experiments and Spacelab flight hardware were identified. GSE items presently on NASA/ESA GSE listings were evaluated for applicability to the Integration Facility operations and 25 items whose capabilities matched those necessary for LSP activities were selected. An additional list of 39 GSE items was also prepared to provide flight hardware support which the NASA/ESA items could not cost effectively perform. Other support equipment required for Integration Facility operations was also defined on an area-by-area basis.

A survey was conducted to document the capability of existing JSC facilities and equipment having possible applicability to LSP processing. This effort defined the presently available nucleus about which LSP operations may be most economically implemented. The survey documented the arrangement, floor space, door sizes, utility services, and existing support equipment available. Results were condensed and are presented in tabular form.

Building 36 was considered the most favorable location for the majority of LSP processing operations and the survey emphasis was placed on it. However two other buildings at JSC were identified as having unique capabilities and these were also surveyed. These additional sites included:

a) Building 8, found to have medical examination capabilities which should be useful in collecting baseline data from crewmembers and other test subjects

b) Building 37, presently being reconfigured to provide a common site for most Life Sciences scientific laboratories. This capability will be required to support tests and analyses required by experiments during integration/test activities as well as during pre and post flight activities.

A summary of the usable space in the facilities surveyed is indicated in Table 1-1.

A comparison of the facility survey results with the subfacility requirements verified that the most logical location for equipment receiving and shipping, test, integration, checkout, test monitoring and in-flight science support was the Building 36 south wing area. Previous SMS II activities conducted in a portion of this area had demonstrated that operations similar to those projected for Life Science flight payloads were well suited to this location.

Several floor plans for Building 36 LSP processing operations were prepared and evaluated based on the information obtained from the survey of the existing facility and on information from the subfacility requirements assessment. The recommended layout resulting from the configuration evaluation requires only modest changes to the existing facility to accommodate the full projected LSP processing load.

The changes are summarized in Table 1-2. The recommended layout utilizes the existing class 100 clean room area as a class 100K integration and test activity area. An addition to the clean room is used to house a portion of the mockups and mockup support equipment. If it should be desired at some future time to return the clean room area to class 100 operation, extensive major rework would not be required.

TABLE 1-1

FACILITY AREA SUMMARY

LOCATION	AREA m^2 · (ft^2)
BUILDING 36	
NORTH WING - OFFICE AREA	540 (5,800)
SOUTH WING - FIRST FLOOR USABLE AREA	1,860 (20,000)
- SECOND FLOOR USABLE AREA	810 (8,700)
- THIRD FLOOR OFFICE AREA	490 (5,300)
	3,700 (39,800)
BUILDING 8	
FIRST FLOOR MEDICAL DISPENSARY AREA	670 (7,200)
BUILDING 37	
FIRST FLOOR - LABORATORIES AREA	2,000 (21,500)
- OFFICE AREA	1;630 (17,500)
SECOND FLOOR - ARCHIVAL AREA	300 (3,200)
THIRD FLOOR - LABORATORY AREA	130 (1,400)
	4,060 (43,600)

TABLE 1-2

SUMMARY OF RECOMMENDED FACILITY MODIFICATIONS

MODIFICATION (To Building 36)	Number of Places Req'd
• Enlarge interior doors to allow passage of racks in upright position.	5
• Refurbish existing clean room and modify controls/equipment as required for class 100K operation.	1
• Add small equipment/personnel airlock and modify room 1010 to allow class 100K cleanliness level to be attached. Connect to existing clean room air handling system.	1
• Add class 100K clean room enclosure for Orbiter/Spacelab mock-ups. Connect to existing clean room air handling equipment.	1
• Install truck docking pit.	2
• Install/move monorail crane	3

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An analysis of network flow charts determined that the Integration Facility should be capable of performing initial receiving and payload processing operations as early as late 1978. From this point a near linear increase in payload processing capability is required until full facility capability is reached by mid 1981.

The rough order of magnitude costs for alternations and additions to the structure, interior partitions, doorways, and dock areas of Building 36 were estimated at $135,000. Rough order of magnitude costs for GSE and support equipment were estimated to be:

NASA/ESA GSE	$0.77 million
other GSE	$0.94 million
other support equipment	$0.33 million
	$2.04 million

These values do not include mockup structures or subsystems, computerized test monitoring equipment, specialized items of specimen holding facilities/ equipment, or design and development costs. GSE and support equipment installation costs are not included.

Section 2
LSP INTEGRATION FACILITY OPERATIONS AND FUNCTIONS

2.1 FACILITY FUNCTIONS

The LSP Integration Facility at NASA/JSC will consist of building accommodations, equipment, and personnel necessary to receive, integrate, test, perform flight checkouts, provide in-flight scientific support and ship payload items to the launch site. The JSC Integration Facility is one element of the total LSP program, and is responsible for Life Science Carry-on Lab, Minilab, and Dedicated Lab payloads. Additional LSP facilities will be required at other locations; for example the launch/landing site and the BESS integration site.

Table 2-1 indicates the current consensus for locations at which Life Science payloads will be integrated. After the initial verification test flights involving Spacelab (which may be integrated at NASA-MSFC) all Level II and I integration occurs at the launch site. (Level III and Level II integration activities do not apply to Carry-on Labs).

Dedicated Labs will be integrated to Level III, tested, and flight checkouts performed at the JSC Integration Facility. Some final Level III interface verifications will be required on arrival of the Dedicated Labs at the launch site to ensure compatibility with other elements of the Shuttle Program.

Level III integration of Minilabs will be conducted at the launch site, as this payload type must be combined with partial payloads of other disciplines prior to loading into the Spacelab module. However, integration of all Minilab components making up the Life Science portion of the shared payload will take place at the JSC Integration Facility, and checkout/tests involving Life Sciences Experimentation will be carried out.

For Carry-on, Mini, and Dedicated Labs, Level IV integration activities may be conducted at PI, contractor, non-NASA, or other NASA locations. Most commonly, assembled experiments will be shipped to the JSC Integration Facility for assembly into a Spacelab rack with other experiments. In the event all experiments to be placed into a rack originate at the same location,

TABLE 2-1

LOCATIONS FOR LEVELS OF LIFE SCIENCE PAYLOAD INTEGRATION

Payload	Integration Level			
	Level I	Level II	Level III	Level IV
Carry-On	L/S	--	--	P,B,R
Mini	L/S	L/S	L/S	P,B,R
Dedicated - 7 Day	L/S	L/S	P 1	P,B,R
Dedicated - 30 Day	L/S	L/S	P 1	P,B,R
BESS	L/S	L/S	B 1	B

L/S - Launch site

P - JSC LSP Integration Facility

-- - No integration at this level

B - ARC or contractor integration site

R - Other NASA location, PI location, contractor location, other non-NASA location

1 - Level III interface verifications at launch site required

Where:

Level I - Cargo (Spacelab) to Orbiter

Level II - Payload to Spacelab

Level III - Experiments (racks) to payload

Level IV - Components to experiments (to racks)

(See Reference 9 for detailed definition of integration levels).

the empty rack may be shipped to that location, to be returned to the Integration Facility with all experiments in place and checked out.

2.2 OPERATIONS PERFORMED IN THE INTEGRATION FACILITY

The information contained in LSP Planning Study report Volumes II and III (References 2 and 3) was utilized to prepare a top level list of operations necessary at the JSC Life Science Integration Facility. Each operation was then examined to determine facility requirements which resulted from the conduct of the operation. Finally the applicability of these requirements to the processing of equipment items, Spacelab components, specimens, and GSE was assessed. The result of this effort is indicated in Table 2-2.

The facility requirements identified in Table 2-2 were next grouped into related sets, thus defining subfacility areas in which similar operations were conducted. These areas are listed in Table 2-3, with an indication to the right of each area of the applicable equipment and specimen types which will be processed in the subfacility. The equipment and specimen indications are coded to denote the extent and frequency with which they will be processed in each area.

Major subfacilities are indicated in parentheses in the first column of Table 2-3. The indicated major subfacilities include all lower level subfacilities which are listed immediately preceeding the parenthesized major subfacilities.

The following example will be useful in clarifying the methodology used to determine the subfacility groupings. The need to perform Level IV integration was identified in the preparation of Table 2-2 (reference the entry in the table indicated by the asterisk) as an operation which will be carried out at the Integration Facility. It was next determined that this operation would require a clean room integration area and a tube and wiring harness fabrication area. Equipment items (e.g., experiments and CORE items), rack and floor elements, and integrated racks were identified as items which would routinely be processed during the Level IV integration operation. Some flight and facility support GSE items were also identified as elements

TABLE 2-2: TOP LEVEL (QUALITATIVE) FACILITY REQUIREMENTS

Operation	Requirements	Equipment Items	Rack & Floor Elements	Integrated Racks	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
Remove from transport and place on transport.	1. Unloading equipment	R	R	R	R	R	R	R	I	I
	2. Dock area	R	R	R	R	R	R	R	I	I
Unpack and inspect.	1. Non-clean room receiving	R	R	R	R			R	(I)	(I)
	2. Specimen inspection area					R	R			
	3. Clean room conditions	R	R	R	R			(R)	(I)	(I)
Acceptance test.	1. Outgassing test capability	R								
	2. Flammability test capability	R								
	3. Performance test capability*	R						R	I	I
Prepare for storage or shipment.	1. Packing area - non-clean room					R	R	(R)	(R)	(R)
	2. Packing area - clean room	R	R	R	R			(R)	(R)	(R)
	3. Equipment cleaning area	R	R					(R)	(R)	(R)
Store or hold.	1. Closely controlled storage environment					(R)	(R)			
	2. Normal room temperature storage environment	R	R	R	R	(R)	(R)	(R)	(R)	(R)
	3. Non-controlled environment (out of doors)							(R)	(R)	(R)
Perform minor modifications and repairs.	1. General shop area	R						R	R	R
	2. Clean room shop area		(R)	(R)	(R)			(R)	(R)	(R)

R - Routine ( ) - Applicable to some items * Clean room capability

I - Only during initial buildup

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TABLE 2-2: TOP LEVEL (QUALITATIVE) FACILITY REQUIREMENTS (continued)

Operation	Requirements	Equipment Items	Rack & Floor Elements	Integrated Racks	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
Tests to verify modifications, repairs and refurbishment.	1. Performance test capability* 2. Performance tert capability, non-clean room capability	R	(R)	(R)	(R)			(R) (R)	(R) (R)	(R) (R)
Remove from store, move and prepare for use.	1. Moving equipment 2. Equipment containers 3. Specimen holding areas	R R	R R	R R	R R	R R	R R	R (R)	(R)	(R)
* Perform level IV integration.	1. Clean room integration area 2. Tube and wiring harness fabrication area	R	R	R R				(R)	(R)	
Level IV interface verification.	Clean room test area			R				(R)	(R)	
Perform level III integration.	1. Clean room integration area 2. Tube and wiring harness fabrication area		R	R	R R			(R)	(R)	(R)
Perform level III interface verification testing.	Clean room test area				R			(R)	(R)	(R)
Perform payload shakedown test and calibration	1. Clean room test area 2. Data management capability				R			(R)	(R)	(R)

R - Routine ( ) - Applicable to some items * Clean room capability

I - Only during initial buildup

TABLE 2-2: TOP LEVEL (QUALITATIVE) FACILITY REQUIREMENTS (continued)

Operations	Requirements	Equipment Items	Rack & Floor Elements	Integrated Packs	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
Integrate payload into mockup	Checkout test area			R				(R)	(P)	
Payload to mockup interface verification.	1. Checkout test area			R				(R)	(R)	(R)
	2. Data management system			R						
Perform shakedown tests and calibration.	1. Checkout test area			R				(R)	(R)	(R)
	2. Data management system			R						
	3. Flight support areas								R	
Perform checkout test	1. Checkout test area			R	(R)	(R)		(R)	(R)	(R)
	2. Data management system			R	(R)	(R)				
	3. Flight support areas			R	(R)	(R)				
Post-operations testing.	1. Checkout test area			R				(R)	(R)	(R)
	2. Data management system			R						
	3. Flight support areas			R					R	
Remove payload from mockup	Checkout test area			R				(R)	(R)	(R)
Perform required payload mods, refurbishment calibrations and testing	1. General machine shop	R						(R)		
	2. Clean room shop area		(R)	(R)				(R)		
	3. Equipment cleaning area	R						(R)		
	4. Performance test capability*	R	(R)	(R)				(R)		
Provide flight support.	1. Payload operations control capability			R	R	R		(R)	(R)	
	2. Data management capability			R						

R - Routine
I - Only during initial buildup

( ) - Applicable to some items

* Clean room capability

TABLE 2-2: TOP LEVEL (QUALITATIVE) FACILITY REQUIREMENTS (continued)

Operation	Requirements	Equipment Items	Rack & Floor Elements	Integrated Racks	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
Post-mission testing.	1. Clean room test area			R	(R)	(R)	(R)	(R)	(R)	
	2. Data management capability			R						
	3. Performance test area*	(R)								
	4. Performance test area	(R)			(R)	(R)	(R)	(R)	(R)	
Post-mission specimen examination/analysis.	Specimen examination/analysis area				R	R				
Payload dismantlement.	1. Clean room work area	(R)	(R)	(R)	(R)			(R)	(R)	(R)
	2. General shop area	(R)	(R)	(R)	(R)			(R)	(R)	(R)
Refurbishment and condition verification.	1. General shop area	R						(R)	(R)	(R)
	2. Equipment cleaning area	R								
	3. Performance test capability*	R						R		
Post-mission data analysis	Data management capability	(R)			(R)	(R)				
Buildup, maintain and modify facility.	1. Facility equipment storage area									
	2. General purpose facility modification area									
Concept verification testing.	1. General purpose laboratories	(R)			(R)	(R)				
	2. Data management capability	(R)								

R - Routine
I - Only during initial buildup
( ) - Applicable to some items
* Clean room capability

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TABLE 2-2 TOP LEVEL (QUALITATIVE) FACILITY REQUIREMENTS (continued)

Operation	Requirements	Equipment Items	Rack & Floor Elements	Integrated Racks	Integrated Payloads	High Order Specimens	Ice Order Specimens	Flight Element GSE	Facility Support GSE	Portable Launch Site GSE
Experiment development and test.	1. General purpose laboratories	(R)				(R)	(R)			
	2. Data management capability	(R)								
	3. Performance test capability	(R)								
	4. General purpose shop									

R - Routine
I - Only during initial buildup
( ) - Applicable to some items
* Clean room capability

TABLE 2-3 DEFINITION OF SUBFACILITY REQUIREMENTS/OPERATIONS

Identification Number	Subfacility Requirements (Subfacility)	Operations	Equipment Items	Rack & Floor Elements	Integrated Rack	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
1.1	Dock area	Remove from transport & place on transport	R	R	R	R	R	R	R	I	I
1.2	Non-clean toom receiving	Unpack and inspect	R	R	R	R	R	R	R	I	I
1.3	Packing area - clean room*	Prepare for storage or shipment	R	R	R	R			(R)	(R)	(R)
1.4	Clean room receiving*	Unpack and inspect									
1.5	Packing area - non-clean room	Prepare for storage or shipment							(R)	(R)	(R)
1.6	Equipment cleaning area*	Prepare for storage, shipment or use	R	R					(R)	(R)	(R)
(1.0)	(Shipping and Receiving)										
2.1	Special drugs stowage										
2.2	Specimen inspection, examination and test	Unpack and inspect				R	R				
2.3	Closely controlled specimen and unique provisions storage requirement*	Store and hold specimens				(R)	(R)				
2.4	Normal room environment specimen storage environment	Store and hold specimens				(R)	(R)				
(2.0)	(Special Requirements Stowage Area)										
3.1	Normal room temperature equipment storage environment [has subparts A thru F]	Store and hold equipment	R	R	R	R			(R)	(R)	(R)
3.2	Non-controlled equipment storage environment [out of doors]	Store and hold equipment							(R)	(R)	(R)
(3.0)	(Equipment Storage)										
4.1	Performance test capability*	Acceptance test	R								
4.2	Outgassing test capability*	Acceptance test	R								
4.3	Flammability test capability	Acceptance test	R								
(4.0)	(Experiment test/checkout lab)										

R - Routine

I - Only during initial buildup

( ) - Applicable to some items

* Clean room capability

TABLE 2-3: DEFINITION OF SUBFACILITY REQUIREMENTS/OPERATIONS (Continued)

Identification Number	Subfacility Requirements (Subfacility)	Operations	Equipment Items	Rack & Floor Elements	Integrated Rack	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
5.1	General shop area	Perform minor modifications & repairs	R						(R)	(R)	(R)
		Refurbishment	R						(R)	(R)	(R)
		Experiment development	R								
		Payload dismantlement	(R)	(R)	(R)	(R)			(R)	(R)	(R)
5.2	Electrical shop	Perform minor modifications & repair	R						(R)	(R)	(R)
		Refurbishment	R						(R)	(R)	(R)
		Experiment development	R								
5.3	Tube Fabrication	Perform level IV integration	R	R	R				(R)	(R)	(R)
		Perform level III integration		R	R	R			(R)	(R)	(R)
(5.0)	(Experiment Development Lab)										
* 6.1	Clean room integration area*	Perform level IV integration	R	R	R				(R)	(R)	
		Perform level III integration		R	R	R			(R)	(R)	(R)
6.2	Wiring harness fabrication area*	Perform level IV integration	R	R	R				(R)	(R)	(R)
		Perform level III integration		R	R	R			(R)	(R)	(R)
6.3	Clean room test area*	Perform level IV interface verification			R						
		Perform level III interface verification			R				(R)	(R)	
		Perform payload shakedown test and calibration			R				(R)	(R)	(R)
6.4	Clean room work area*	Payload dismantlement	(R)	(R)	(R)				(R)	(R)	(R)
(5.0)	(Clean room integration area)										

R - Routine

I - Only during initial buildup

( ) - Applicable to some items

* Clean room capability

TABLE 2-3: DEFINITION OF SUBFACILITY REQUIREMENTS/OPERATIONS (Continued)

Identification Number	Subfacility Requirements (Subfacility)	Operations	Equipment Items	Rack & Floor Elements	Integrated Rack	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
7.1	Checkout test area*	Install payload in mockup			R				(R)	(R)	
		Payload to mockup interface verification			R			(R)	(R)	(R)	
		Perform shakedown tests & calibration			R			(R)	(R)	(R)	
		Perform checkout test			R			(R)	(R)	(R)	
		Post operations testing			R			(R)	(R)	(R)	
(7.0)	(Orbiter/Spacelab Mockup)	Remove payload from simulator			R			(R)	(R)	(R)	
8.1	Data management capability	Perform payload shakedown test & calibration			R						
		Payload to mockup interface verification			R						
		Perform checkout test			R						
		Post operations testing			R						
		Provide flight support			R						
		Post mission testing			R						
(8.0)	(Data Lab)	Experiment development & test	(R)								

R - Routine

I - Only during initial buildup

( ) - Applicable to some items

* Clean room capability

TABLE 2-3: DEFINITION OF SUBFACILITY REQUIREMENTS/OPERATIONS (Continued)

Identification Number	Subfacility Requirements (Subfacility)	Operations	Equipment Items	Rack & Floor Elements	Integrated Rack	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
9.1	Test control area	Perform shakedown test & calibration (payload integrated into mockup)			R						
		Perform checkout test			R	(R)	(R)				
		Post operations testing			R	(R)	(R)				
9.2	Science monitoring area	Preform shakedown test & Calibration (Payload integrated into mockup)			R						
		Perform checkout test			R	(R)	(R)				
		Post operations testing			R	(R)	(R)				
		Provide flight support			R	(R)	(R)				
(9.0)	(Test Control/Flight Support Areas)										
10.1	Facility equipment storage area	Store spare, expendable and out of service facility equipment									
10.2	General purpose facility modification area	Buildup, maintain and modify facility									
(10.0)	(Facility maintenance area)										
11.1	General purpose laboratories	Concept verification testing	(R)			(R)	(R)				
		Experiment development & test	(R)			(R)	(R)				
11.2	Isotope management lab	Store isotopes & required associated monitoring/handling equipment	(R)								
(11.0)	(General purpose scientific labs)										

R - Routine

I - Only during initial buildup

( ) - Applicable to some items

* Clean room capability

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TABLE 2-3: DEFINITION OF SUBFACILITY REQUIREMENTS/OPERATIONS (Continued)

Identification Number	Subfacility Requirements (Subfacility)	Operations	Equipment Items	Rack & Floor Elements	Integrated Rack	Integrated Payloads	High Order Specimens	Low Order Specimens	Flight Element GSE	Facility Support GSE	Facsimile Launch Site GSE
12.1	Conference rooms	Conduct conferences and meetings to coordinate integration activities Provide NASA, contractor, and PI personnel with office space									
12.2	Office areas										
(12.0)	(Office and Meeting Room Space)										

R - Routine
I - Only during initial buildup
( ) - Applicable to some items
* Clean room capability

which would be processed. The applicability and frequency with which these items are involved in Level IV integration are indicated in the right hand portion of the Table. Inspection of Table 2-3 (see asterisk entry) shows that the Level IV integration activities may be effectively grouped with the Level III integration activities for performance in the subfacility labeled "Clean Room Integration Area". The hardware items and specimen types involved in the processing flow of this subfacility are also indicated in Table 2-3.

Paragraphs 2.2.1 through 2.2.12 contain capsule descriptions of the operations to be carried out within the subfacilities identified.

2.2.1 Shipping and Receiving

This subfacility is the arrival and departure point for all elements involved in the Integration Facility activities. The subfacility contains equipment needed to clean surface dirt from incoming shipments and transporters, packing and crating materials and equipment, temporary storage areas, and items needed to record, tag, identify, and coordinate incoming and outgoing shipments. Supplies and equipment needed to package cleaned components are also assigned to this subfacility, and are located in the clean room area. Shipment operations of the facility will be coordinated with the JSC Logistics Division.

2.2.2 Special Requirements/Items Stowage

A subfacility will be required to store and process items such as drugs, test specimens and other unique supporting articles at the JSC LS development facility. Areas for sample/specimen inspection, examination and testing to support shared payload checkout operations are included. Specimens and controls for experiments being processed at JSC will be housed in the Special Requirements Stowage Subfacility. It is anticipated that some capability to monitor and record implanted sensor outputs and specimen condition will be required at this subfacility.

2.2.3 Equipment Storage

Both controlled and non-controlled storage areas will be provided by this subfacility for ground and flight items. Environmentally controlled areas will be allocated inside the Integration Facility for CORE items, experiments GSE, test equipment, and documentation. An outside fenced storage area will be needed for workstands and similar bulky equipment which can tolerate an uncontrolled outdoor environment.

2.2.4 Experiment Test/Checkout Lab

This lab is divided into three major parts: a) a performance test area where acceptance and checkout of experiments occurs, b) an area for conducting outgassing tests of experiments and equipment items, and c) a flammability test area where tests of materials will be conducted to verify their suitability for use in the Shuttle or Spacelab environment.

2.2.5 Experiment Development Lab

The Experiment Development Lab will be used to fabricate and modify components of experiments. Its primary function will be to perform minor modifications to correct deficiencies identified in experiment tests and simulations, and to troubleshoot and repair failed equipment. The lab will also be used to refurbish returned flight equipment and occasionally to fabricate components of experiments bring developed. The lab will consist of a general mechanical shop area and a general electrical shop area.

2.2.6 Clean Room Integration Area

This area will be used to perform Level IV and Level III integration, and perform shakedown tests and calibrations of payloads. The subfacility will include a wiring harness fabrication area, a clean room test area for interface verifications and checkout testing, a clean room work area in which payloads may be dismantled on return from the landing site, as well as the clean room area necessary for integration activities.

2.2.7 Orbiter/Spacelab Mockup

In this subfacility the Life Science payloads will be installed into the Spacelab or Orbiter mockups for interface verification, shakedown tests, experiment calibrations, and checkout tests. On completion of the checkout tests additional testing may be performed in the mockup if required to correct abnormalities identified. The payloads will then be removed from the mockup for shipment preparation activities.

2.2.8 Data Lab

This subfacility will include data management capability needed to support checkout and calibration tests, interface verification, payload checkout operations, post checkout testing, and experiment development testing. The Data Lab will also provide data handling capability to support Life Science payloads in flight, and to support post flight tests. The Data Lab will interface with the checkout test area, experiment integration area, Science Monitoring areas, Test Control Area, the Science Payload Operations Control Center, Mission Control Center, and possibly with remote science data monitoring terminals.

2.2.9 Test Control/Flight Support Area

Areas allocated for the control of Integration Facility tests and checkout operations, and areas allocated for science data monitoring will be provided by this subfacility. The Science Monitoring Areas will be used for both Integration Facility test monitoring by visiting PI's and other personnel, as well as for in-flight support of Life Science Payloads.

2.2.10 Facility Maintenance Area

The Facility Maintenance Area subfacility will provide storage space for facility equipment used to maintain, buildup, and modify the Integration Facility. It will also contain a general purpose facility modification area in which minor maintenance activities may be carried out. Examples of activities which this subfacility might support include packing replacement in small pumps, pipe threading, checkout of thermostatic controls for flow loops, and storage of spares for worn out items in critical components needed

to support Integration Facility operations. Major facility item rework and extensive repair efforts would be supported by the JSC facility maintenance capability presently housed in Building 329.

2.2.11 General Purpose Scientific Labs

Many experiments proposed for the Life Science Payloads program will require standard physical, chemical, microbial, biomedical and other analyses. These analyses in large part may be conducted by laboratories at JSC which are controlled and staffed by Life Science Directorate personnel. The existing JSC Life Science laboratory capability will be utilized by the Integration Facility. Programmatic decisions will be required on an experiment-by-experiment basis to accommodate analyses which existing capability is unable to provide, however it is projected that most analyses of this type will be performed at the PI's home lab.

2.2.12 Office and Meeting Room Space

This subfacility will provide office space for visiting PI's interfacing with the Life Science program while at JSC. Office space will also be needed for contractor personnel, and conference rooms will be required to accommodate payload activity discussions. Most effective use of personnel may be obtained if these areas are in close proximity to the integration, checkout test and science monitoring areas.

2.3 FACILITY CHARACTERISTICS

On completion of the task to group activities into subfacility areas, a review was conducted to identify characteristics to which priority should be given in formulating the subfacility requirements. The characteristics sought were primarily those which would drive the overall facility design, as the scope of the current effort did not allow all requirements for each subfacility to be specified.

As a result of this review it was determined that major facility requirements could be categorized into four primary classifications: physical, environmental, utilities, and support equipment. The items considered under each of these headings are shown in the following lists:

a) Physical Characteristics

- floor area
- floor shape
- ceiling height or clear height in area
- door size and type
- access requirement to adjacent areas
- type construction (if special)
- other requirements for non-standard physical accommodations (e.g., raised flooring for cabling)

b) Environmental

- temperature limits and controllability
- relative humidity range and controllability
- cleaniness level
- number air changes required per hour
- cooling or heating load (if abnormal)
- acoustic
- other requirements for non-standard environmental accommodations (e.g., relative humidity rate of change specification)

c) Utilities

- Electrical power (voltage, wattage, frequency, phase)
- data cables
- communications
- thermal control fluids
- sewer
- vacuum
- plant air
- process gases and liquids
- acid waste disposal system
- other requirements for non-standard utility accommodations (e.g., special CO_2 lines for fire fighting)

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d) Support Equipment

d 1) Fixed Support Equipment
- hoists
- work platforms
- pumps
- fixed-in-place GSE
- metal working machinery

d 2) Movable Support Equipment
- equipment carts
- scaffolds
- specimen carriers
- vans
- forklifts
- test equipment
- benches
- file cabinets
- consoles
- moveable GSE

Section 3
LSP REQUIREMENTS FOR FACILITY DESIGN

3.1 APPROACH

A two phase approach was taken in determining LSP requirements imposed on the Integration Facility design. First, the types and numbers of payloads which the individual subfacilities will be handling were identified. Second, based on the processing load determined, requirements of the individual areas making up each subfacility were defined. Additional details of these two steps are discussed in paragraphs 3.1.1 and 3.1.2.

3.1.1 Types and Numbers of Payloads to be Accommodated

In accordance with the guidelines outlined in Section 1.4, it was assumed that the Integration Facility would accommodate Carry-on Labs, Mini-labs, and Dedicated Labs.

Information on LSP requirements from initial LSP Planning Study tasks (Section 4 of Reference 2, supplemented with network flow and payload processing information from Appendices B and F of Reference 3), was used in assessing subfacility processing loads for the various payload types. The processing loads determined were modified slightly for compatibility with the more optimum set of subfacilities determined from the analyses outlined in Section 2 of this report. A summary of payload processing loads used to assess facility requirement is shown in the left portion of Table 3-1. The table also indicates (on the right) the facility processing loads from References 2 and 3 for comparison.

Integrated facility processing requirements determined in previous LSP Planning Study work show that the Integration Facility should have some initial capability to receive equipment and verify experiment concepts by late 1978. From this point, the facility capability must be increased in a near linear fashion to full operational capability by mid 1981.

TABLE 3-1 FACILITY AREA PROCESSING LOADS

INTEGRATION FACILITY SURVEY		FROM REFERENCES 2 AND 3	
Nomenclature	Processing Load	Nomenclature	Processing Load
Shipping and Receiving	Capability to hold simultaneously two Carry-on Labs, two Minilabs and two Dedicated Labs.	Shipping and Receiving	Nominal load is six payloads in process simultaneously.
Special Requirements/Items Holding Area	Able to accommodate flight specimens, back-up specimens, and controls for two Minilabs and two Dedicated Labs at same time.	Specimen Holding and Conditioning Labs	Included in Shipping and Receiving Facility.
Equipment Storage	Sized to accommodate 300 CORE items totaling 45 m^3 (1600 ft^3). Also accommodates up to 75 experiments and associated experiment specific gear. Assume 200 packages, each a 0.6 M (2 ft) cube.	Equipment Storage	Store 300 CORE items totaling 45 m^3 (1600 ft^3).
Experiment Test/Checkout Lab	Portions of several (up to 5) payloads being processed simultaneously. Space to accommodate 30 experiments. Experiments not actively being processed returned to storage.	Experiment Modification and Test Lab (part of)	Four to five payloads in progress simultaneously.
Experiment Development Lab	Existing scientific labs to be used as applicable. General mechanical and electrical shops to be implemented in Integration Facility.	Experiment Development and Verification Lab (part of)	Use existing capability as possible.
Clean Room Integration Area	Capable of parallel operations on two Dedicated Labs, two Minilabs, and two Carry-on Labs.	Experiment Modification and Test Labs (part of) and Simulation Lab (part of)	Four to five payloads in progress simultaneously is feasible

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TABLE 3-1 FACILITY AREA PROCESSING LOADS (concluded)

INTEGRATION FACILITY SURVEY		FROM REFERENCES 2 AND 3	
Nomenclature	Processing Load	Nomenclature	Processing Load
Orbiter/ Spacelab Mock-up	One Orbiter/Spacelab mock-up. Results in critical scheduling, but is feasible with quick turn around.	Simulator Labs (part of)	One simulator can suffice, on a tight schedule.
Data Lab	Data lab processing capability. Driver is Dedicated lab.	Data Lab	Dedicated lab is driver.
Test Control/ Flight Support Area	One Test Control Room, Three Science Monitoring Area rooms desirable (one Science Monitoring Area room used for checkout test support).	Life Science Monitoring Area	By precise scheduling, two Science Monitoring Areas could support life science payloads in-flight (excluding BESS).
Facility Maintenance Area	General purpose facility storage and work area.	(No sub-facility parallel)	
General Purpose Scientific Labs	Assume use of existing facilities.	Experiment Development and Verification Lab (part of)	Use existing facilities.
Office and Meeting Room Space	Two conference rooms, office accommodations for 150 persons.	Office Space	Space for 220-300 persons. Should be located near integration activities.

3.1.2 Subfacility Requirements Definition Methodology

The key facility characteristics identified and described in Section 2.3 were used in preparing a data sheet to record requirements of individual subfacilities. The data sheet produced is shown in Figure 3-1. The data sheets were structured to indicate the subfacility and component processing area nomenclature, the requirements and operations unique to the area, and the physcial, environmental, utility and support equipment requirements.

A data sheet similar to that shown in the figure was prepared for each of the component processing areas in each subfacility of the Integration Facility. The subfacility and their component processing areas included:

- Shipping and Receiving
  - Dock area
  - Non-clean room receiving
  - Packing area - Clean room
  - Clean room receiving
  - Packing area - non clean room
  - Equipment cleaning area
- Special Requirements/Items Holding Area
  - Specimen inspection, examination and test
  - Closely controlled specimen storage
  - Normal room environment specimen storage
- Equipment Storage
  - Normal room temperature storage

    CORE item storage
    Experiment
    GSE storage
    Test equipment storage
    Documentation storage
    Integrated payload storage

  - Non-controlled storage
- Experiment Test/Checkout Lab
  - Performance test area
  - Outgassing test area
  - Flammability test area

FIGURE 3-1 DATA SHEET

LIFE SCIENCE PAYLOADS SUBFACILITY REQUIREMENTS

SUBFACILITY:

REQUIREMENT:

OPERATIONS:

DRIVING PAYLOADS/DATA SOURCE:

PHYSICAL: FLOOR SIZE _____ X _____ HEIGHT _____

DOOR SIZE _____ X _____

ARRANGEMENT OF ELEMENTS

ENVIRONMENTAL: TEMPERATURE _____ TO _____ ± _____ °F

HUMIDITY RANGE _____ TO _____ % RH

CLEANLINESS _____ K CLASS AIR CHANGES _____/

AIR COOLING/HEATING LOAD _____/_____ BTU/HR (INTERNAL ONLY)

UTILITIES:

POWER: 1. _____VOLTS _____(AC/DC) _____WATTS _____HZ

2. _____VOLTS _____(AC/DC _____WATTS _____HZ

3. _____VOLTS _____(AC/DC) _____WATTS _____HZ

DATA CABLES

COMMUNICATION

OTHER

FIGURE 3-1 DATA SHEET (Continued)

LIFE SCIENCE PAYLOADS SUBFACILITY REQUIREMENTS

FIXED SUPPORT EQUIPMENT:

HOIST CAPACITY _____ HEIGHT _____

RANGE _____ X _____ X _____

BENCHES - NO. _____ WIDTH _____ HEIGHT _____

LENGTH _____

GSE ITEMS

1.
2.
3.

SCAFFOLDS

MACHINE SHOP TOOLS

MOVABLE SUPPORT EQUIPMENT:

GSE ITEMS

1.
2.
3.

SCAFFOLDS

VANS FORKLIFTS

FLAT BEDS

GENERAL PURPOSE EQUIPMENT

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- Experiment Devleopment Lab
  - General mechanical shop area
  - General electrical shop area
  - Tube fabrication area
- Clean Room Integration Area
  - Clean room integration area
  - Wiring harness fabrication area
  - Clean room test area
  - Clean room work area
- Orbiter/Spacelab Mock-up
  - Mock-up area
- Data Lab
  - Data management area
- Test Control/Flight Support Area
  - Test control area
  - Science monitoring area
- Facility Maintenance Area
  - Facility equipment storage
  - General purpose facility modification area
- General Purpose Scientific Labs
  - General purpose labs
  - Isotope management lab
- Office and Meeting Room Space
  - Conference rooms
  - Office areas

On completion of the compilation of the data sheets for each component processing area, the results were integrated to produce first subfacility and then overall Integration Facility requirements. Subfacility requirements are presented in the following section (3.2) and overall requirements are presented in Section 3.3. Support equipment requirements of the Integration Facility are presented in Section 3.4.

3.2 SUBFACILITY REQUIREMENTS

An example of the procedure used to assess subfacility requirements is presented in this section, along with a summary of the requirements for each major Integration Facility element.

Figures 3-2 through 3-4 show data sheets for the three component processing areas of the subfacility called the Experiment Test/Checkout Lab. The component processing areas which make up this subfacility include:

a) A performance test area in which acceptance and checkout tests are conducted on experiments and integrated assemblies arriving at the Integration Facility. (See Figure 3-2.)

b) An outgassing test area where offgassing tests are made on experiment assemblies which have not been subjected to stringent materials controls during fabrication. (See Figure 3-3.)

c) A flammability test area in which the fire safety of candidate experiment materials is evaluated. The equipment in the flammability test area will be used to provide data proposed by PI's for use in the LSP program, but which have not been previously used in manned space flights. Materials whose properties are recorded in approved documentation will not normally be retested. (See Figure 3-4.)

Figures 3-2 through 3-4 illustrate the type of information and level of detail included on the data sheets for each of the 30 component processing areas which make up the 12 subfacilities. A complete set of data sheets for all 30 component processing areas may be found in Section A of Reference 10.

A summary of the facility space, environment, electrical power, and special capability requirements from the data sheets is presented in Table 3-2. The floor areas listed in the table are based on floor plans that approach squares. Larger rooms will be required for most operations if the rooms are irregular in shape. The ceiling heights listed will accommodate normal operations forseen for the payloads processed or activities conducted in each area. Ceiling allowances have been made for overhead crane space where a crane is needed. Door sizes were selected to accommodate passage of items

PERFORMANCE TEST AREA DATA SHEET

LIFE SCIENCE PAYLOADS

SUBFACILITY REQUIREMENTS

SUBFACILITY: PERFORMANCE TEST AREA - EXPERIMENT TEST/CHECKOUT LAB

REQUIREMENT: CONDUCT PERFORMANCE AND ACCEPTANCE TESTS. CLEAN ROOM ENVIRONMENT REQUIRED.

OPERATIONS: CONDUCT ACCEPTANCE TESTS ON INCOMING EQUIPMENT UP TO INDIVIDUAL INTEGRATED RACKS.

DRIVING PAYLOADS/DATA SOURCE: ASSUME AREA MUST BE SUFFICIENT TO ACCOMMODATE UP TO SIX DOUBLE RACKS SIMULTANEOUSLY. NO DOCUMENTED REQUIREMENT.

PHYSICAL: FLOOR SIZE 6.1m(20ft) X 6.1m(20ft) HEIGHT 7.6m (25 ft) (1)

DOOR SIZE 1.8m(6ft)W X 3.0m(10ft) H

ARRANGEMENT OF ELEMENTS

(1) HOOK HEIGHT

ENVIRONMENTAL: TEMPERATURE 18°C(65°F) TO 26°C(78°F)± —

HUMIDITY RANGE 30 TO 50 % RH

CLEANLINESS 100 K CLASS AIR CHANGES 6 TO 10 /HR. (MINIMUM)

AIR COOLING/HEATING LOAD — / NOMINAL (INTERNAL ONLY)

UTILITIES:

POWER: 1.	120 VOLTS	AC	(AC/DC)	12,000 WATTS	60 HZ	(2)
2.	208 VOLTS	AC	(AC/DC	6,240 WATTS	60 HZ	(2)
3.	440/220 VOLTS	AC	(AC/DC)	10,000 WATTS	60 HZ	(3)
	120/208 Y	AC		10,000 WATTS	400 HZ	(3)
DATA CABLES	28 Y	DC		2,800 WATTS	N/A	

CABLES NEEDED TO ACCOMMODATE 64 ANALOG AND 16 DIGITAL I/O CHANNELS

COMMUNICATION

2 TELEPHONE EXTENSIONS

(2) SINGLE PHASE

(3) THREE PHASE

OTHER NOTE: K = K BOTTLE SUPPLY

AVIATORS BREATHING OXYGEN (K)

HIGH PURITY DRY NITROGEN (K)

GASSEOUS HELIUM (K)

LIQUID NITROGEN - DEWAR

SHOP AIR

COOLING WATER SUPPLY & RETURN

FIGURE 3-2 PERFORMANCE TEST AREA DATA SHEET

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PERFORMANCE TEST AREA DATA SHEET

LIFE SCIENCE PAYLOADS

SUBFACILITY REQUIREMENTS

FIXED SUPPORT EQUIPMENT:

HOIST CAPACITY 908 Kg (2,000 lb) HEIGHT 7.6 m (25 ft)

RANGE TBD X _____ X _____

BENCHES - NO. 6 WIDTH 0.92 m (3 ft) HEIGHT 0.92 m (3 ft)

LENGTH 2.44 m (8 ft)

GSE ITEMS N/A

1.
2.
3.

SCAFFOLDS

MACHINE SHOP TOOLS

MOVABLE SUPPORT EQUIPMENT:

GSE ITEMS N/A

1.
2.
3.

SCAFFOLDS

VANS FORKLIFTS

FLAT BEDS 2 - 1.2 m x 1.5 m (4 ft x 5 ft)

GENERAL PURPOSE EQUIPMENT

FIGURE 3-2 PERFORMANCE TEST AREA DATA SHEET (continued)

OUTGASSING TEST AREA DATA SHEET

LIFE SCIENCE PAYLOADS

SUBFACILITY REQUIREMENTS

SUBFACILITY: OUTGASSING TEST - EXPERIMENT TEST/CHECKOUT LAB.

REQUIREMENT: SUBJECT EQUIPMENT ITEMS WHICH HAVE NOT BEEN FABRICATED TO STRINGENT MATERIAL CONTROLS TO OFFGASSING TESTS.

OPERATIONS: PERFORM OFFGASSING ACCEPTANCE TESTS AT EQUIPMENT ITEM LEVEL. CLASS 100K CLEAN ENVIRONMENT REQUIRED.

DRIVING PAYLOADS/DATA SOURCE: APPLICABLE TO ALL PAYLOADS, TO EQUIPMENT ITEM LEVEL. DATA SOURCE IS PARAGRAPHS 7.10.3 THROUGH 7.10.8 OF SLP/2104, MAY 76. EQUIPMENT MUST BE OPERATED AT MAXIMUM EXPECTED USAGE TEMPERATURE DURING TESTS, SEE JSC SPR-0022, NHB 8060.1A. PARAGRAPH 412.

PHYSICAL: FLOOR SIZE 4.6m (15ft) X 4.6m (15ft) HEIGHT 3.1m (10ft)

DOOR SIZE 1.8m (6ft) W X 2.1m (7ft) H

ARRANGEMENT OF ELEMENTS

ENVIRONMENTAL: TEMPERATURE 18°C (65°F) TO 26°C (78°F) ± —

HUMIDITY RANGE 30 TO 50 % RH

CLEANLINESS 100 K CLASS AIR CHANGES 6 TO 10 / HR. (MINIMUM)

AIR COOLING/HEATING LOAD — / NOMINAL (INTERNAL ONLY)

UTILITIES:

POWER: 1.	120 VOLTS	AC	(AC/DC)	6,000	WATTS	60	HZ ①
2.	208 VOLTS	AC	(AC/DC	6,240	WATTS	60	HZ ①
3.	120/208 VOLTS	AC	(AC/DC)	6,240	WATTS	60	HZ ②
	120/208 Y	AC		6,240	WATTS	400	HZ ②
DATA CABLES	28 V	DC		1,400	WATTS	N/A	

LIMITED NUMBER OF CABLES REQUIRED TO MONITOR EXPERIMENT STATUS DURING TESTS. EXPERIMENT DEPENDENT.

COMMUNICATION

/ TELEPHONE EXTENSIONS

OTHER NOTES FOR POWER REQUIREMENTS:

① SINGLE PHASE

② THREE PHASE

FIGURE 3-3 OUTGASSING TEST AREA DATA SHEET

ORIGINAL PAGE IS OF POOR QUALITY

OUTGASSING TEST AREA DATA SHEET

LIFE SCIENCE PAYLOADS

SUBFACILITY REQUIREMENTS

FIXED SUPPORT EQUIPMENT:

HOIST CAPACITY *NONE REQ'D* HEIGHT _____

RANGE _____ X _____ X _____

BENCHES - NO. _____ WIDTH _____ HEIGHT _____

LENGTH _____

OTHER SUPPORT EQUIPMENT

GSE ITEMS *N/A*

1.
2.
3.

SCAFFOLDS

MACHINE SHOP TOOLS

20	OUTGASSING FLASKS, WITH LID, GAGES, AND TUBING
2	BELL JARS AND BELL JAR BASE CARTS
1	PRESSURE REGULATION SYSTEM
2	VACUUM GAGE (1 THERMOCOUPLE TYPE)
1	FUME HOOD
1	CHROMATOGRAPH AND ACCESSORIES (DUAL COLUMN)
1	STRIP CHART RECORDER
A/R	CALIBRATION FLUIDS
2	VACUUM CHAMBERS [0.6 m (2 ft) CUBE INSIDE]
2	VACUUM PUMPS. 1.7 m^3/hr @ 9.6×10^{-4} N/m^2 (1 cfm @ 28.5 in. Hg) OR MORE CAPACITY
4	QUARTZ LAMPS
10	INFARED LAMPS
TBD	MISC. GLASSWARE AND FITTINGS

MOVABLE SUPPORT EQUIPMENT:

GSE ITEMS *N/A*

1.
2.
3.

SCAFFOLDS

VANS FORKLIFTS

FLAT BEDS

GENERAL PURPOSE EQUIPMENT

EXPERIMENT SPECIFIC EQUIPMENT NEEDED TO SUPPORT OPERATION OF EQUIPMENT ITEMS DURING TESTS, (e.g. COOLANT CARTS, GAS SUPPLY, CONTROL SIGNAL GENERATORS, ETC.). ASSUME THIS EQUIPMENT AVAILABLE FROM INTEGRATION AREA.

FIGURE 3-3 OUTGASSING TEST AREA DATA SHEET (continued)

FLAMMABILITY TEST AREA DATA SHEET

LIFE SCIENCE PAYLOADS

SUBFACILITY REQUIREMENTS

SUBFACILITY: FLAMMABILITY TEST - EXPERIMENT TEST/CHECKOUT LAB

REQUIREMENT: VERIFY ACCEPTABILITY OF FLIGHT EXPERIMENT MATERIALS BY SAMPLE TESTS.

OPERATIONS: CONDUCT FLAMMABILITY ACCEPTANCE TESTS,

DRIVING PAYLOADS/DATA SOURCE: REFERENCE SLP/2104 MAY 76, PARAGRAPH 7.10.3 FOR DATA, SEE ALSO PARAGRAPH 7.10.5 OF SAME DOCUMENT, AND NHB 8060.1A.

PHYSICAL: FLOOR SIZE 4.6m (15ft) X 4.6m (15ft) HEIGHT 3.1m (10ft)

DOOR SIZE 1.8m (6ft) H, X 2.1m (7ft) W

ARRANGEMENT OF ELEMENTS

ENVIRONMENTAL: TEMPERATURE — TO 24°C (75°F) ± 3°C (5°F) °F

HUMIDITY RANGE 30 TO 50 % RH

CLEANLINESS UNCONTROLLED K CLASS AIR CHANGES — /

AIR COOLING/HEATING LOAD — / NOMINAL (INTERNAL ONLY)

UTILITIES:

POWER:

1.	120	VOLTS	AC	(AC/DC)	6000	WATTS	60	HZ ⚠
2.	208	VOLTS	AC	(AC/DC	6240	WATTS	60	HZ ⚠
3.		VOLTS		(AC/DC)		WATTS		HZ

⚠ SINGLE PHASE.

DATA CABLES

NONE

COMMUNICATION

/ TELEPHONE EXTENSION

OTHER

FIGURE 3-4 FLAMMABILITY TEST AREA DATA SHEET

FLAMMABILITY TEST AREA DATA SHEET

LIFE SCIENCE PAYLOADS

SUBFACILITY REQUIREMENTS

FIXED SUPPORT EQUIPMENT:

HOIST CAPACITY *NONE REQ'D* HEIGHT _____

RANGE _____ X _____ X _____

BENCHES - NO. *1* WIDTH *0.92 m (3 ft)* HEIGHT *0.92 m (3 ft)*

LENGTH *2.44 m (8 ft)*

GSE ITEMS *N/A*

1. *1 PRESSURE REGULATION SYSTEM*
2. *1 OPTICAL PYROMETER*
3. *2 VACUUM GAGE (1 THERMOCOUPLE TYPE)*
   1 TRANSFORMER
   1 FUME HOOD

SCAFFOLDS *2 72 LITER BELL JARS*

2 VACUUM PUMPS, WITH ASSOCIATED VALVES AND CONTROLS

MACHINE SHOP TOOLS *2 HIGH VOLTAGE SUPPLY FOR SAMPLE IGNITION*

1 VARIABLE VOLTAGE TRANSFORMER

MOVABLE SUPPORT EQUIPMENT:

GSE ITEMS *N/A*

1.
2.
3.

SCAFFOLDS

VANS FORKLIFTS

FLAT BEDS

GENERAL PURPOSE EQUIPMENT

FIGURE 3-4 FLAMMABILITY TEST AREA DATA SHEET (continued)

TABLE 3-2 SUMMARY LIFE SCIENCE PAYLOADS SUBFACILITY REQUIREMENTS

	Subfacility	Floor Area m^2	Floor Area (ft^2)	Ceiling Height m	Ceiling Height (ft)	Door Size width x height m	Door Size (ft)	Environment ⚠1	Electrical Services ⚠2 10^3 watts 1	2	3	4	5	Data Cables	Hoist Capacity kg	Hoist Capacity (tons)	Remarks - Special Capabilities Required
1.0	SHIPPING AND RECEIVING	304	(3266)														
	1.1 Dock Area	70	(750)	4.6	(15)	4.6x4.6	(15x15)	U	12	12				NR	NR		Covered dock area.
	1.2 Non-Clean Room Receiving	126	(1360)	12.2	(40)	4.6x6.1	(15x20)	AC	12	5				NR	18.2K	(20)	Need automotive van.
	1.3 Packing Area - Clean Room	17	(180)	3.1	(10)	1.8x2.1	(6x7)	C	10	12				NR	NR		Vacuum bag equipment required.
	1.4 Clean Room Receiving	17	(180)	3.1	(10)	1.8x2.1	(6x7)	C	10	6				NR	NR		Precision inspection equipment required.
	1.5 Packing Area - Non-Clean Room	37	(400)	6.1	(20)	4.6x6.1	(15x20)	AC	12	6				NR	4.5K	(5)	Crating equipment.
	1.6 Equipment Cleaning Room	37	(396)	6.1	(20)	4.6x6.1	(15x20)	C	12	6				NR	NR		Cleaning supplies and equipment.
2.0	SPECIAL REQMT'S HOLDING AREA	86	(925)														
	2.1 Specimen Inspection, Exam and Test	28	(300)	3.1	(10)	1.8x2.1	(6x7)	AC	12	6				Req'd	NR		Special examination equipment required.
	2.2 Closely Controlled Specimen Storage	21	(225)	2.7	(9)	1.8x2.1	(6x7)	C	12	6			✓1	NR	NR		Equipment requirements experiment dependent.
	2.3 Normal Room Environment Specimen Storage	37	(400)	2.7	(9)	1.8x2.1	(6x7)	AC	12	6		6	✓1	Req'd	NR		Special illumination, acoustic, waste requirements.
3.0	EQUIPMENT STORAGE	666	(7160)														
	3.1 Normal Room Temperature Storage	317	(3410)														
	3.1A CORE Item - Storage	37	(400)	3.1	(10)	1.8x2.1	(6x7)	AC	2					NR	NR		Controlled access required
	3.1B Experiment Equipment Storage	37	(400)	3.1	(10)	1.8x2.1	(6x7)	AC	2					NR	NR		Controlled access required
	3.1C GSE Storage	22	(240)	3.1	(10)	1.8x2.1	(6x7)	AC	2					NR	NR		11.2m^2 (120 ft^2) controlled storage
	3.1D Test Equipment Storage	21	(225)	3.1	(10)	0.9x2.1	(3x7)	AC	2	6				NR	NR		
	3.1E Documentation Storage	11	(120)	3.1	(10)	0.9x2.1	(3x7)	AC	2					Req'd	NR		CRT, keyboard and link to data base.

NOTES: ⚠1 C = Clean class 100K, 20-24°C (68-75°F), 30-50 percent relative humidity;
AC = 21 + 3°C (75 + 5°F), 30-50 percent relative humidity;
IS = Inside storage 2-49°C (35-120°F);
U = Non-environmentally controlled outside conditions
⚠2 1 = 120 vac 60 Hz 1 Ph; 2=208 vac 60 Hz 1 Ph; 3 = 120/208 vac 60 Hz 3 Ph;
4 = 120/208 vac 400 Hz 3 Ph; 5 = 28 vdc; ✓denotes quantity included in prior entry.

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TABLE 3-2 SUMMARY LIFE SCIENCE PAYLOADS SUBFACILITY REQUIREMENTS (Continued)

Subfacility	Floor Area m^2 (ft^2)	Ceiling Height m (ft)	Door Size width x height m (ft)	Environment ⚠1	Electrical Services ⚠2 10^3 watts 1	2	3	4	5	Data Cables	Hoist Capacity kg (tons)	Remarks - Special Capabilities Required
3.1F Integrated Payload Storage	188 (2025)	12.2 (40)	4.6x4.6 (15x15)	AC	6	6				NR	NR	Assume storage in shipping containers. Fenced outside storage area.
3.2 Non-controlled Storage	349 (3750)	N/A	Gate 4.6 W (Gate 15x)	U			None			NR	NR	
4.0 EXPERIMENT TEST/CHECKOUT LAB	79 (850)											
4.1 Performance Test Area	37 (400)	7.6 (25)	1.8x3.1 (6x10)	C	12	6	10	10	3	Req'd	0.9K (1)	Can accommodate individual integrated racks For materials and individual equipment items Vacuum pumps, bell jars and controls.
4.2 Outgassing Test Area	21 (225)	3.1 (10)	1.8x2.1 (6x7)	C	6	6	6	6	1	Req'd	NR	
4.3 Flammability Test Area	21 (225)	3.1 (10)	1.8x2.1 (6x7)	AC	6	6				NR	NR	
5.0 EXPERIMENT DEVELOPMENT LAB	168 (1800)											
5.1 General Mechanical Shop Area	84 (900)	3.1 (10)	1.8x2.1 (6x7)	AC	12	12	21			NR	NR	Machine shop tools required. Electrical test equipment required
5.2 General Electrical Shop Area	84 (900)	3.1 (10)	1.8x2.1 (6x7)	AC	12	6	6	6	3	NR	NR	
5.3 Tube Fabrication Area	Included in general mechanical shop area space			AC	6	6				NR	NR	
6.0 CLEAN ROOM INTEGRATION AREA	230 (2475)											
6.1 Clean Room Integration Area	209 (2250)	12.2 (40)	4.6x6.1 (15x20)	C	18	10	10	12	6	Req'd	9.1K (10)	Experiment utilities and equipment required.
6.2 Wiring Harness Fabrication Area	21 (225)	3.1 (10)	0.9x2.1 (3x7)	C	6	6				NR	NR	
6.3 Clean Room Test Area	Included in integration area space			C	✓	✓	✓	✓	✓	Req'd	9.1K (10)	
6.4 Clean Room Work Area	Included in integration area space			C	✓	✓	✓	✓	✓	Req'd	NR	

NOTES: ⚠1 C = Clean class 100K, 20-24°C (68-75°F), 30-50 percent relative humidity;
AC = 21 ± 3°C (75 ± 5°F), 30-50 percent relative humidity
IS = Inside storage 2-45°C (35-120°F)
U = Non-environmentally controlled outside conditions
⚠2 1 = 120 vac 60 Hz 1 Ph; 2 = 208 vac 60 Hz 1 Ph; 3 = 120/208 vac 60 Hz 3 Ph;
4 = 120/208 vac 400 Hz 3 Ph; 5 = 28 vdc; ✓ denotes quantity included in prior entry

TABLE 3-2 SUMMARY LIFE SCIENCE PAYLOADS SUBFACILITY REQUIREMENTS (Continued)

Subfacility	Floor Area m^2	Floor Area (ft^2)	Ceiling Height m	Ceiling Height (ft)	Door Size width x height m	Door Size (ft)	Environment [1]	Electrical Services [2] 10^3 Watts 1	2	3	4	5	Data Cables	Hoist Capacity kg	Hoist Capacity (tons)	Remarks - Special Capabilities Required
7.0 ORBITER/SPACELAB MOCK-UP	342	(3680)														
7.1 Mock-up Area	342	(3680)	12.2	(40)	7.3x5.2	(24x17)	C	12	8	10	10	7	Req'd	1.8K	(2.0)	Orbiter MID/AFD and Spacelab M/U required.
8.0 DATA LAB	56	(600)														
8.1 Data Management Area	56	(600)	3.1	(10)	1.8x2.1	(6x7)	AC	6	6	6			Req'd	NR		Computer and support gear required.
9.0 TEST CONTROL/FLIGHT SUPPORT AREA	195	(2100)														
9.1 Test Control Area	84	(900)	3.1	(10)	1.8x2.1	(6x7)	AC	12	6			1	Req'd	NR		Audio/video recorders and consoles required.
9.2 Science Monitoring Area	111	(1200)	3.1	(10)	1.8x2.1	(6x7)	AC	12	6				Req'd	NR		Three monitoring areas desirable
10.0 FACILITY MAINTENANCE AREA	142	(1525)														
10.1 Facility Equipment Storage	58	(625)	3.1	(10)	1.8x2.1	(6x7)	AC	6	6				NR	NR		Uncontrolled access storage.
10.2 Gen. Purpose Facility Mod. Area	84	(900)	3.1	(10)	1.8x2.1	(6x7)	AC	6	12	12			NR	NR		Major rod's, supported by Bldg. 329.
11.0 GENERAL PURPOSE SCIENTIFIC LABS	2000	(21,500)														
11.1 General Purpose Labs	1991	(21,400)	3.1	(10)	0.9x2.1	(3x7)	AC	As determined by lab equip.					Req'd	NR		Bldg. 37 facilities to be utilized.
11.2 Isotope Management Lab	9	(100)	3.1	(10)	0.9x2.1	(3x7)	AC	6					Req'd	NR		Need monitor and spill clean-up equipment.

NOTES:

[1] C = Clean class 100K, 20-24°C (68-75°F), 30-50 percent relative humidity;
AC = 2[illegible] 3°C (75 ± 5°F), 30-50 percent relative humidity;
IS = [illegible] storage 2-49°C (35-120°F)
U = [illegible] environmentally controlled outside conditions;

[2] 1 = 120 [illegible] 60 Hz 1 Ph; 2 = 208 vac 60 Hz 1 Ph; 3 = 120/208 vac 60 Hz 3 Ph;
4 = 120/208 vac 400 Hz 3 Ph; 5 = 28 vdc; ✓ denotes quantity included in prior entry

TABLE 3-2 SUMMARY LIFE SCIENCE PAYLOADS SUBFACILITY REQUIREMENTS (Continued)

Subfacility	Floor Area m^2	Floor Area (ft^2)	Ceiling Height m	Ceiling Height (ft)	Door Size width x height m	Door Size (ft)	Environment (1)	Electrical Services (2) 10^3 watts 1	2	3	4	5	Data Cables	Hoist Capacity kg	Hoist Capacity (tons)	Remarks - Special Capabilities Required
12.0 OFFICE AND MEETING ROOM SPACE	809	(8700)														
12.1 Conference Rooms	112	(1200)	2.7	(9)	0.9x2.1	(3x7)	AC	10					NR	NR		Two rooms. Projection equipment.
12.2 Office Areas	697	(7500)	2.7	(9)	0.9x2.1	(3x7)	AC	23					NR	NR		75 rooms, accommodate 150 persons

NOTES:

(1) C = Clean class 100K, 20-24°C (68-75°F), 30-50 percent relative humidity;
AC = 21±3°C (75±5°F), 30-50 percent relative humidity
IS = Inside storage 2-49°C (35-120°F)
U = Non-environmentally controlled outside conditions

(2) 1 = 120 vac 60 Hz 1 Ph; 2 = 208 vac 60 Hz 1 Ph; 3 = 120/208 vac 60 Hz 3 Ph;
4 = 120/208 vac 400 Hz 3 Ph; 5 = 28 vdc; ✓ denotes quantity included in prior entry

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involved in the activities of each area, and include an allowance for carts, dollies, or transporters where required.

Electrical service requirements projected for each area are shown in the group of columns near the center of Table 3-2. The requirements shown indicate the maximum electrical load projected for each area by type of power, as indicated in the notes. It is considered highly unlikely that each component processing area will be operating near maximum power usage simultaneously. Thus, the maximum power requirements of the Integration Facility should be significantly less than the sum of the values shown. An overview of special capabilities required by each area is indicated in the right hand colum of Table 3-2.

A summary of the subfacility utility support requirements for other than electrical power is indicated in Table 3-3. This information was also taken from the data sheets of Reference 10, and includes requirements for vacuum services, data links, gases, and other test support utilities as well as conventional facility utility services.

In addition to the accommodations outlined in Tables 3-2 and 3-3, normal plant security, fire protection, food service and similar types of institutional support services will also be required by the Integration Facility.

TABLE 3-3

SUBFACILITY UTILITY SUPPORT REQUIREMENTS

(Excludes Electrical Power)

Subfacility	Utility Support Requirements (Excludes Electrical Power)	
	Tele-phones	Other
1.0 Shipping and Receiving	6	o 1.9 cm (3/4 in) water hydrant and 60 m (200 ft) hose.
2.0 Special Requirements/Items Holding Area	2	o Data cables inside subfacility. Cables also necessary to interface with integration area. o Variable intensity and cycle for lighting. o Acoustic noise control. o Hot and cold water. o Sewer
3.0 Equipment Storage	2	o Data links to computerized documentation data base.
4.0 Experiment Test and Checkout Lab	4	o Data cables for 64 analog and 16 digital data lines. o Aviator's breathing air (K-bottle supply) o High purity dry nitrogen (K-bottle supply) o Shop air (with backup source) o Cooling water o Liquid nitrogen (dewar acceptable) o Gaseous helium (K-bottle supply) o Floor drain
5.0 Experiment Development Lab	2	o Shop air o Facility hot water o Facility cold water o Sink connection to sewer

TABLE 3-3 (continued)

SUBFACILITY UTILITY SUPPORT REQUIREMENTS

(Excludes Electrical Power)

Subfacility	Utility Support Requirements (Excludes Electrical Power)	
	Telephones	Other
6.0 Clean Room Integration Area	3	o Data lines to data lab required (50 shielded coax, 200 twisted shielded pairs-dependent on final data system design) o Two intercom lines o Shop air (with back up source) o Sanitary sewer o Facility chilled water supply/return o Facility cold water (potable) o Facility hot water (potable) o Utility vacuum o Distilled water o Liquid nitrogen (dewar acceptable o Gaseous oxygen (breathing) (K-bottle source) o Gaseous nitrogen (K-bottle source) o Gaseous hydrogen (K-bottle source) o Sample/calibration gasses - lecture bottles o Missile grade air
7.0 Orbiter/Spacelab Mock-up	(phone patch capability)	o Data cables required (25 coax, 200 twisted shielded pairs - dependent on final data system design) o 5 closed circuit TV lines o 5 intercom circuits (phone patch capability) o Sanitary sewer o Facility chilled water supply/return

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TABLE 3-3 (continued)

SUBFACILITY UTILITY SUPPORT REQUIREMENTS

(Excludes Electrical Power)

Subfacility	Utility Support Requirements (Excludes Electrical Power)	
	Tele-phones	Other
7.0 Orbiter/Spacelab Mock-up (continued)		o Shop air (with back-up source) o Facility cold water (potable) o Facility hot water (potable) o Utility vacuum o Distilled water o Liquid nitrogen (dewar acceptable) o Gaseous oxygen (breathing) (K-bottle source) o Gaseous nitrogen (K-bottle source) o Gaseous hydrogen (K-bottle source) o Sample/calibration gasses - lecture bottle o Missile grade air
8.0 Data Lab	4	o Data lines - number dependent on final data system design, to MCC, integration area, simulation area, science monitoring area test control area.
9.0 Test Control/Flight Support Areas	4	o Data lines to data lab - number and type dependent on final system design. o Phone patch capability from consoles
10.0 Facility Maintenance Area	1	o No additional utility support requirements identified.

TABLE 3-3 (concluded)

SUBFACILITY UTILITY SUPPORT REQUIREMENTS

(Excludes Electrical Power)

Subfacility	Utility Support Requirements (Excludes Electrical Power)	
	Telephones	Other
11.0 General Purpose Scientific Labs	*	* Existing scientific lab capability to be used. Items shown below are needed in addition for isotope lab. o Facility chilled water supply/return o Facility cold water o Floor drain
12.0 Office and Meeting Room Space	101	o Normal water, sewer, and restroom facilities to support office building activities.

3.3 INTEGRATED SPACE REQUIREMENTS

Integrated floor area requirements for each of the 12 subfacilities are indicated in Table 3-4. The subfacilities are listed in the left hand column of the table, and other columns denote the overall type of accommodations required. The numbers to the right of a subfacility indicate the floor space of the various accommodation types needed by the subfacility.

The totals at the bottom of the table show that an overall area of slightly over 2040 M^2 (22,000 ft^2) is required to support laboratory activities, 86 M^2 (925 ft^2) is required for specimen examinations and storage, and 420 M^2 (4500 ft^2) are required for outside dock and storage activities. It is projected that the remaining Integration Facility activities will require slightly over 2510 M^2 (27,000 ft^2). Approximately 700 M^2 (7,500 ft^2) of the 2510 M^2 (27,000 ft^2) are required for activities which must be conducted in a clean 100K environment. The remaining Integration Facility area 1815 M^2 (19,500 ft^2), the support lab areas, and the specimen areas should be provided with an air conditioned environment.

The most productive LSP processing should result if most areas listed in Table 3-4 are licated in or immediately adjacent to a single building. This arrangement allows improved communications, reduces handling and transport time, and lowers the amount of time spent by Integration Facility personnel in traveling between porcessing areas.

Should a single building of sufficient size to accommodate the total space requirements indicated in Table 3-4 [$\approx$ 5000 M^2 (54,000 ft^2) including outside areas] not be available, Integration Facility activities may be apportioned among several buildings. Apportionment into four separate areas as indicated by the designations at the top of Table 3-4 should result in little impact to processing efficiency. Should division of Integration Facility activities be required, the payload processing flow and efficiency of the proposed arrangement must be examined carefully.

TABLE 3-4 COMBINED SUBFACILITY SPACE REQUIREMENTS

Subfacility	AREA 1 — Non Clean Room Area m^2 (ft^2)	AREA 1 — Clean Room Areas: Clean Room Integration and Checkout Area m^2 (ft^2)	AREA 1 — Clean Room Areas: Clean Room Mock-up Area m^2 (ft^2)	AREA 1 — Covered Dock Area m^2 (ft^2)	AREA 2 — Outside Storage Area m^2 (ft^2)	AREA 3 — Specimen Area m^2 (ft^2)	AREA 4 — Support Labs Area m^2 (ft^2)
1.0 Shipping and Receiving	164 (1760)	70 (756)	--	70 (750)	--	--	--
2.0 Special Reqmt's Holding Area	--	--	--	--	--	86 (925)	--
3.0 Equipment Storage	317 (3410)	--	--	--	349 (3750)	--	--
4.0 Experiment Test/Checkout	21 (225)	58 (625)	--	--	--	--	--
5.0 Experiment Development Lab	167 (1800)	--	--	--	--	--	--
6.0 Clean Room Integration Area	--	230 (2475)	--	--	--	--	--
7.0 Orbiter/Spacelab Mock-up	--	--	342 (3680)	--	--	--	--
8.0 Data Lab	56 (600)	--	--	--	--	--	--
9.0 Test Control/Flight Support Area	195 (2100)	--	--	--	--	--	--
10.0 Facility Maintenance Area	142 (1525)	--	--	--	--	--	--
11.0 General Purpose Scientific Labs	--	--	--	--	--	--	2,000 (21,500)
12.0 Office and Meeting Room Space	753 (8100)	--	--	--	--	--	56 (600)
Total Support Lab Area							2,056 (22,100)
Total Special Reqmt's Holding Area						86 (925)	
Total Outside Storage/Dock				419 (4,500)			
Total Integration Facility NCR[1]	1815 (19,520)						
Total Clean Room Area[2]		700 (7,536)					
Total Area 1 Interior Area	2,515 (27,056)						

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NOTES:

1 NCR = Non Clean Room

2 Excludes specimen holding clean room requirements

3.4 SUPPORT EQUIPMENT REQUIREMENTS

A number of support equipment items needed to conduct the payload processing activities were identified during the Integration Facility survey. These support equipment items may be classified generally into two categories:

a) equipment necessary to process or directly support the processing of Spacelab flight hardware, and

b) other support equipment needed for activities of the Integration Facility.

Details of the required Spacelab GSE are discussed in Section 3.4.1, and information on non-GSE support equipment is presented in Section 3.4.2.

3.4.1 Spacelab GSE Items

In order to determine Spacelab GSE items needed at the Integration Facility, a listing of currently identified GSE was obtained from the Spacelab GSE Allocation and Requirements Plan (Reference 11), which is under level II PRCB control. This GSE list is indicated in Table 3-5. The GSE part numbers shown on the left in the table are those assigned by NASA/ESA, and are coded to identify the type of GSE and the organization responsible for supplying the item. Two GSE types are indicated by the numbers; mechanical GSE (MGSE) and electrical GSE (EGSE). The following identification coding in used.

Identification No.	Type GSE	Source
611XXX	EGSE	ESA
612XXX	MGSE	ESA
613XXX	EGSE	NASA
614XXX	MGSE	NASA

Subassembly components of the GSE items are denoted by the indented entries in Table 3-5.

The applicability of each major GSE item to premission experiment processing, Level IV integration, Level III integration, and post mission experiment processing is indicated in Table 3-6. Check marks in the columns to the

TABLE 3-5 SPACELAB OPERATIONAL GSE

(from Reference 11.)

611001		Automatic Test Equipment
	-01	Computer and Peripherals
	-02	Computer Software Modules
	-03	Computer I/O Interfaces
	-04	Measuring and Stimuli Equipment
	-05	Recording Equipment
	-06	Timing Equipment
	-07	Telemetry Front End
	-08	Telecommand Equipment
	-09	PCM Simulator
	-10	Patch, Survey and Switching Unit
	-11	Operators Console
	-12	Electrical Test and Service Equipment
	-13	DC Ground Power Supply
611023		Recorder & Communication Control Unit Tester
611301		Orbiter Interface Adapter
611401		Experiment Segment/Pallet Simulator
611501		Experiment/Subsystem Simulator
611601		Core Segment Simulator
611910		Computer Tester
611911		I/O Unit Tester
611912		Mass Memory Test Equipment
611913		CRT Keyboard Unit Tester
611914		RAU Unit Tester
611915		CDMS Control Panel Unit Tester
611916		Time Display Unit Tester
611918		CCTV Unit Tester (Camera and Monitor)
611919		Intercom Unit Tester
611920		Caution and Warning Unit Tester
611921		High Rate Recorder Unit Tester
611922		Video Recorder Unit Tester
611930		EPDS Unit/Subsystem Test Equipment
611940		Sensor Test Stand
611941		Electrical Component Checkout Unit
611950		Signal Conditioner Checkout & Display Unit
612001		Module Handling Cage
612002		Transport Dolly

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TABLE 3-5 SPACELAB OPERATIONAL GSE (Continued)

612006		Vertical Sling Kit
	-01	Spreader Beam Assembly (A)
	-02	Single Sling SM (A)
	-03	Single Sling LG (A)
	-04	Double Sling (A)
	-05	Spreader Beam Assembly (B)
	-06	Single Sling SM (B)
	-07	Single Sling LG (B)
	-08	Double Sling (B)
	-09	Hoist Band
	-10	Single Extendable Sling
612007		End Cone Stand
612008		Feed Through Protective Covers Kit
	-01	Forward End Cone Utilities Cover
	-02	Aft End Cone Utilities Cover
	-03	Pallet Utilities Cover
612009		Module Segment, Floor Covers
612010		Pallet Segment, Floor Covers
612011		Racks & Floor Installation & Removal Kit
	-01	Support Frame
	-02	Roller Rail Assembly
	-03	Driving Mechanism
612012		Insulation Transport Kit
	-01	Module Segments Container (2)
	-02	End Cone Segments Container (2)
	-03	Ring Segments Container (1)
612013		Pallet Segment Support
612014		Igloo Transport Kit
612015		Igloo Handling Kit
	-01	Core Integration Stand
	-02	Assembly/Maintenance Stand
	-03	Cross Beam
	-04	Installation/Removal Tools
	-05	Coolant Hose Adapters
612016		Airlock Handling Kit
	-01	Hoist Fixture
	-02	Support Dolly
	-03	Installation and Maintenance Tools
	-04	Assembly and Maintenance Stand
612019		View Ports Handling Kit
	-01	Hoisting Fixture
	-02	Installation Guide
	-03	Removal Tool

TABLE 3-5 SPACELAB OPERATIONAL GSE (Continued)

612021		Horizontal Access Kit (Internal)
	-01	Ladder-Rails
	-02	Trolley-Equipment Transfer
	-03	Flat Panels
	-04	Ventilation and Utilies Duct
	-05	Jib Boom
	-06	Access Stand, Module Interior
	-07	Trolley Winch
	-08	Entrance Stairs (Internal)
612022		Vertical Access Kit
	-01	Ladder-Rails
	-02	Trolley Equipment Lowering
	-03	Access Platform - Sectioned
	-04	Utilities Ducting
	-05	Jib Boom
	-06	Emergency Breathing Kit
	-07	Dolly Winch
	-08	Portable Stowage Container
	-09	Vertical Access Ladder
612026		Utility Bridge Support (Aft)
612028		Utility Bridge Assembly Stand (Aft)
	-01	Dolly Platform
	-02	Pallet Interface Plate Stand
	-03	End Cone Interface Support
	-04	Special Cables and Hoist Fittings
612030		Utility Bridge Transport Kit (Aft)
	-01	Container Platform
	-02	Container Lid
	-03	Container Cover
612031		Utility Support Mating Tool (Forward)
612032		Vertical Removal Kit (KSC Manipulator Interface)
612035		Position Jig - Bulkhead Tunnel Interface
	-01	Reference Plate
	-02	Precision Stand
612038		Module Flange Mate/Demate Kit
	-01	Mating Bolts (8)
	-02	Demating Tools (8)

TABLE 3-5 SPACELAB OPERATIONAL GSE (Continued)

612039		Pallet Mate/Demate Kit
	-01	Turnbuckle Tension Rod with Strain Gage
	-02	Attachment Force Tool
612040		Optical Alignment Kit
	-01	Theodolite with Auto-Collimation Eyepiece
	-02	Variable Height Vertical Support
	-03	Theodolite Leveling Pad
	-04	Theodolite Target and Mirrors
612041		Insulation Handling Kit
	-01	Support Frame
	-02	Alignment Guide and Tools
	-03	Storage Containers
612042		Seal Installation Kit
	-01	Taper Pin Fittings
	-02	Sleeve Fittings
612043		Aft Flight Deck Equipment Handling Kit
	-01	Equipment Manipulator
	-02	Component Attachment Adapters
612044		Aft Flight Deck Equipment Transport Kit
	-01	Equipment Rack
	-02	Dolly Platform
	-03	Environmental Cover
612045		Subfloor Installation/Removal Kit
	-01	Subfloor Support
	-02	Subfloor Hoisting Structure
612046		Module Shell, Internal Access
	-01	Floor Segments (4)
	-02	Access Stand
	-03	Two Platforms - Rails Transfer Track
612047		Rack and Floor Shipping Cover
612048		Racks and Floor Transport Platform
612049		Rack and Floor Support Braces Kit
	-01	Truss Structure
	-02	Support Frame
612050		Double Rack Handling and Transport Kit
	-01	Rack Handling Fixture
	-02	Transport Container
612052		Acceleration Limit Indicator
612053		End Cone Shipping Cover
612054		End Cone Transport Platform
612056		Handling Ring Kit
	-01	Module Segment Ring
	-02	End Cone Major Diameter Ring
	-03	End Cone Minor Diameter Ring
612057		Module End Cone Shipping Cover
612058		Module End Cone Transport Platform
612059		Pallet Cover
612060		Pallet Platform
612065		Single Rack Handling and Transport Kit

TABLE 3-5 SPACELAB OPERATIONAL GSE (Continued)

612067		Desiccant Canister, Large
612068		Desiccant Canister, Medium
612069		Desiccant Canister, Small
612071		Active Desiccant Cart
612075		Installed Airlock Leak Check Kit
	-01	Leak Test Dome
	-02	Vacuum Pump
	-03	Helium Leak Detector
612076		Spacelab Local Leak Check Kit (Feed Through)
612077		Gas Component Test Stand
612078		Gas Servicing Unit
612079		Condensate Water Servicing Unit
612080		Portable Leak Detection Unit
	-01	Hand Operated Vacuum Pump Assembly
	-02	Electronic Chasis
	-03	Probe
	-04	Rechargeable Battery
	-05	Headphone Jacks
612083		Water Servicer
612084		Freon Servicer
612086		Freon Leak Detector
612087		Optical Properties Measurement Unit
612091		Portable Leak Tester
612092		Installation Tool Kit (Gask-O-Seal)
612101		Aft Airlock Transport Kit
	-01	Lower Container
	-02	Lid
	-03	Support Ring
	-04	Isolation Mounts
	-05	Filter Screen
	-06	3 Axis Monitoring Equipment
	-07	Relative Humidity Indicator
612102		Top Airlock Transport Kit
	-01	Lower Container
	-02	Lid
	-03	Support Ring
	-04	Isolation Mounts
	-05	Filter Screen
	-06	3 Axis G Monitoring Equipment
	-07	Relative Humidity Indicator
612105		C-5A Tiedown Kit (U.S.)
612106		Road Tiedown Kit (U.S.)
612107		Transport Kit - Integrated Spacelab

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TABLE 3-5 SPACELAB OPERATIONAL GSE (Continued)

612108		Stabilizer Link - Integrated Spacelab
612109		Trunnion Bearing Retainer
612110		Horizontal Sling Kit - Spacelab Elements
612111		Handling Adapter Kit, End Cone
612112		Connection Support, Racks and Floors to Pallet
612113		Trunnion Handling Fittings
612X01		View Port Transport Kit
	-01	Containers
	-02	Container Lids
	-03	Support Rings
	-04	Isolators
612XXX		Cleaning Kit
612XXX		IPS Handling Kit
612XXX		IPS Service Kit
612XXX		IPS Test and Checkout Kit
612XXX		IPS Transportation Kit
612XXX		Refrigeration Unit
613016		X-Ray Unit
613038		Continuity Tester
613039		Grounding/Bonding Tester
613041		EMI Test Equipment
614001		External Access Kit, Transporter Installation
614002		Horizontal Sling Kit
614003		Utility Support (Forward)
614004		Forward Utility Handling Kit
614005		Forward Utility Shipping Container
614006		Positioning Aids - Subsystem
614007		Support and Handling Kit, Tunnel
	-01	Interior Access Assembly
	-02	Segments Handling Sling Kit
	-03	Segments Handling Pallet
	-04	Handling Sling
	-05	Flex Segments Handling Device
	-06	Handling Dolly
	-07	Segments Shipping and Storage Containers
	-08	Shipping Container
	-09	Protective Cover Kit
	-10	Protective End Rings
	-11	Support Struts Shipping Container
	-12	Flex Segments Shipping Container
	-13	Pneumatic Regulation Panel
	-14	Leak Detection Kit
	-15	Weight and Balance Kit

TABLE 3-5 SPACELAB OPERATIONAL GSE (Continued)

	-16	Electrical Test Set
	-17	Segment End Plates
	-18	Interior Lighting Kit
	-19	Tunnel Supports
	-20	Bellows Support
	-21	Tunnel Support Slings
	-22	Tunnel Assembly Workstand
	-23	Bellows Retractor
	-24	Tunnel Access Platforms
	-25	Tunnel/Spacelab Mating Tool
	-26	Tunnel Vertical Removal Kit
	-27	Tunnel Horizontal Internal Access Kit
	-28	Tunnel Vertical Internal Access Kit
614008		Acceleration Monitor Recorder, Continuous
614009		C-5A Lifting Trailer Modification Kit
614010		Transporter - Spacelab, Road
614011		C-5A Lifting Trailer
614012		Transporter - Spacelab Segments, Road
614013		Cargo Lift Trailer
614014		Adapter Kit, Cargo Lift Trailer
614015		Integration and Checkout Stand
	-01	Clearance Gage
	-02	Traveling Bridge
	-03	Platforms
	-04	Ladders
	-05	Stairs
	-06	Utilities Support
614016		Pallet Staging/Refurbishment Stand
614017		End Cone Staging/Refurbishment Stand
614018		Rack Staging/Refurbishment Stand
614019		Utilities/Igloo Staging/Refurbishment Stand
614021		Forward Utilities Refurbishment Stand
614022		Desiccant Drying Oven
614023		Weight and Balance Kit
	-01	Sling Set
	-02	Load Cell Set
	-03	Flexural Pivot Set
	-04	Adapters Set
	-05	Display Set
	-06	Precision Platform Set
614024		Airlock Checkout Adapter
614025		Ground Air Conditioning Unit
614026		Cabin Gas Analysis Unit
614027		External Access Kit, Orbiter Installation

TABLE 3-6 INTEGRATION FACILITY GSE REQUIREMENTS

GSE ITEMS		ACTIVITY			
NO.	NOMENCLATURE	PREMISSION EXPERIMENT PROCESSING	LEVEL IV INTEGRATION	LEVEL III INTEGRATION	POST MISSION EXP. ELEMENT PROCESSING
	ACCESS				
612009	Module Segment, Floor Covers	✓		✓	✓
612010	Pallet Segment, Floor Covers	✓	✓	✓	✓
612021	Horizontal Access Kit (Internal)(-01 thru -08)			✓	
612022	Vertical Access Kit (-01 thru -09)				
612045	Module Shell, Internal Access (-01 thru -03)	✓		⊘	✓
614001	External Access Kit, Transporter Installation				
614027	External Access Kit, Orbiter Installation				
	HANDLING				
612001	Module Handling Cage	✓		✓	✓
612006	Vertical Sling Kit (-01 thru -10)	✓	✓	✓	✓
612008	Feed Through Protective Covers Kit (-01 thru -03)	✓		✓	✓
612011	Racks & Floor Installation & Removal Kit (-01 thru -03)	✓		○	✓
612013	Pallet Segment Support	✓	✓	✓	✓
612015	Igloo Handling Kit (-01 thru -05)			✓	✓
612016	Airlock Handling Kit (-01 thru -05)				
612019	View Ports Handling Kit (-01 thru -03)				
612026	Utility Bridge Support (Aft)		✓	✓	✓
612031	Utility Support Mating Tool (Forward)			✓	✓
612032	Vertical Removal Kit (KSC Manipulator Interface)				
612038	Module Flange Mate/Demate Kit (-01, -02)			✓	
612039	Pallet Mate/Demate Kit (-01, -02)			✓	✓
612041	Insulation Handling Kit (-01, -03)	✓		✓	✓
612042	Seal Installation Kit (-01, -02)			✓	
612043	Aft Flight Deck Equipment Handling Kit (-01, -02)			✓	✓
612045	Subfloor Removal/Installation Support (-01, -02)			✓	✓
612049	Rack & Floor Support Braces Kit (-01, -02)	⊘	⊘	⊘	⊘
612050	Handling Ring Kit (-01, -02)	✓	✓	✓	✓
612110	Horizontal Sling Kit - Spacelab Elements	⊘	⊘	⊘	⊘
612111	Handling Adapter Kit - End Cone	✓		✓	✓
614002	Horizontal Sling Kit	✓		✓	

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TABLE 3-6 INTEGRATION FACILITY GSE REQUIREMENTS (Continued)

GSE ITEMS		ACTIVITY			
NO.	NOMENCLATURE	PREMISSION EXPERIMENT PROCESSING	LEVEL IV INTEGRATION	LEVEL III INTEGRATION	POST MISSION EXP. ELEMENT PROCESSING
	HANDLING (Continued)				
614003	Utility Support (Forward)				✓
614004	Forward Utility Handling Kit				✓
614005	Forward Utility Shipping Container				✓
614006	Positioning Aids - Subsystem	✓	✓	✓	✓
614007	Support and Handling Kit, Tunnel (-01 thru -28)				
	TRANSPORTATION				
612002	Transport Dolly	✓	✓	⊘	✓
612012	Insulation Transport Kit (-01 thru -03)	✓			✓
612014	Igloo Transport Kit			✓	✓
612X01	View Port Transport Kit (-01 thru -04)				✓
612030	Utility Bridge Transport Kit (Aft)(-01 thru -03)	✓	✓		✓
612044	Aft Flight Deck Equipment Transport Kit (-01 thru -03)			✓	✓
612047	Racks & Floor Shipping Cover	✓	⊘		✓
612048	Racks & Floor Transport Platform	⊘	⊘	⊘	⊘
612050	Double Rack Handling & Transport Kit (-01 thru -02)	⊘	⊘		⊘
612052	Acceleration Limit Indicator	⊘	⊘		⊘
612053	End Cone Shipping Cover	✓			✓
612054	End Cone Transport Platform	✓		✓	✓
612057	Module - End Cone Shipping Cover	✓			✓
612058	Module - End Cone Transport Platform	✓		✓	✓
612059	Pallet Cover	✓	✓	✓	✓
612060	Pallet Platform	✓	✓	✓	✓
612065	Single Rack Handling & Transport Kit	⊘	⊘		⊘
612067	Desiccant Canister, Large	⊘	⊘		⊘
612068	Desiccant Canister, Medium	⊘	⊘		⊘
612069	Desiccant Canister, Small	⊘	⊘		⊘
612071	Active Desiccant Cart	⊘	⊘		⊘
612101	Aft Airlock Transport Kit (-01 thru -07)	✓			✓
612102	Top Airlock Transport Kit (-01 thru -07)	✓			✓

TABLE 3-6 INTEGRATION FACILITY GSE REQUIREMENTS (Continued)

GSE ITEMS		ACTIVITY			
NO.	NOMENCLATURE	PREMISSION EXPERIMENT PROCESSING	LEVEL IV INTEGRATION	LEVEL III INTEGRATION	POST MISSION EXP. ELEMENT PROCESSING
	TRANSPORTATION (Continued)				
612105	C-5A Tiedown Kit	✓	✓		✓
612106	Road Tie Down Kit	✓	✓		
612107	Transport Kit - Integrated Spacelab				
612112	Connection Support - Floor/Racks to Pallet	✓	✓	✓	✓
612XXX	IPS Service Kit	✓	✓	✓	
612XXX	IPS Test and Checkout Kit	✓	✓		
612XXX	IPS Transportation Kit	✓	✓		
612XXX	IPS Handling Kit	✓	✓		
614008	Acceleration Monitor Recorder, Continuous	✓	✓		✓
614009	C-5A Lifting Trailer Modification Kit	✓	✓		✓
614010	Transporter - Spacelab, Road				
614011	C-5A Lifting Trailer	✓	✓	✓	✓
614012	Transporter - Spacelab Segments, Road	✓	✓	✓	✓
614013	Cargo Lift Trailer	✓	✓	✓	✓
614014	Adapter Kit, Cargo Lift Trailer	✓	✓	✓	✓
	MISCELLANEOUS				
612007	End Cone Stand	✓		✓	✓
612028	Utility Bridge Assembly Stand (Aft)(-01 thru -04)	✓		✓	✓
612035	Position Jig - Bulkhead Tunnel Interface (-01, -02)				✓
612040	Optical Alignment Kit (-01 thru -04)		✓	✓	
612075	Installed Airlock Leak Check Kit (-01 thru -03)			✓	
612076	Spacelab Local Leak Check Kit (Feed Through)			✓	
612092	Installation Tool Kit (Gask-O-Seal)			✓	
612104	Trunnion Bearing Retainer	✓	✓	✓	✓
612108	Stabilizer Link - Integrated Spacelab				✓
612113	Trunnion Handling Fittings	✓	✓	✓	✓
612XXX	Cleaning Kit	✓	✓	✓	✓
614015	Integration & Checkout Stand (-01 thru -06)			✓	✓
614016	Pallet Staging/Refurbishment Stand		✓	✓	✓

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TABLE 3-6 INTEGRATION FACILITY GSE REQUIREMENTS (Continued)

GSE ITEMS		ACTIVITY			
NO.	NOMENCLATURE	PREMISSION EXPERIMENT PROCESSING	LEVEL IV INTEGRATION	LEVEL III INTEGRATION	POST MISSION EXP. ELEMENT PROCESSING
	MISCELLANEOUS (Continued)				
614017	End Cone Staging/Refurbishment Stand	✓	✓	✓	✓
614018	Rack Staging/Refurbishment Stand	✓	✓	✓	✓
614019	Utilities/Igloo Staging/Refurbishment Stand			✓	✓
614021	Forward Utilities Refurbishment Stand				
614022	Desiccant Drying Oven	✓	✓	✓	✓
614023	Weight & Balance Kit (-01 thru -06)		✓		
614024	Airlock Checkout Adapter				
	SERVICE/SUPPORT				
612077	Gas Component & ECS Checkout Unit				✓
612078	Gas Servicing Unit				✓
612079	Condensate Water Servicing Unit				✓
612080	Portable Leak Detection Unit (-01 thru -05)		✓		✓
612083	Water Servicer				✓
612084	Freon Servicer				✓
612085	Freon Leak Detector		✓		✓
612087	Optical Properties Measurement Unit				✓
612091	Portable Leak Tester		✓	✓	✓
612XXX	Refrigeration Unit				✓
613016	X-Ray Unit		✓	✓	✓
614025	Ground Air Conditioning Unit				✓
614026	Cabin Gas Analysis Unit				✓
	SIMULATORS				
611301	Orbiter Interface Adapter				
611401	Experiment Segment/Pallet Simulator				
611501	Experiment/Subsystem Simulator				
611601	Core Segment Simulator			✓	

TABLE 3-6 INTEGRATION FACILITY GSE REQUIREMENTS (Continued)

GSE ITEMS		ACTIVITY			
NO.	NOMENCLATURE	PREMISSION EXPERIMENT PROCESSING	LEVEL IV INTEGRATION	LEVEL III INTEGRATION	POST MISSION EXP. ELEMENT PROCESSING
	ELECTRICAL/ELECTRONIC				
611001	Automatic Test Equipment (-01 thru -14) (1)				
611023	Recorder & Communication Control Unit Tester				✓
611910	Computer Tester				✓
611911	I/O Unit Tester				✓
611912	Mass Memory Test Equipment				✓
611913	CRT Keyboard Unit Tester				✓
611914	PAU Unit Tester		○	○	⊘
611915	CDMS Control Panel Unit Tester				✓
611916	Time Display Unit Tester				✓
611918	CCTV Unit Tester (Camera & Monitor)				✓
611919	Intercom Unit Tester				✓
611920	Caution & Warning Unit Tester				✓
611921	High Rate Recorder Unit Tester				✓
611922	Video Recorder Unit Tester				✓
611930	EPDS Unit/Subsystem Test Equipment				✓
611940	Sensor Test Stand				✓
611941	Electrical Component Checkout Unit				✓
611950	Signal Conditioner Checkout & Display Unit				✓
613038	Continuity Tester		✓	✓	✓
613039	Grounding/Bonding Tester		✓	✓	✓
613041	EMI Test Equipment	○	○	⊘	⊘
	(1) Equipment with similar function required				

right of a GSE item represent requirements for use of that item from Reference 11. It should be noted that there is no presently identified plan by NASA to procure items from this list for support of Level IV integration or for use of the items at locations other than MSFC and KSC. A circle in a column to the right of a GSE item represents an assessment made in the course of this survey that the item is needed to support Integration Facility activities.

A brief description of the projected usage of each item circled in Table 3-6 is given in Table 3-7. The descriptions were prepared with the aid of the GSE descriptions contained in Reference 12.

Table 3-7 also indicates the number of each item projected for use in the Integration Facility, and a cost estimate for each item. The source of the cost estimate is indicated in parenthesis to the right of the cost figure. The letter R indicates that the cost estimate is from Reference 12, and the letter E that the cost estimate has been made by personnel conducting this survey. All cost estimates should be considered non-firm, rough order of magnitude (ROM) engineering estimates. The estimates do not include development costs, but assume all development costs will be borne by the initial procurement for GSE to be used at MSFC and KSC. Costs may be expected to vary significantly dependent on the final GSE item designs. The projected cost for the total number of units estimated for the Integration Facility is slightly over $0.77 million. This estimate assumes that two presently available items, the C-5A Lifting Trailer (614011) and the Cargo Lift Trailer (614013), are provided at no cost to the LSP program. In some cases the GSE items shown in Table 3-7 may be capable of providing more functions than those required by Integration Facility activities. In these cases it may prove cost effective to design and fabricate a substitute GSE item for use in the Integration Facility. The decisions as to which, if any, items this approach is applicable must be deferred until more design details are available for the baseline GSE items.

TABLE 3-7 INTEGRATION FACILITY NASA/ESA GSE

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
ACCESS					
612046	Module Shell, Internal Access (-01, -06, -03)	Substitute floor for mock-up modification and for use in shared lab simulations.	1	5 K (R)	5 K
HANDLING					
612011	Racks and Floor Installation and Removal Kit (-01, -02, -03)	Used to install and remove racks and floors from mock-up.	1	45 K (R)	45 K
612049	Rack and Floor Support Braces Kit (-01, -02)	Stiffens rack and floor segments during shipment and handling	3	2 K (R)	6 K
612110	Horizontal Sling Kit - Spacelab Elements	Utilized in handling and hoisting of Spacelab elements (details TBD)	1	5 K (E)	5 K
TRANSPORTATION					
612002	Transport Dolly (rack and floor)	Dolly provides mobility inside integration facility to racks and floor sets.	3	29 K (R)	87 K
612047	Racks and Floor Shipping Cover	Environmental protection during shipment of rack and floor assemblies.	2	7 K (R)	14 K
612048	Racks and Floor Transport Platform	Used with shipping cover for transport of rack and floor assemblies.	2	1 K (R)	2 K
612050	Double Rack Handling and Transport Kit (-01 and -02)	Provides shipping container for tall or empty double racks. Includes rack hoisting fixture.	2	8 K (R)	16 K

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TABLE 3-7 INTEGRATION FACILITY NASA/ESA GSE (continued)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
ACCESS					
612046	Module Shell, Internal Access (-01, -06, -03)	Substitute floor for mock-up modification and for use in shared lab simulations.	1	5 K (R)	5 K
HANDLING					
612011	Racks and Floor Installation and Removal Kit (-01, -02, -03)	Used to install and remove racks and floors from mock-up.	1	45 K (R)	45 K
612049	Rack and Floor Support Braces Kit (-01, -02)	Stiffens rack and floor segments during shipment and handling	3	2 K (R)	6 K
612110	Horizontal Sling Kit - Spacelab Elements	Utilized in handling and hoisting of Spacelab elements (details TBD)	1	5 K (E)	5 K
TRANSPORTATION					
612002	Transport Dolly (rack and floor)	Dolly provides mobility inside integration facility to racks and floor sets.	3	29 K (R)	87 K
612047	Racks and Floor Shipping Cover	Environmental protection during shipment of rack and floor assemblies.	2	7 K (R)	14 K
612048	Racks and Floor Transport Platform	Used with shipping cover for transport of rack and floor assemblies.	2	1 K (R)	2 K
612050	Double Rack Handling and Transport Kit (-01 and -02)	Provides shipping container for tall or empty double racks. Includes rack hoisting fixture.	2	8 K (R)	16 K

TABLE 3-7 INTEGRATION FACILITY NASA/ESA GSE
(continued)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
612052	Acceleration Limit Indicator	Self contained three axis maximum g force recorder for shipping acceleration	3	5 K (R)	15 K
612065	Single Rack Handling and Transport Kit	Provides shipping container for full or empty single racks. Includes rack hoisting fixture.	2	8 K (R)	16 K
612067	Desiccant Canister, Large	Consists of silica gel canisters and interface hoses. Used for humidity control during shipment.	3	10 K (R)	30 K
612068	Desiccant Canister, Medium	Same as 612067	3	8 K (R)	24 K
612069	Desiccant Canister, Small	Same as 612067	3	6 K (R)	18 K
612071	Active Desiccant Cart	Used for active humidity and temperature control for major Spacelab assemblies during shipment.	1	29 K (R)	29 K
612105	C-5A Tiedown Kit	Straps, rings, and slings for tying down Spacelab hardware for air transit.	1	11 K (R)	11 K
612112	Connection Support - Floor/Racks to Pallet	Secures hardware to shipping pallet. (Details are TBD)	2	5 K (E)	10 K
614008	Acceleration Recorder, Continuous	Monitors continuous three axis acceleration profile during transit.	2	5 K (R)	10 K
614009	C-5A Lifting Trailer Modification Kit	Extends platform of C-5A lifting trailer to 16m x 5 m (52.5 x 16.4 ft) to accommodate Spacelab elements.	1	11 K (R)	11 K

TABLE 3-7 INTEGRATION FACILITY NASA/ESA GSE (continued)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
614011	C-5A Lifting Trailer	This item is part of standard C-5A equipment. It will be used to hoist elements for transfer to C-5A cargo bay (see item 614009)	1	Assumed GFE	Assumed GFE
614013	Cargo Lift Trailer	Used to hoist Spacelab elements to height of aircraft floor. Used for shipment of less than full rack/ floor sets on other than C-5A aircraft.	1	Assumed GFE	Assumed GFE
614014	Adapter Kit, Cargo Lift Trailer	Interfaces with item 614013 for lifting and transfer to aircraft of equipment.	1	11 K (R)	11 K
MISCELLANEOUS					
612040	Optical Alignment Kit (-01 thru -04)	Provides a precise reference during mating of rack/floor sets into mock-up.	1	5 K (R)	5 K
SIMULATORS					
611601	Core Segment Simulator	Used during checkout and simulations. Includes a flight type computer and software, mass memory, computer I/O unit, recorder, and simulated Spacelab EPDS equipment. Used to eliminate need for some costly flight equipment during checkout and simulations. (Capabilities are under review.)	1	352 K (R)	352 K

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TABLE 3-7 INTEGRATION FACILITY NASA/ESA GSE (concluded)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
ELECTRICAL/ ELECTRONIC					
611914	RAU Unit Tester	Simulates input signals of subsystems and experiments and checks RAU output signals. Used for set-up tests and troubleshooting during integration activities.	1	24 K (R)	24 K
613041	EMI Test Equipment	Used to verify that EMI will be at a sufficiently low level to preclude interference with Spacelab systems or experiment operations.	1	27 K (R)	27 K
				TOTAL	773 K

NOTE:

R denotes cost estimate from Reference 12.

E denotes cost estimate made in this survey.

In addition to the NASA/ESA GSE items listed in Table 3-7, an additional set of GSE items were identified by this survey. The additional items are presented in Table 3-8, and include equipment capable of providing LSP flight hardware related processing functions either more effectively than NASA/ESA items or in addition to those provided by NASA/ESA items. (Additional support equipment less directly involved with Spacelab flight hardware is discussed in Section 3.4.2.)

The two characters preceeding the identification numbers assigned to the additional GSE items in Table 3-8 are XX to differentiate items from those on the NASA/ESA list. The third character is coded in the same fashion as that previously indicated; i.e., 3 denotes an item of electrical GSE for which NASA should be responsible, and 4 a mechanical GSE item of NASA responsibility. No 1 or 2 third digit characters were assigned. The remaining three characters were assigned in an arbitrary fashion. A column describing the projected usage of each item is included in Table 3-8, along with a column for the number of units required and cost information. The numbers in brackets below the cost figures indicate estimated development costs in man-hours. As in Table 3-7, all costs should be considered as preliminary, non-firm, rough order-of-magnitude (ROM) engineering estimates. All estimates indicated were made by Integration Facility survey personnel based on past engineering experience.

Total cost for the required numbers of items indicated in Table 3-8 is estimated at $0.94 million with 17,000 man-hours required for development; plus development and unit costs of the operational era Orbiter and Spacelab mock-ups and the Integration Facility computer aided test monitoring equipment. Costs for these items are dependent on preliminary design analyses which were considered outside the scope of this survey. As a reference cost comparison point, the Spacelab Automatic Test Equipment, which will have capability considerably in excess of that required for Integration Facility computer aided test monitoring equipment, is estimated to require $230,000 for development and to have a unit cost of $949,000.

TABLE 3-8 ADDITIONAL GSE ITEMS

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
ACCESS					
XX4101	General Purpose Scaffolding	Exterior access to Orbiter and Spacelab mock-ups and to racks and equipment being integrated.	1	8 K (E) [None]	8 K
XX4102	Protective Covers	Pads to shield and protect flight hardware during LSP Facility based operations.	1	1 K (E) [40]	1 K
HANDLING					
XX4201	Mobile Hoist/Sling	One ton capacity portable hydraulic lift with sling. Used to lift and position items for integration.	1	3 K (E) [None]	3 K
XX4202	Small Equipment Transport Cart	Laboratory-type cart for moving small items about in the integration facility.	6	.2 K (E) [None]	1.2 K
XX4203	Rack Transport Cart	Underslung cart for movement of racks inside building. Sized to carry a single or double rack, empty or integrated, with environmental cover.	4	3 K (E)	12 K
XX4204	Aft Flight Deck Handling Apparatus	Holding and positioning apparatus for installation of equipment with aft flight deck consoles.	1	5 K (E) [200]	5 K
TRANSPORTATION					
XX3301	Transportation Instrumentation Kit	The kit will be attached to critical environmentally controlled items in shipment to obtain a continuous record of humidity, temperature, cleanliness, and acceleration levels.	1	50 K (E)	50 K

TABLE 3-8 ADDITIONAL GSE ITEMS (continued)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
TRANSPORTATION					
XX4302	Aft Flight Deck Equipment Transport Container	Shipping container for aft flight deck equipment. Also serves as interface fit check equipment.	2	30 K (E) [750]	60 K
XX4303	Tiedown Slings for Road Transport of Spacelab Elements	Tiedown straps and other devices used to secure Spacelab elements to transporter for movement from airfield to LSP facility. (Used with XX4304)	1	3 K (E) [120]	3 K
XX4304	Road Transport Trailer for Spacelab Elements	Used to transport Spacelab components and integrated payloads between LSP integration site and airfield.	1	15 K (E) [640]	15 K
MISCELLANEOUS					
XX4401	Assembly Stand	Consists of a pair of rails which interface with item 612011, and scaffolding/access stairs. Used to position rack/floor sets for installation and removal from mock-up.	1	60 K (E) [700]	60 K
XX4402	Cleaning and Inspection Kit	Used to clean and verify the cleanliness of experiments and Spacelab equipment during integration and checkout.	1	10 K (E) [460]	10 K
XX4403	Rack Integration Access Stand	Work station and access platforms used for experiment integration to racks and to rack assemblies.	3	12 K (E) [460]	36 K
XX4404	Dessicant Drying Oven	Heater, blower, oven and controls used to dry dessicant containers.	1	15 K (E) [360]	15 K

TABLE 3-8 ADDITIONAL GSE ITEMS (continued)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
XX4405	Weight and Balance Kit	Support truss, slings, load cells and associated equipment. Used to verify weight and c.g. of experiments and integrated payloads.	1	175 K (E) [3520]	175 K
SERVICE/ SUPPORT					
XX3501	Cable Kit	A collection of standardized interface cables for use in integration, checkout, and simulation.	1	75 K (E) [2000]	75 K
XX3502	Lighting Kit	A set of portable lights and cables designed for use inside the Spacelab mockup during integration.	1	10 K (E) [300]	10 K
XX3503	Calibration Kit	Items commonly used in calibration of sensors and transducers supplemented by JSC metrology lab.	1	50 K (E) [500]	50 K
XX4504	Vacuum Servicing Cart	A general purpose portable vacuum source with controls. Used with experiments using cryogens.	1	25 K (E) [200]	25 K
XX4505	Cryogenic Transport Cart	Portable dewar for integration area transport of LN_2.	2	2 K (E) [None]	4 K
XX4506	Trace Gas Cart	Provides trace gases to experiments and detectors.	2	3 K (E) [50]	6 K
XX4507	Pressure Test Cart	General purpose cart used to pressure test equipment and to provide high accuracy pressure readout for calibration and set-up.	1	15 K (E) [200]	15 K

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TABLE 3-8 ADDITIONAL GSE ITEMS (continued)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
XX3508	Mass Spectrometer Leak Detector	Provides capability in excess of that available from item 612080.	1	5 K (E) [None]	5 K
XX3509	Battery Test/Service Cart	Used to monitor and service batteries used in various experiments.	1	3 K (E) [100]	3 K
XX3510	Ultrasonic Test Cart	Nondestructive test equipment used to inspect experiment equipment for structural flows.	1	15 K (E) [None]	15 K
XX4511	Fluid Flow Measurement Kit	Provides a range of flowmeters and transducers with readout equipment for experiment checkout flow measurements.	1	20 K (E) [200]	20 K
XX4512	Chilled Water Coolant Cart	A portable cart containing a Freon vapor compression refrigeration unit, an interface heat exchanger, and a circulating water loop. The water loop interfaces with experiment assemblies using liquid cooling.	1	15 K (E) [400]	15 K
XX4513	Freon Coolant Cart	A portable cart containing a Freon cooling loop and controls. The unit interfaces with the facility cold water system and with the Spacelab Water Servicer (612083) to provide checkout and simulation coolant [9960 watt max. (34 K Btu/hr. max.)]	1	20 K (E) [500]	20 K
XX4514	Portable Leak Detector	Equipment for locating leaks in lines, fittings and components. Used with gaseous helium supply.	1	3 K (E) [160]	3 K

TABLE 3-8 ADDITIONAL GSE ITEMS (continued)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
XX4515	Water Coolant Loop Assembly	Used to provide chilled water during checkout operations. Simulates Spacelab ECS water loop operation.	1	85 K (E) [1000]	85 K
XX4516	Freon Leak Detector	Portable unit used to check for Freon leaks in cooling units and interconnecting plumbing.	1	1 K (E) [75]	1 K
XX4517	Ground Air Conditioning Unit	This unit interfaces with the Spacelab cooling ductwork and provides cooling, humidity control, and filtration during integration and checkout operations.	1	25 K	25 K
XX4518	Gas Analysis Unit	Used to check mockup atmosphere composition during ground operations.	1	35 K (E) [1000]	35 K
SIMULATIONS					
XX4601	Spacelab Mock-up	Used in preflight simulations.	1	TBD [TBD]	TBD
XX4602	Orbiter Mock-up	Used in preflight simulations.	1	TBD [TBD]	TBD
ELECTRICAL/ ELECTRONIC					
XX3701	Electrical Load Banks	Used for experiment and integration equipment tests.	2	4 K (E) [200]	8 K

TABLE 3-8 ADDITIONAL GSE ITEMS (continued)

Number	Nomenclature	Projected Usage	No. Units Required	Est. Unit Cost (ROM) $	Est. Total Cost (ROM) $
XX3702	Computer Aided Test Monitoring Equipment	Performs functions similar to ATE (611001), but structured to support level IV and III JSC effects. Functions include stimulation and command generation, generation of display formats, test data evaluation and reduction, data recording, downlink/ uplink control, utility profile monitoring. Includes software.	1	TBD [TBD]	TBD
XX3703	Continuity Tester	Equipment used to check interface cables and to verify conductor identification within cable bundles.	1	55 K (E) [1000]	55 K
XX3704	Grounding/Bonding Test Unit	Items used to check the grounding of installed experiment equipment to structure.	1	10 K (E)	10 K
				TOTAL	939 K

NOTE:

E denotes cost estimate made in this survey.

Numbers in brackets denote estimated man-hours required for development

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The total unit costs for all items shown in Tables 3-7 and 3-8 (with the exception of the 2 cargo lift trailers, the Orbiter/Spacelab mockups, and the computerized test monitoring equipment) is approximately $1.71 million.

3.4.2 Other Support Equipment

Non-GSE items needed to support Integration Facility tasks are listed in Table 3-9. The items shown in the table are taken from the data sheets included in Section A of Reference 10, and are arranged in the table by subfacility. A preliminary, rough order-of-magnitude (ROM) non-firm estimate of the cost of most items is provided to the right of the item. The following assumptions were made in preparing the equipment cost estimates:

a) automotive, mobile crane and forklift equipment is provided from existing motor pool items.
b) some equipment will be shared by two or more areas as noted in the table.
c) computational equipment used in the data lab is assumed to be leased as are acoustic couplers.
d) no costs are necessary for the use of existing scientific laboratory capability.
e) design development, set-up and interface connection and verification costs are not included.

The total cost of equipment whose cost is indicated in Table 3-9 is approximately $331,000. Slightly over $100,000 of this amount is accounted for by office furniture, storage cabinets, workbenches, and similar equipment which may be available from within NASA. Costs for several items which are not well defined at this time are not included in the above cost figures. These items include:

a) waste/dead animal disposal, data monitoring, and habitat units for specimen holding.
b) subsystem equipment to replace the Orbiter and Spacelab flight systems in the mockup area.

TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
1.0	SHIPPING AND RECEIVING				
1.1	Dock Area				
	flat bed carts	4	200	800	
	hand tools for crate disassembly	1 set	100	100	
	hand trucks	2	75	150	
	4.5×10^3 Kg (5 ton) capacity forklifts	2	---	---	motor pool equipment used on "as required" basis
	18×10^3 Kg (20 ton) portable crane	1	---	---	
1.2	Non Clean Room Receiving				
	18×10^3 Kg (20 ton) monorail	1	22,500	22,500	plus installation
	crane work benches	3	150	450	
	desks with chairs	2	275	550	
	stools	3	50	150	
	0.9×10^3 Kg (one ton) automotive van	1	---	---	motor pool equipment dedicated to facility
	misc. hand tools	1 set	100	100	
	hand truck	2	75	150	
	flat bed carts	2	200	400	
1.3	Packing Area - Clean Room				
	laminar flow work bench	1	3,000	3,000	
	tape dispensers	1	50	50	
	storage bins for materials	1	250	250	
	vacuum bagging equipment	1	1,000	1,000	
	work bench	1	150	150	
	heat sealing equipment	1	300	300	
1.4	Clean Room Receiving				
	hand tools for crate/package opening	1 set	100	100	
	magnifying glasses, jeweler's loupes	3	50	150	
	precision measuring equipment	1 set	3,000	3,000	

TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Continued)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
1.4	Clean Room Receiving (continued)				
	0-500 gram scale	1	250	250	
	0-45 Kg (1-100 lb) scale	1	300	300	
	0-227 Kg (0-500 lb) scale	1	300	300	
	workbench	1	150	150	
	stool	1	50	50	
1.5	Packing Area - Non Clean Room				
	hand tools	1 set	100	100	
	crating material storage bin	1	250	250	
	tape dispensers	2	50	100	
	roll paper/packing material holders	1	100	100	
	band strapping equipment	1	150	150	
1.6	Equipment Cleaning Area				
	portable scaffold/workstand	1	500	500	
	4.6 m (15 ft) stepladder	1	75	75	
	storage cabinets for cleaning supplies	2	175	350	
	vacuum cleaner and accessories	1	300	300	
2.0	SPECIAL REQMTS/ITEMS HOLDING AREA				
2.1	Specimen Inspection, Examination and Test				
	examination table	1	300	300	
	examination equipment	1 set	500	500	expt. dependent
	laboratory carts	3	125	375	
	specimen transport container	3	100	300	various types
	transducer test equipment	1 set	2,000	2,000	expt. dependent
	waste and dead animal disposal equipment	1	TBD	TBD	use of existing incinerator may be possible

TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Continued)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
2.2	Closely Controlled Specimen Storage				
	incubator	2	500	1,000	Equipment requirements are highly experiment dependent. PI provided equipment used as possible. Special environments likely to be required.
	aquaria	2	1,000	2,000	
	plant holding facility	2	700	1,400	
	vertebrate holding cages	6	TBD	TBD	
	refrigerator	1	600	600	
	freezer	1	600	600	
	workbench	1	150	150	
2.3	Normal Environment Specimen Storage				
	work benches	2	150	300	
	electrical equipment racks	2	200	400	
	data monitoring equipment	1 set	TBD	TBD	(type TBD)
	specimen transport carts	2	500	1,000	
	plant holding facility	2	500	1,000	
	aquaria	2	700	1,400	
	incubators	2	300	600	
	refrigerators	1	600	600	
	special waste disposal equipment	1 set	TBD	TBD	
	laboratory holding units for medium and small vertebrates	1 set	TBD	TBD	experiment dependent
3.0	EQUIPMENT STORAGE				
3.1	Normal Room Temperature Storage				
	metal shelf storage units	26	175	4,550	(0.6 x 2.4 x 2.4 m)
	desk	2	200	400	
	chair (desk)	2	75	150	
	5-drawer file cabinets	12	150	1,800	
	CRT terminal w/keyboard	1	2,500	2,500	
3.2	Non-Controlled Storage (Outdoors)				
	9×10^3 Kg (10 ton) mobile crane	1	---	---	motor pool equipment used on "as required" basis
	4.5×10^3 Kg (5 ton) forklift				

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TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Continued)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
4.0	EXPERIMENT TEST/CHECKOUT LAB				
4.1	Performance Test Area				
	0.9 x 10^3 Kg (one ton) overhead hoist	1	2,000	2,000	
	work benches	3	150	450	
	flat bed carts	2	200	400	
4.2	Offgassing Test Area				
	outgassing flasks, w/accessories	10	100	1,000	
	bell jars	2	125	250	
	bell jar base carts	2	300	600	
	pressure regulation system	1	400	400	
	vacuum measurement equipment	2	150	300	
	fume hood	1	1,000	1,000	
	gas chromatograph (dual column)	1	---	---	assume use of
	strip chart recorder	1	---	---	existing equipment
	calibration gas bottles	12	25	300	
	vacuum chambers -0.6 m cube min.	2	2,000	4,000	(2x2x2 ft min)
	vacuum pumps -1.7 m^3/hr @ 9.6x10^4n/m^2	2	200	400	(1cmf @ 28.5 in. Hg)
	quartz lamps	4	150	600	
	infrared lamps	6	15	90	
	glassware and fittings	1 set	300	300	
	experiment specific support equipment	A/R	---	---	integration area equipment used as needed
	work bench	1	150	150	
4.3	Flammability Test Area				
	ignition source transformer	1	200	200	
	pressure regulation system	1	400	400	
	optical pyrometer	1	200	200	
	vacuum gage	2	50	100	
	fume hood	1	1,000	1,000	
	72 liter bell jars	2	125	250	
	bell jar base carts	2	300	600	
	vacuum pumps w/controls	2	200	400	
	high voltage supply	2	100	200	
	workbench	1	150	150	

TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Continued)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
5.0	EXPERIMENT DEVELOPMENT LAB				
5.1	General Mechanical Shop Area				
	lathe - 15.2 cm (6 in.)	1	4,000	4,000	
	mill - vertical	1	4,000	4,000	
	heliarc	1	1,000	1,000	
	brake, 0.3 x 122 cm capacity	1	700	700	(1/8 in. x 48 in. cap.
	shear, 0.3 x 122 cm capacity	1	1,000	1,000	(1/8 in. x 48 in. cap.
	drill press	2	300	600	
	band saw, multipurpose	1	1,000	1,000	
	grinders	2	150	300	
	sander	1	250	250	
	vise	2	100	200	
	storage cabinet	3	175	525	
	parts bins	2	200	400	
	work benches	3	150	450	
	stools	5	75	375	
5.2	General Electrical Shop Area				
	workbench	3	150	450	
	multimeters	6	100	600	
	lab oscilloscope	1	450	450	
	dual trace memory scope	1	700	700	
	signal generator	1	300	300	
	frequency meter	2	500	1,000	
	data signal amplifiers	4	200	800	
	lab thermocouple readouts	3	250	750	
	event counters/timers	2	350	700	
	four channel chart recorders	2	400	800	
	low voltage power supplies	2	200	400	
	high voltage power supplies	2	200	400	
	stools	3	50	150	
	standard electrical hand tools	1 set	250	250	
	storage cabinets	3	175	525	
5.3	Tube Fabrication Area				
	tube bender	1	800	800	
	tube flare	1	1,000	1,000	
	tube storage rack	1	200	200	
	parts bins	1	250	250	
	tube master storage rack	1	200	200	
	standard mechanics hand tools	1 set	250	250	

TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Continued)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
6.0	CLEAN ROOM INTEGRATION SUBFACILITY				
6.1	Clean Room Integration Area				
	air compressor, 26m^3/hr @ 6.9x10^5 n/m^2	1	1,000	1,000	(15cfm 100 psi B/U)
	workbench	6	150	900	
	flat bed carts	2	200	400	
	8-bay gas bottle racks	3	200	600	
	emergency lighting units	6	50	300	
	4.5 x 10^3 Kg (5 ton) electric forklift	1	---	---	motor pool equipmen
	hazardous material disposal system	1	1,500	1,500	(e.g., chromate tank).
	freon coolant cart w/accessories	1	2,500	2,500	
	refrigerator	1	600	600	
	freezer	1	600	600	
	mechanical and electrical hand tools	1 set	1,000	1,000	
	9 x 10^3 Kg (10 ton) monorail crane	1	---	---	use crane presently located in bldg. 36 room 1010
6.2	Wiring Harness Fabrication Area				
	work bench	2	150	300	
	wire spool storage racks	2	100	200	
	equipment storage cabinet	2	175	350	
	stool	4	50	200	
6.3	Clean Room Test Area				
	no additional equipment required - share use of clean room integration area equipment (6.1 above)				
6.4	Clean Room Work Area				
	no additional equipment required - share use of clean room integration area equipment (6.1 above)				

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TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Continued)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
7.0	ORBITER SPACELAB MOCK-UP				
7.1	Mock-up Area				
	monorail hoist -1.8x10^3 Kg (2.0 ton)	1	6,000	6,000	plus installation
	scaffolds-0.6x6.1x1.5 H m	2	300	600	(2x20x5H ft)
	emergency lighting units	4	50	200	
	radiation monitoring equipment	1 set	5,000	5,000	
	fire protection clothing	2	1,000	2,000	
	CO_2 fire fighting supply	1	2,000	2,000	
	LN_2 cold traps	2	2,500	5,000	
	LN_2 storage system (equipment listed in the integration area, 6.1, is also used in the Mock-up Area. See also GSE items listed in Tables 3-7 and 3-8)	1	---	---	existing
	simulated Orbiter/Spacelab subsystems	1 set	TBD	TBD	dependent on design
8.0	DATA LAB				
8.1	Data Management Area				
	terminal controller/keyboard	3	1,500	4,500	
	acoustic coupler	2	---	---	assumed leased
	CRT display units	3	1,000	1,000	
	line printer	1	---	---	assume computer
	computer	1	---	---	and associated
	card reader	1	---	---	equipment is
	card punch	1	---	---	leased
	desk	3	200	600	
	chair	3	75	225	
	tables	2	100	200	
	bookcase	2	50	100	
	five drawer file cabinet	2	150	300	
9.0	TEST CONTROL/FLIGHT SUPPORT AREA				
9.1	Test Control Area				
	audio switch gear	1	300	300	
	video switch gear	1	500	500	
	audio recorders	2	700	1,400	
	video tape recorders	2	6,000	12,000	

TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Continued)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
9.1	Test Control Area (continued)				
	video monitors	4	500	1,000	
	CRT display	1	1,000	1,000	
	keyboard, terminal controller	1	1,500	1,500	
	communications headsets	6	75	450	
	audio amplifiers	3	100	300	
	public address speakers	2	50	100	
	2-bay control consoles	4	500	2,000	
	chairs	4	75	300	
	five drawer file cabinets	2	150	300	
	four shelf bookcases	2	50	100	
9.2	Science Monitoring Area				
	strip chart recorders	9	4,000	36,000	
	CRT displays	9	1,000	9,000	
	keyboard, terminal controller	9	1,500	13,500	
	acoustic couplers	6	---	---	assume leased
	line printer (shared by 3 areas)	1	---	---	assume leased
	video monitor	6	500	3,000	
	communication headsets	9	75	675	
	2-bay desk-type consoles	15	500	7,500	
	chairs (desk)	15	75	1,125	
	tables	3	100	300	
	chairs (for tables)	12	50	600	
	bookcases	6	50	300	
	five drawer file cabinets	6	150	900	
10.0	FACILITY MAINTENANCE AREA				
10.1	Facility Equipment Storage Area				
	steel shelf storage units	4	175	700	
10.2	General Purpose Facility Modification Area				
	machinist's vise	1	100	100	
	pipe vise	1	50	50	
	steel storage bin unit	1	250	250	
	steel storage cabinet	1	175	175	
	hand tools	1 set	150	150	
	work bench	2	150	300	
	flat bed cart	1	200	200	

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TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Continued)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
11.0	GENERAL PURPOSE SCIENTIFIC LABORATORIES				
11.1	General Purpose Labs				
	use of existing laboratory equipment is assumed for activities in the following areas:	--	---	---	assume use of existing capability
	environmental physiology				
	cardiovascular				
	neuroscience				
	cardiopulmonary				
	bioinstrumentation				
	microprocessing				
	food and nutrition				
	toxicology				
	biochemistry				
	microbiology				
	data archival library				
	photographics				
11.2	Isotope Management Lab				
	plastic lined deionized water storage tank (chilled)	1	1,000	1,000	for heat source storage
	padding for floor	1	200	200	
	transport cart	1	300	300	
	handling tools	1 set	250	250	
	air monitor system	1	4,000	4,000	
	alpha survey meter	1			
	gamma survey meter	1	2,000	2,000	
	neutron survey meter	1			
	personnel dosimeters	25	250	6,250	
	log books	1	10	10	
	securable storage cabinets	2	250	250	
	personnel protective and incident control equipment (see data sheet)	2	200	400	

TABLE 3-9 INTEGRATION FACILITY EQUIPMENT LIST (Concluded)

Ref. No.	Item	Qty Req'd	Unit Cost, $	Total Cost, $	Remarks
12.0	OFFICE AND MEETING ROOM SPACE				
12.1	Conference Rooms				
	tables 1.2x6.1 m (4 x 20 ft)	2	300	600	
	chairs (straight back)	60	50	3,000	
	16 mm sound projectors	2	300	600	
	vu-graph projectors	2	125	250	
	projection screens	2	75	150	
	chalk boards	2	40	80	
12.2	Office Areas				
	desks	150	200	30,000	
	tables	20	100	2,000	
	chairs (desk type)	150	75	11,250	
	chairs (straight back)	100	50	5,000	
	file cabinets	125	150	18,750	
	chalk boards	75	40	3,000	
	cork boards	40	25	1,000	
	coat racks	25	25	625	
	bookcases	75	50	3,750	

Section 4
DESCRIPTION OF AVAILABLE JSC LIFE SCIENCE FACILITIES

The Lyndon B. Johnson Space Center (JSC) will be a primary location for Shuttle/Spacelab Life Sciences payload integration and simulation activities within NASA. The JSC resources required to support Shuttle era Life Sciences Payload (LSP) activities will be composed of existing capabilities supplemented as necessary by additional resources. The following paragraphs have been prepared as the result of a facility survey conducted in June 1976 and provide a brief description of existing facilities and equipment. The capabilities described provide a nucleus about which final JSC LSP processing accommodations may most economically be implemented. A description of the recommended Shuttle era LSP processing facility configuration is provided in Section 5.0.

The current JSC Life Sciences Directorate facility resources may be divided into three major categories: bioengineering, biomedical research and health services. The bioengineering operations are located in Building 36 which will also serve as the primary Life Science Payload (LSP) Integration Facility. Biomedical research and certain health services functions are being consolidated into Building 37 from several other JSC facilities. Additional health services accommodations are available from the JSC Dispensary and Dental clinic housed in Building 8. A layout of the NASA JSC site depicting facility locations and nomenclature is provided in Figure 4-1.

4.1 FACILITY SURVEY RESULTS

4.1.1 Building 36 -- Bioengineering and Test Support Facility

The Bioengineering and Test Support Facility, Building 36, consists of two wings. The north wing, a single story unit of approximately 957 m^2 (10,300 ft^2), currently provides the primary office area for NASA - JSC Bioengineering Systems Division personnel. A plan view of the north wing office area is shown in Figure 4-2 for reader familiarization/orientation.

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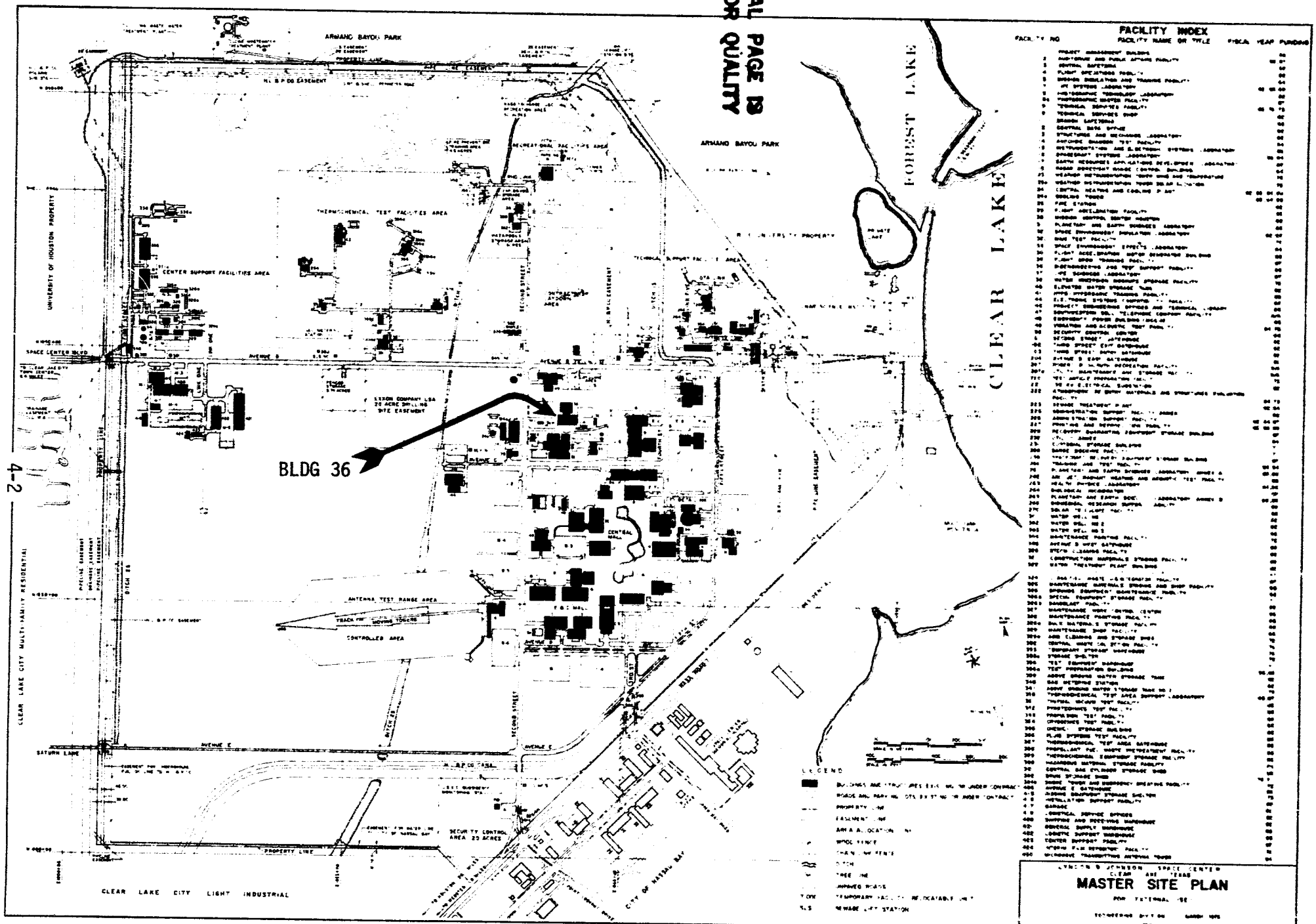

FIGURE 4-1: NASA JOHNSON SPACE CENTER FACILITY LOCATION AND NOMENCLATURE

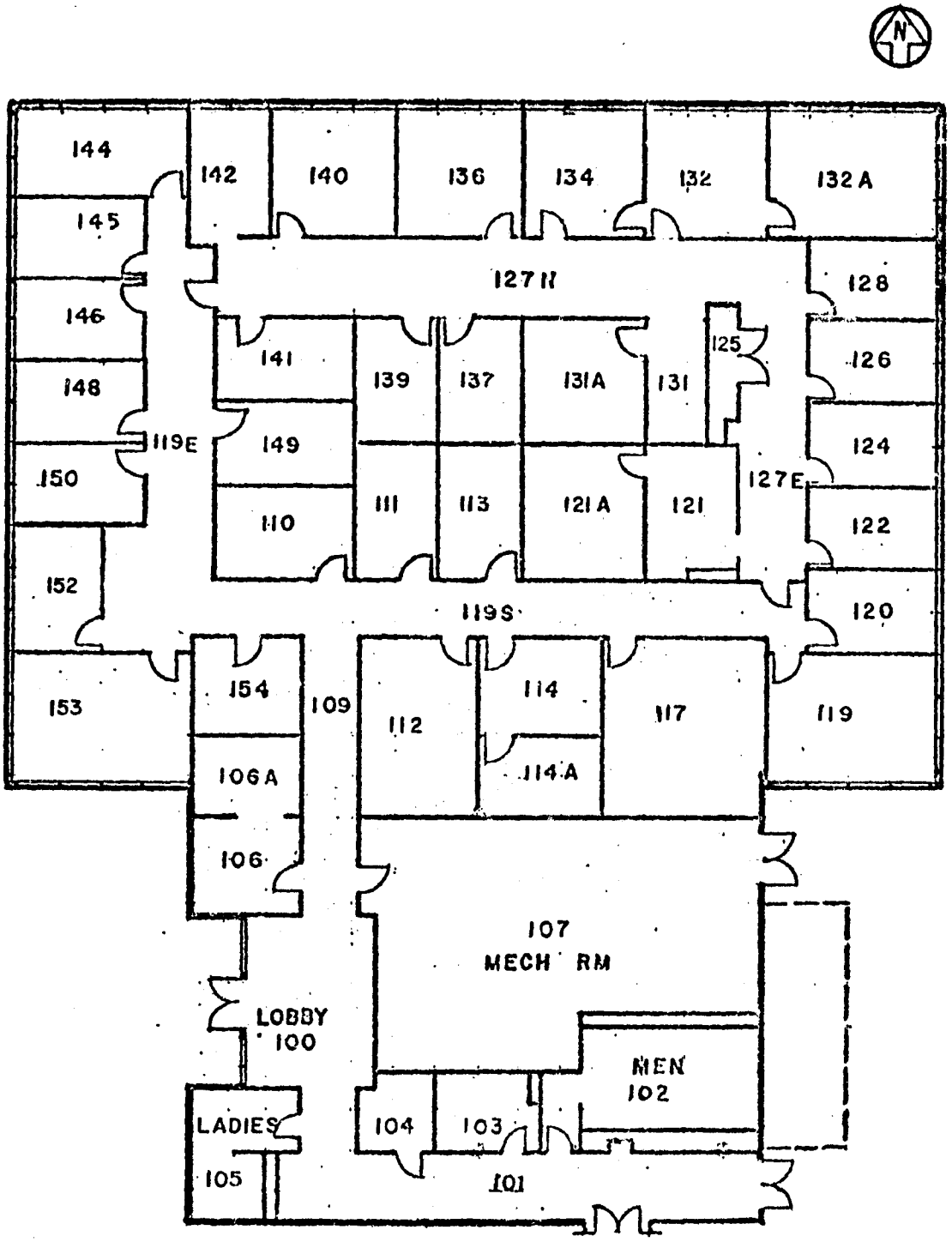

FIGURE 4-2: NORTH WING FLOOR PLAN -- OFFICE AREA BUILDING 36

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The general characteristics of the north wing office area are listed in Table 4-1.

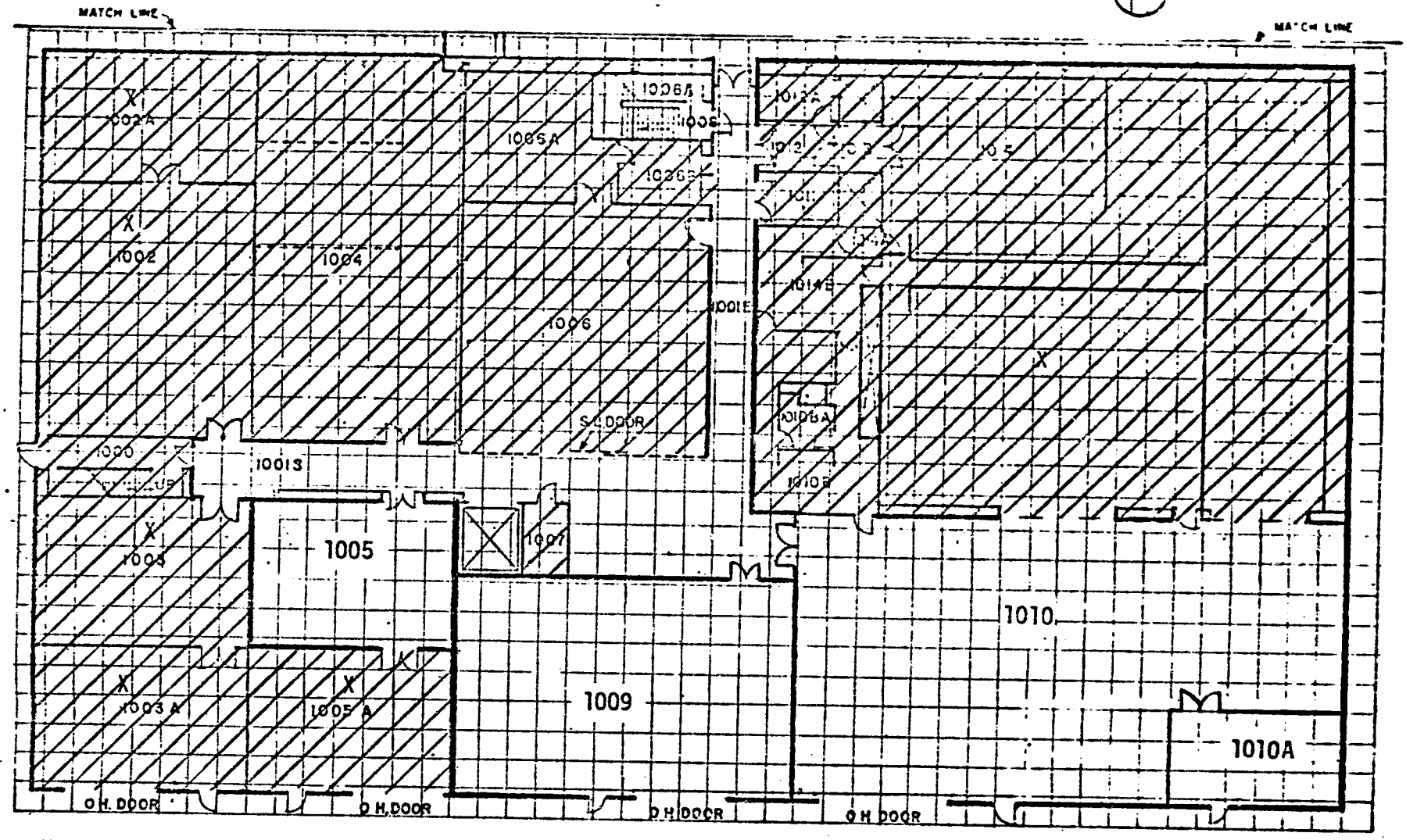
TABLE 4-1

BUILDING 36 OFFICE AREA GENERAL CHARACTERISTICS

	PARAMETER
Number of Offices	36
Office Floor Space	539 m^2 (5800 ft^2)
Office Size (Range)	8.7 - 33.9 m^2 (93 - 365 ft^2)
Office Size (Average)	14.9 m^2 (160 ft^2)
No. Personnel Currently Accommodated	≈55
No. Conference Rooms	1
Conference Room Size	23.7 m^2 (255 ft^2)
Standard Accommodations	Office furniture Elect. Receptacles Telephones Lighting

A compilation of facility physical characteristics and existing utilities on a room-by-room basis (north wing) is provided in Section B, Table B.1, of Reference 10. The information is formatted in chart form and includes floor area, volume, door dimensions and all utility services currently available.

The south wing of Building 36 consists of a three story [≈13.7 m (45 ft high)] structural steel/metal building with laboratory, general purpose shops or office floor plan layouts on a portion of each level. The entire south wing is air-conditioned, equipped with large exterior overhead doors and provides interior utility trenches. A central vacuum system and both single and three phase electrical power are provided. High bay areas extend the full height of the structure; clean room facilities extend to the 9.1 m (30 ft) level. A traveling hoist is located in the high bay area. Figure 4-3 depicts a current floor plan of the first floor



X = Available to LS for future expansion of capabilities

FIGURE 4-3: BUILDING 36 SOUTH WING SMD SUPPORT AREAS -- FIRST FLOOR

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with the non-cross-hatched areas presently available for LSP Building 36 operations.

An overview of the general characteristics of the south wing areas are listed in Table 4-2.

TABLE 4-2

BUILDING 36 SOUTH WING AREA CHARACTERISITCS

First Floor Area	2070 m^2 (22,300 ft^2)
Usable Floor Space (First Floor)	1860 m^2 (20,000 ft^2)
Second Floor Area	1080 m^2 (11,600 ft^2)
Usable Floor Space (Second Floor)	810 m^2 (8,700 ft^2)
Third Floor Area	1020 m^2 (11,000 ft^2)
Usable Floor Space (Third Floor)	490 m^2 (5,300 ft^2)
Office Floor Space	640 m^2 (6,900 ft^2)
Clean Room Floor Area	430 m^2 (4,600 ft^2)
Shop Areas	230 m^2 (2,500 ft^2)
Fabrication/Checkout Areas	450 m^2 (4,800 ft^2)
High Bay Area	330 m^2 (3,600 ft^2)
Usable Area Dedicated to Life Sciences	1040 m^2 (11,200 ft^2)
Total Usable Room Area	3160 m^2 (34,000 ft^2)
Hoist Capacity	9080 kg (10 ton)
Exterior Door Size (w x h)	6.5 m x 9.1 m (21' 4" x 30') 4.6 m x 6.1 m (15' x 20')

4.1.1.1 Spacelab Mission Development Area -- First Floor

A. Area Presently Assigned to Life Sciences (Mid-1976)

The ground level SMD support area encompasses the rooms for which the designation LS appears beneath the room number in Table 4-3. A physical characteristics summarization is provided for each room to establish a baseline level of

TABLE 4-3: Facility Characteristics and Equipment Summary -- Building 36, South Wing, First Floor

ROOM NO.	ROOM NOMENCLATURE	DIMENSIONS M (FT)		MAJOR UTILITIES	SUPPORT EQUIPMENT
		AREA M^2 (FT^2)	HEIGHT M (FT)		
1005 LS	Existing Science Monitoring Areas for LSP Simulations	10.4 x 7.0 (34 x 23)		POWER o 120 VAC, 20A, 60HZ, 1Ø o 208 VAC, 20A, 60HZ, 1Ø OTHER o 7.6cm (3 in.) floor drain o Utility air outlet o Utility trench o Telephone outlets	o Monitoring Consoles o Strip chart recorders o Electrostatic recorders o Tape recorders o Instrument stowage racks o Power supplies o Stowage cabinets o Equip. transport racks
		73 (782)	1.3 (14.0)		
1009 LS	Experiment to rack Integration Area and Experiment Shipping & Receiving	16.5 x 10.7 (54 x 35)		POWER o 120 VAC, 20A o 208 VAC, 20A, 1Ø o 208 VAC, 50A, 3Ø o 200A, 3Ø breaker box OTHER o Utility trench with sump pump o 7.6 cm (3 in) floor drain o Utility air o Telephone outlets o Water outlets (hot/cold)	o Spacelab equipment racks 105.4 and 57.2 cm (41.5 and 22.5 in) o Power distribution units -- rack mounted o Spacelab floor fixtures o Leveling/transport platforms (floor fixtures) o Electronic work benches o Equipment stowage racks 48.3 and 53.3 cm (19 and 21 in) o Equipment stowage cabinets
		176 (1890)	4.1 (44.5)		

TABLE 4-3: Facility Characteristics and Equipment Summary -- Building 36, South Wing, First Floor (Cont'd)

ROOM NO.	ROOM NOMENCLATURE	DIMENSIONS M (FT) AREA M^2 (FT^2)	DIMENSIONS M (FT) HEIGHT M (FT)	MAJOR UTILITIES	SUPPORT EQUIPMENT
1010 LS	Existing Simulation Area and Test/Check-out Laboratory	27.5 x 13.7 (90 x 45)		POWER o 120 VAC, 20A, 60HZ, 1Ø o 120/208 VAC, 20A, 3Ø o 208 VAC, 40A, 1Ø o 28 VAC, 100A, 2 pole o 120/208, 400 HZ, 3Ø OTHER o 10 ton monorail hoist (30' hook height) o Utility trench o Floor drain o Water - Hot/cold 5.1cm (2 in) - Fire system line 10.2 cm (4 in) o Vacuum pump	o Spacelab mockup with raised floor, equipment racks, floor sections, and end cones (2-2.7 meter units) o Orbiter mockup with mid-deck, aft flight deck and all habitability elements o Test monitoring consoles o Magnetic tape recorders o Strip chart recorders o Generalized Data processor system o Electronic equipment racks [48.3 cm (19 in) standard] o Equipment stowage room o DC power supplies o Graphic wattmeter o Miscellaneous electronic pneumatic and personnel support equipment
		333 (3580)	13.6 (44.5)		

TABLE 4-3: Facility Characteristics and Equipment Summary -- Building 36, South Wing, First Floor (Cont'd)

ROOM NO.	ROOM NOMENCLATURE	DIMENSIONS M (FT) AREA M^2 (FT^2)	DIMENSIONS M (FT) HEIGHT M (FT)	MAJOR UTILITIES	SUPPORT EQUIPMENT
1010A LS	Equipment stowage room - small items	8.2 x 4.9 (27 x 16)		POWER o 120 VAC, 20A, 60HZ, 1Ø OTHER o Utility air o Utility trench o Floor drain	o Stowage lockers, shelves and bins
		40 (430)	3.1 (10.0)		
1010B 1010BA 1014B	Clean room personnel preparation area	-	-	o Intercom system o Vacuum line 6.4 cm (2.5 in) o Floor drain o Utility air o Water (hot & cold)	o Stowage lockers o Dressing facilities o Toilet o Washroom
		34 (420)	2.6 (8.5)		
1011	Particle monitoring room (clean room)	4.0 x 2.4 (13 x 7.8)		o Intercom system o Vacuum line 6.4 cm (2.5 in) o Motor starter box 1.5 H.P.	o Electronic equipment stowage racks o Particle monitoring system
		4.7 (50)	3.1 (10.0)		
1012	Vacuum cleaning (clean room equipment)	4.0 x 2.1 (13 x 7.0)		o Equipment airlock to clean room o Vacuum system	NOTE: Airlock is a 2.1 x 2.0 m (7.0 x 6.4 ft) room for equipment transfer -- designated as room 1013
		8.5 (91)	3.1 (10.0)		

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TABLE 4-3: Facility Characteristics and Equipment Summary --.Building 36, South Wing, First Floor (Cont'd.)

ROOM NO.	ROOM NOMENCLATURE	DIMENSIONS M (FT) AREA M^2 (FT^2)	DIMENSIONS M (FT) HEIGHT M (FT)	MAJOR UTILITIES	SUPPORT EQUIPMENT
1012A	Clean room maintenance	4.0 x 2.1 (13 x 7.0)		POWER o 120 VAC, 20A, 60HZ, 1Ø o Motor starter box 7.5 H.P. OTHER o Vacuum line 7.6 cm (3 in) o Shop vacuum cleaner	
		8.5 (91)	3.1 (10.0)		
1014	Clean room facility-100 class	21.4 x 19.8 (70 x 65)		POWER o 120 VAC, 30A, 60HZ, 1Ø o 208/120 VAC, 20A, 3Ø o 208/120 VAC, 400HZ, 3Ø o Intercom system o Particle sensor OTHER o Vacuum lines o Intercom system o Floor drains o Telephone outlets o Vent lines 2.54 cm & 5.08 cm (1 & 2 in) o GN_2 supply lines o GC supply lines	o Environmental control system test stand o Particle count dark room o Work tables, chairs and stools (stainless steel) o Stowage cabinets (glass front and metal) o Equipment transfer containers (portable) o Materials packing stand o Junior partitions o Access scaffolding o Clean room wearing apparel
		423 (4550)	9.2 (30.0)		

simulation support capability. Dimensions of each area, major utilities and support equipment, including mockups/ hardware used in previous simulations, are defined. It should be noted that many of the hardware items and mockups are portable and/or transportable and may be moved between rooms and facilities. Table 4.3 provides only an overview of the characteristics and capabilities of rooms presently assigned to the JSC Life Sciences Directorate. However, the results of a detailed facility floor area and utilities survey is provided in Section C, Table C.1 of Reference 10. A survey of major systems and equipment on the first floor available for LSP simulation support was also conducted. The results of the survey are contained in Section C, Table C.2 of Reference 10. The table contains data relative to equipment nomenclature, manufacturer, model and NASA identification numbers, dimensions and general descriptive information. Usable Life Sciences assigned first floor area contains approximately 622 m^2 (6,700 ft^2).

B. Other First Floor Areas

Areas on the first level of Building 36 not assigned to the Life Sciences Directorate consist of a class 100 clean room, a machine shop facility, and several rooms currently being used primarily for equipment stowage and temporary office space. These areas are shown crosshatched in Figure 4-3. A summary of the clean room accommodations are indicated in Table 4-3 (rooms 1010B through 1014). The areas not assigned to Life Sciences consist of 11 rooms with approximately 1236 m^2 (13,300 ft^2). Rooms 1003A and 1005A contain 4.6 m (15 ft) wide by 6.1 m (20 ft) high exterior doors with a ceiling height of 13.5 m (44.5 ft). The machine shop area contains 139 m^2 (1500 ft^2) in a woven wire enclosure and houses several commercial machine tools including a metal lathe and floor mounted grinders/buffers.

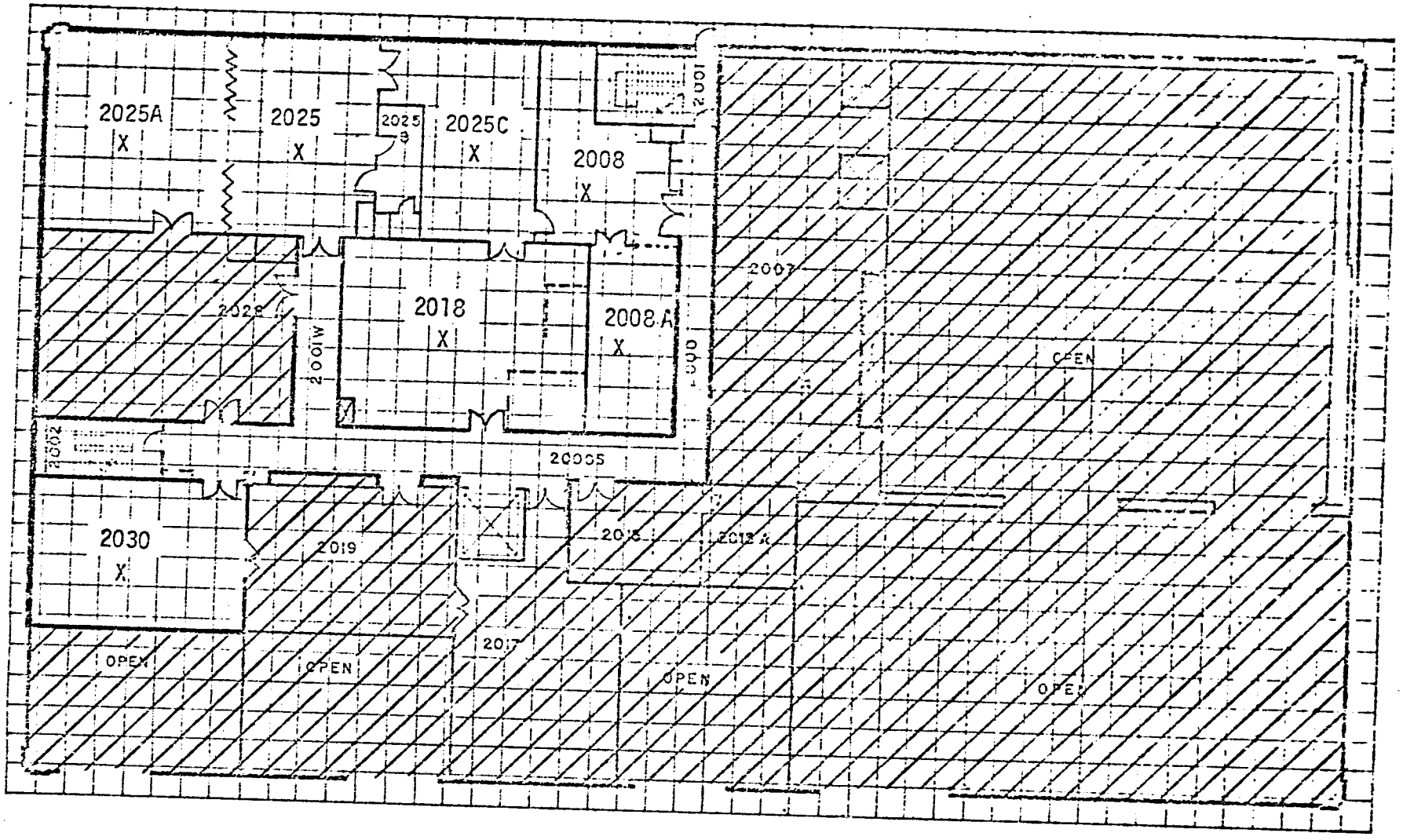
The rooms currently used for stowage are equipped with various utilities including electrical power, phone service, utility air, a welding hood, utility trenches and a fume hood. A set of double doors [i.e., two .9 x 2.1 m (3 x 7 ft)] provide a 1.8 x 2.1 m (6 x 7 ft) entrance into most rooms. The ceiling heights range from 3.0 x 4.3 m (10 to 14 ft). The 3.0 m (10 ft) high rooms have suspended ceilings. All rooms are fully air-conditioned.

A number of miscellaneous, highly portable equipment items are located in various rooms on the first floor south wing of Building 36. The items are described in Section C, Table C.5 of Reference 10. The equipment, however, does not presently appear to be applicable to the Life Science Payload Program.

4.1.1.2 Building 36 -- Second Floor

A. Areas Presently Assigned to Life Sciences

The second level of the SMD support area (Figure 4-4) currently allocated to the Life Sciences Bioengineering Division contains approximately 418 m^2 (4500 ft^2). The area presently supports life sciences instrumentation development, integration and maintenance; equipment/parts stowage; a small workshop facility; engineering offices; and an area containing provisions for 1000 class instrument/hardware cleaning and packaging. The second level is serviced by a freight elevator. A summary of the facility characteristics and major supporting hardware currently available on the second level of Building 36 is provided in Table 4-4. The results of a detailed second floor study of the facilities and equipment (including all areas) is contained in Section C, Table C.3 of Reference 10. A total facility survey was conducted for possible future expansion of JSC Spacelab simulation activities. Major systems and equipment currently available for LSP support are listed in



X = AVAILABLE TO LS

FIGURE 4-4: Building 36 South Wing SMD Support Areas -- Second Floor

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TABLE 4-4: Facility Characteristics and Equipment Summary -- Building 36, South Wing, Second Floor

ROOM NO.	ROOM NOMENCLATURE	DIMENSIONS M (FT)		MAJOR UTILITIES	SUPPORT EQUIPMENT
		AREA M^2 (FT^2)	HEIGHT M (FT)		
2008	Hardware cleaning and packaging	7.0 x 5.5 (23 x 18)		POWER o 120 VAC, 20A, 60HZ, 1Ø OTHER o Floor drain 7.6 cm (3 in) o Water (hot and cold) o Utility air o Telephone outlets	o Laminar flow work bench (2) o Small autoclave o Hardware packaging bench (polyethylene packaging) o Miscellaneous small parts stowage
		39 (414)	4.8 (15.8)		
2008A	Hardware stowage area	4.3 x 8.8 (14 x 29)		POWER o 120 VAC, 20A, 60HZ, 1Ø OTHER o Utility air	o Biomedical and physiological measurement and monitoring equipment o Microscopes o Strip chart recorders o Oscilloscopes o Power supplies o Miscellaneous meters and electronic equipment
		38 (406)	4.3 (14.0)		
2018	Electronic subsystem fabrication and maintenance	12.2 x 8.8 (40 x 29)		POWER o 120 VAC, 20A, 60HZ, 1Ø o 208 VAC, 60HZ, 1Ø OTHER o Utility air	o Electronic work benches o Power supplies o Oscilloscopes o Miscellaneous electronic checkout equipment
		108 (1160)	4.3 (14.0)		

TABLE 4-4: Facility Characteristics and Equipment Summary -- Building 36, South Wing, Second Floor (Cont'd)

ROOM NO.	ROOM NOMENCLATURE	DIMENSIONS M (FT) AREA M^2 (FT^2)	DIMENSIONS M (FT) HEIGHT M (FT)	MAJOR UTILITIES	SUPPORT EQUIPMENT
2025	Equipment assembly room	9.2 x 7.3 (30 x 24)		POWER o 120 VAC, 20A, 60HZ, 1Ø o 208 VAC, 20A, 60HZ, 1Ø OTHER o Floor drain 7.6 cm (3 in) o Water (hot and cold) o Vacuum line and pump	o Elevated electronic floor o Electronic work benches o Strip chart recorders o Stowage lockers and bins o General purpose engraver unit
		67 (720)	4.8 (15.8)		
2025A	Electronic checkout room	9.5 x 8.5 (31 x 28)		POWER o 120 VAC, 20A, 60HZ, 1Ø OTHER o Floor drain o Utility air o Water (hot and cold)	o Elevated electronic floor o Strip chart recorder o Teletype machine o Tape recorders o General purpose work bench o Varian computer o Universal prom programmer o Centronics printout
		81 (868)	4.8 (15.8)		

TABLE 4-4: Facility Characteristics and Equipment Summary -- Building 36, South Wing, Second Floor (Cont'd)

ROOM NO.	ROOM NOMENCLATURE	DIMENSIONS M (FT) AREA M^2 (FT^2)	DIMENSIONS M (FT) HEIGHT M (FT)	MAJOR UTILITIES	SUPPORT EQUIPMENT
2025C	General purpose shop	9.2 x 8.2 (30 x 27)		POWER o 120 VAC, 20A, 60HZ, 1Ø o 208 VAC, 20A, 60HZ, 1Ø OTHER o Floor drain 7.6 cm (3 in) o Utility air o Water (hot and cold)	o Laboratory oven o Residual gas analyzer o Cleaning unit - circulating bath o Flume hood o Electronic work benches o General shop tools
		75 (810)	4.8 (15.8)		
2030	Engineering Offices	10.7 x 7.0 (35 x 23)		POWER o 120 VAC, 20A, 60HZ, 1Ø o 208 VAC, 20A, 60HZ, 1Ø OTHER o Utility air o Telephone outlets	o Office furniture
		75 (805)	4.8 (15.8)		

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Table C.4 of Reference 10. Data relative to equipment nomenclature, manufacturer, model, NASA identification and overall dimensions are provided for the equipment located in areas presently assigned to the JSC Life Sciences Directorate.

B. Other Second Floor Areas

Several areas on the second floor of Building 36 are used to support research activities conducted by the Environmental Effects Project Office, Science and Applications Directorate. Approximately 279 m^2 (3000 ft^2) of the second level are allocated to this project. The area consists of five usable rooms designated as general laboratory and engineering office space. The rooms are equipped with standard utilities including electrical power, phone service, vacuum lines, and utility air. Special laser controls and data cables are located in the laboratory areas. The ceiling heights range from 3.0 x 4.8 m (10 to 15.8 ft) and access is provided by either one or two .9 x 2.1 m (3 x 7 ft) doors. All rooms are fully air-conditioned.

4.1.1.3 Building 36 -- Third Floor

The third level of Building 36, south wing is currently occupied by JSC Science and Applications Directorate personnel with no Life Sciences involvement. However, for long range Spacelab Payload support purposes, the area was surveyed to identify general characteristics and facility utility services available. The area is configured primarily for engineering offices. A third level floor plan is shown in Figure 4-5.

The area contains a total of 1022 m^2 (11,000 ft^2) with approximately 492 m^2 (5,300 ft^2) of usable floor space. Much of third floor is dedicated to utility services support including air-conditioning distribution system and mechanical/structural areas. Standard utilities common to technical offices are provided. The room heights range from 3.0 x 4.8 m (10 to 15.8 ft) and have .9 x 2.1 m (3 x 7 ft) access doors. An overview of the third floor facility characteristics is provided in Table C.6, Section C of Reference 10.

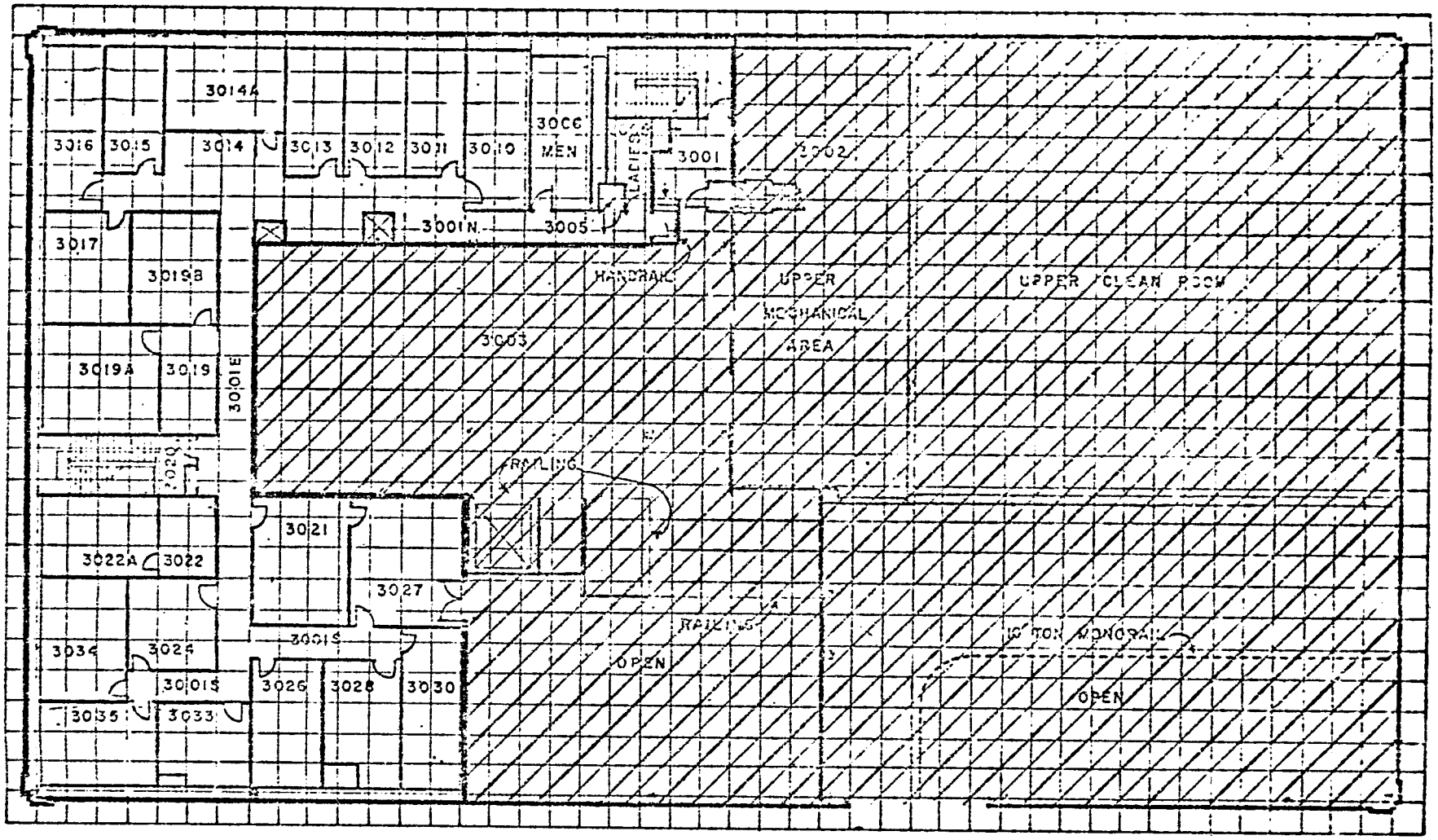

FIGURE 4-5: Building 36 South Wing -- Third Floor

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4.1.2 Building 37 -- Life Sciences Laboratory

The JSC Life Sciences Laboratory, Building 37, will not be utilized as a main line integration facility for Shuttle era LSP programs. The facility laboratories and equipment, however, will be available to support biological and health services disciplines associated with the planned flight programs. The facility construction is a combination of structural steel framing, metal siding and precast aggregate facing. The interior is configured for both laboratories and general offices. The laboratories and offices are located primarily on the ground level with a Life Sciences archival library on the second floor. A gas analysis laboratory is housed on the third level. An underground radiation counting laboratory is also included in the Building 37 complex.

The first floor laboratory and office area contains approximately 4180 m^2 (45,000 ft^2) with 1626 m^2 (17,500 ft^2) allocated to offices and 1997 m^2 (21,500 ft^2) to ten (10) laboratories. The remaining first floor footage [approximately 557 m^2 (6000 ft^2)] is used as computer, conference and rest rooms, and as corridors and reception areas. A floor plan of the first floor (Building 37) office and laboratory area was undergoing interior modification at the time of report preparation; however, the general location of the laboratory areas (mid-1976 JSC planning) are indicated on the floor plan, Figure 4-6.

The second floor of Building 37 contains approximately 1812 m^2 (19,500 ft^2). With the exception of about 297 m^2 (3200 ft^2), the entire second floor is allocated to electrical, mechanical and elevator equipment. The area is accessed/serviced by stairs and a freight elevator. Future plans indicate that the 297 m^2 (3200 ft^2) area will house the Life Science archival library. A floor plan for the second level is shown in Figure 4-7.

The third level of Building 37 contains only the gas analysis laboratory and an open (no floor) overhead crane bay. The gas analysis laboratory consists of a 133 m^2 (1430 ft^2) area containing a complement of analysis equipment. The area is serviced by a stairway and freight elevator.

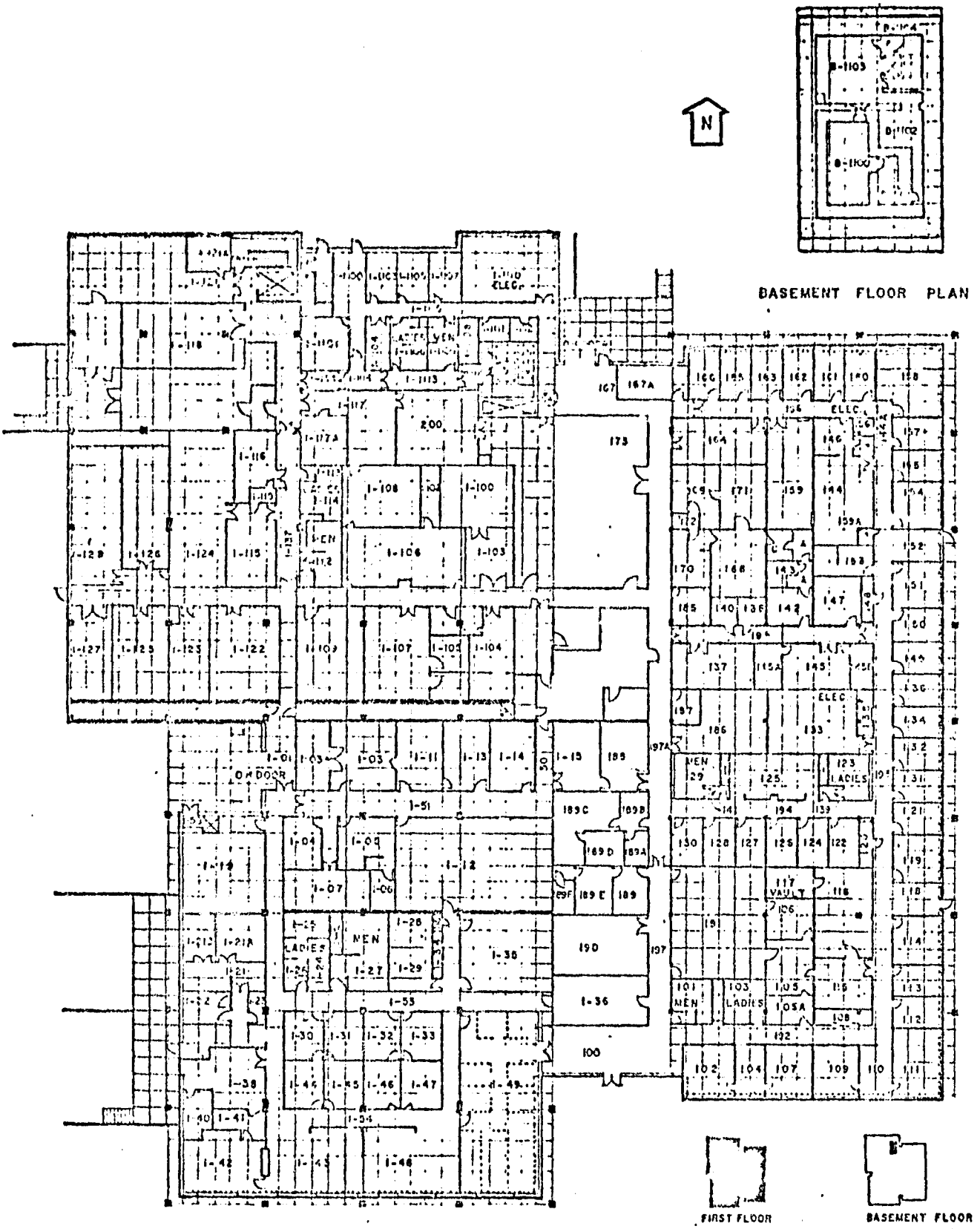

FIGURE 4-6: Building 37 Floor Plan -- First Floor

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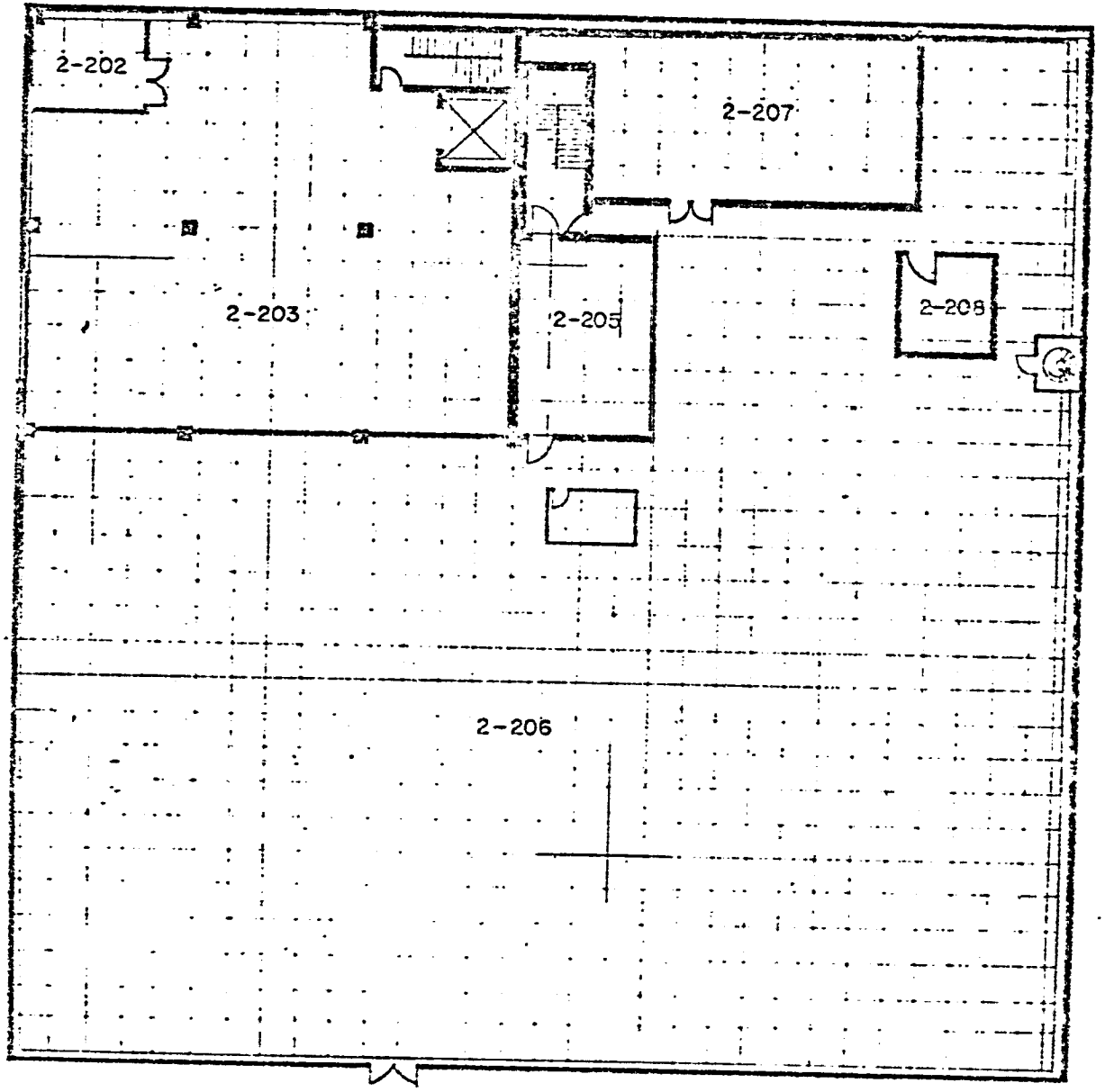

FIGURE 4-7: Building 37 Floor Plan -- Second Floor

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A bilevel tank farm is also contained in the Life Sciences Laboratory Complex. The tank farm is located in an adjoining structure on the north side of Building 37. The first level contains 268 m^2 (2890 ft^2) and houses two holding tanks, one treatment tank and one liquid nitrogen tank. The second level contains 111 m^2 (1190 ft^2) and is primarily a pump room. Table D.1 of Section D in Reference 10 identifies the laboratories and facilities provided in Building 37 including floor dimension and area allocated to each subfacility. A loading ramp (truck freight) is also provided on the north side of Building 37 for cargo handling.

In addition to the specialized dedicated laboratory equipment, a full complement of utilities including electrical power, vacuum sources, natural gas, water and air are sufficiently distributed for laboratory operations. The incoming electrical service is supplied by a 12.47 KV, 3 conductor source and routed via selector switches, transformers and main busses to the appropriate areas. Redundant electrical service is provided for critical applications by a 350 KW emergency generator system.

4.1.3 Building 8 -- Technical Services

The JSC Medical Dispensary is located on the first floor in the east wing of Building 8. (A photographic Technology Laboratory occupies the remaining first floor area). The dispensary health services and associated laboratories will provide general health care services in a supporting capacity to the Life Science Payload programs. The dispensary provides standard medical services ranging from physical examinations through emergency room treatment including cardiac conditions. The facility contains approximately 669 m^2 (7,200 ft^2) of floor space with some 32 rooms allocated to medical laboratories, examination rooms and office areas (areas not cross-hatched in Figure 4-8). Mobile medical units are available for emergency transport to the dispensary and limited local/in-transit treatment. Table 4-5 provides a summary description of the Building 8 medical

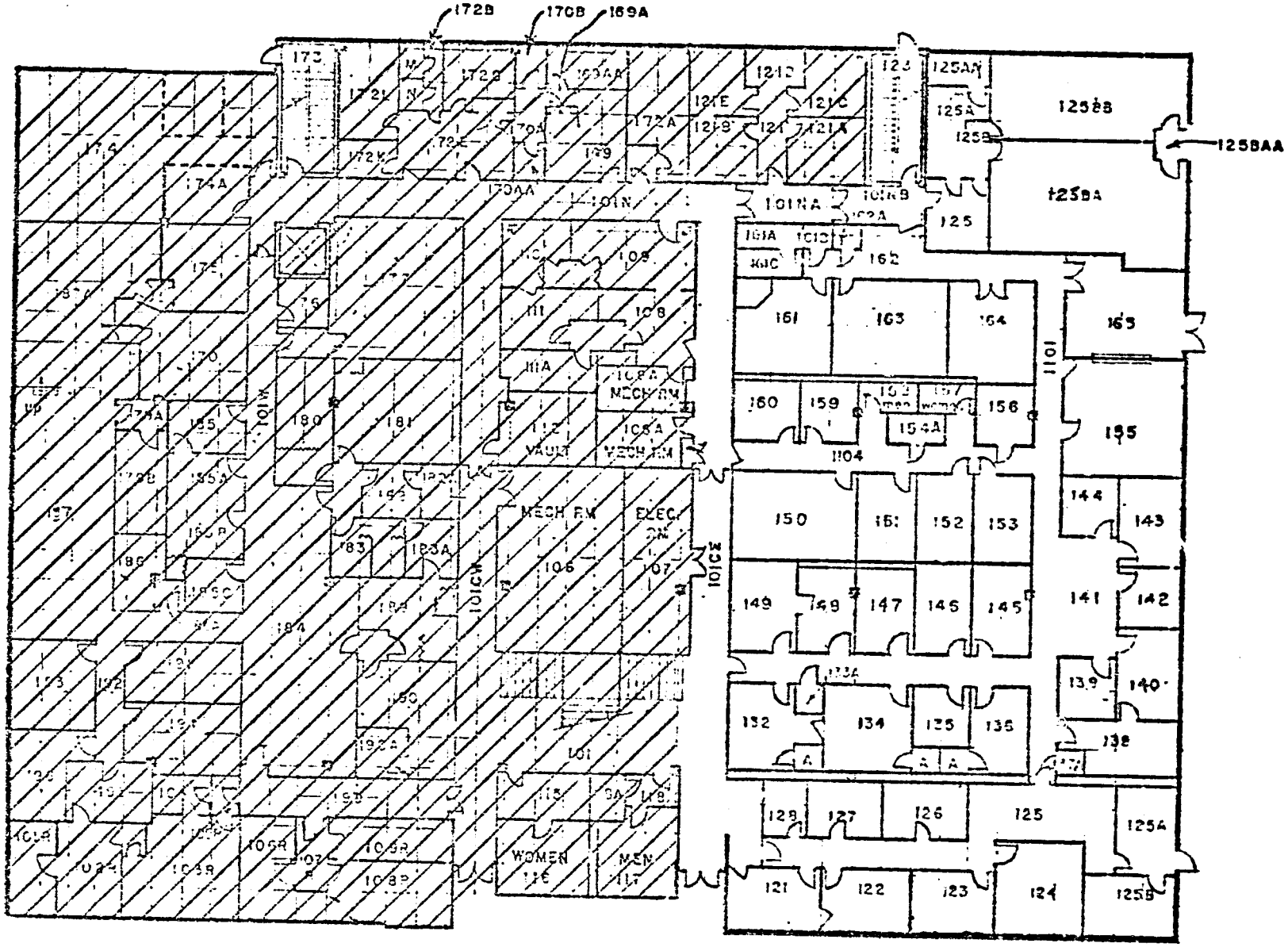

FIGURE 4-8: Building 8 -- JSC Medical Dispensary

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TABLE 4-5: JSC Medical Dispensary Facility Summary

ROOM NO.	NOMENCLATURE	FUNCTION
121	NASA Office	
122	Flight Medicine Nurse Office	maintains medical records, clerical functions, etc.
123	NASA Office	
124	NASA Office	
125	Flight Medicine Secretary/ Reception Areas	secretary's desk, equipment, med. rec. entries, clerical tasks reception, appointments, etc.
126	Flight Medicine Patient Examining Room	medical equipment necessary to accomplish physical examination by physician, provide immunizations, treatments.
127	Flight Medicine Physician's Examining Room	same as above.
128	Flight Medicine Storage	computer CRT and terminal. astronaut medical records
132	Clinic Physician's Examining Room and Office	
134	Clinic Physician's Examining Room and Office	
136	Nursing Station	pharmaceutical supplies, immunization storage, reference books, special diets, nurses make chart entries.
138	Clinic Physician's Examining Room and Office	
139	X-Ray Film Storage	
140	Project Manager's Office	patient consultations, meetings with NASA personnel, administrative details reference library
141	Lobby	waiting area
142	Administrative Office	personnel records, administrative tasks, NASA report-preparation, storage, etc.
143	Secretary & Diagnostic Coding Clerk's Office	secretarial functions including all files. FAA certificate preparation, data report coding.
144	Supply Officer's Office	reference manuals (catalogues). safety glasses issued, supplies ordered.

TABLE 4-5: JSC Medical Dispensary Facility Summary

ROOM NO.	NOMENCLATURE	FUNCTION
145	Chief Nurses Office	patient consultations, administrative tasks, training preparations, report preparation.
146	Treatment Room	physiotherapy, minor office surgery treatment for abrasions, etc. patient observation.
147	Treatment Room	same as above
150	EKG and Pulmonary Function Testing	testing and exercise EKG's (ergometer) and vital capacity testing.
151	Eye Room	visual acuity screening, tonometry, eyewash capability, ear wash. Vertical (adjustable) treatment chair.
152	Supply Storage	medical supplies (including pharmeceutical) and equipment storage.
153	Audio Room	contains two audio booths and recorders used to determine hearing acuity
155	Medical Records Reception/ Storage	contains 7,000+ medical records. form preparation for various examinations. patient check-in point. central telephone call director.
156	Immunization/Nurses Station	initial "drop-in" patient interview and/or treatment. immunizations, allergy and other patient-provided injections and treatments. pharmaceutical supplies and bandages, etc.
159	Equipment Sterilization and Packaging (autoclave). Linen Storage	
160	Clinical Laboratory Drawing Room	sample drawing (blood), hematology.
161	X-Ray	technologist station, all X-rays, including industry related when requested, taken and processed
161A	X-Ray Laboratory/Processing Dark Room	
163	*Clinical Laboratory (scheduled to be moved to Building 37 in mid 1976)	all laboratory work, routine and special, for physical examinations and diagnostic work with the exception of immunology.

TABLE 4-5: JSC Medical Dispensary Facility Summary

ROOM NO.	NOMENCLATURE	FUNCTION
164	Emergency Room	all equipment necessary for treatment of emergency conditions including cardiac. primarily for stabilization of condition until transfer can be made to local hospital.

facility/capability as presently configured for JSC personnel treatment. No substantial changes are needed to support manned aspects of Life Science Space Shuttle experiments and payloads.

Section 5

IMPLEMENTATION OF REQUIREMENTS

Preliminary analyses of implementation possibilities determined that Integration Facility operations may be initiated in a cost effective manner by utilizing some areas in each of the JSC buildings surveyed as described in Section 4. Portions of Buildings 8 and 37 in their present configurations were found to provide accommodations very close to those needed by several of the LSP subfacilities. More extensive efforts were required, however, to determine the preferred arrangements for Building 36.

Two plans providing details of Integration Facility related operations in the Bioengineering and Test Facility (Building 36) are presented in this Section. In addition, details of the manner in which related operations may be conducted in Buildings 8 and 37 are presented. The plans for Buildings 8 and 37 are applicable for use with either of the Building 36 configurations.

The first of the two Building 36 designs illustrates a concept in which the building is shared between Life Sciences and other disciplines utilizing approximately the present floor space allocations. This concept requires that space for PI and contractor office areas, equipment storage, and additional required functions be made available in other JSC facilities, and that these operations be conducted remote from the "on-line" LSP integration and checkout activities.

The second design illustrates a configuration in which as many LSP functions as possible are placed in Building 36. This concept results in reduced transit time between activity sites for personnel, reduced equipment movement, and improved communications. However, this dedicated Integration Facility design does require that Building 36 be used only for operations associated with Life Science Payloads.

5.1 MEDICAL AND LABORATORY SUPPORT

Buildings 8 and 37 will be the primary facilities used to provide medical

and laboratory support to JSC Life Science payload processing operations for either the shared or dedicated mode of Integration Facility operations. Each building is somewhat unique in its capacity to support the specific LSP subfacilities requirements as defined in Section 3.0. The recommended utilization of each of these two facilities is the same for either the shared or dedicated concept and is summarized in paragraphs 5.1.1 and 5.1.2.

5.1.1 Building 8

The major function of the Building 8 Medical Dispensary for the LSP program will consist of support to all experiments involving man-in-the-loop, either as a subject being tested, principal investigator conducting the experiments or scientific observer/passenger. Support will include physical examinations, immunizations, laboratory tests, and diagnostics for obtaining baseline experiment data and for qualifying personnel for Shuttle flight. Extensive medical records will be maintained on all flight personnel. Physiotheraphy, patient observation, and minor treatment of abrasions, burns, etc., occuring to LSP associated personnel during JSC residency will be provided, including emergency treatment of more serious conditions until transfer to a local hospital. It is not anticipated that LSP support operations will interfere with the JSC occupational health functions carried out in the facility, nor will significant equipment or personnel additions be required. No extensive expansion of the floor space presently allocated to medical operations in Building 8 is projected for support of Life Science payloads alone. Some expanded capability may be required, however, to support medical operations of the total Shuttle Program. (Reference Figure 4-9 for a layout of the Building 8 area in which medical operations are conducted, and Table 4-7 for a description of current capabilities.)

5.1.2 Building 37

The JSC Life Sciences Laboratory, Building 37, is equipped to provide LSP subfacility support in the biomedical, physiological, food, toxicology, radiation, bioinstrumentation and health services disciplines. Various laboratories are available for supporting a wide range of both human and lower specimen research, examination, test and treatment. The following complement of facilities/laboratories is located in Building 37:

- Microbiology Laboratory
- Biochemistry Laboratory
- Environmental Physiology Laboratory
- Neuroscience Laboratory
- Cardiopulmonary Laboratory
- Bioinstrumentation Laboratory
- Cardiovascular Laboratory
- Microprocessor Laboratory
- Food and Nutrition Laboratory
- Toxicology Facility
- Gas Analysis Laboratory
- Life Sciences Archival Library

The laboratory facilities will not be totally dedicated to supporting the JSC LSP program. Utilization of the subfacilities and resources will be on a scheduled basis to meet specific experiment requirements and checkout test timelines.

Extensive interior modifications to Building 37 were implemented following the Skylab Program in order to consolidate the above laboratories for the Space Shuttle period. No additional modifications have been identified as required for LSP support by this study. Floor plans and descriptive information for Building 37 may be found in Section 4.1.3 of this report.

5.2 PRIMARY INTEGRATION AND TEST SUPPORT FACILITY.

Building 36 will serve as the primary LSP integration and test support facility at JSC. Portions of the facility were used in early 1976 for conducting a Spacelab mission development test (Spacelab Mission Simulation II). This test involved medium fidelity mockups of the Spacelab core and experiment modules, Orbiter cabin mid deck and aft flight deck, 1-G tunnel assembly, Spacelab equipment racks and associated support hardware. The integration and test areas were not environmentally conditioned to the 100K clean level as required for Shuttle and Spacelab flight payloads; however, the Building 36 south wing proved to be highly compatible with integration and test payload operations. Only relatively minor modifications should be required to configure the facility for flight qualified Spacelab operations.

5.2.1 Clean Room Area

Initially a survey of Building 36 was conducted to identify the resources and capability available in the building for support of the subfacility requirements as specified in Table 3-2, Section 3.2 of this report. The results of this survey were presented in Section 4. Next, an assessment was made of the arrangement of subfacilities within Building 36 which would lead to the most effective payload processing flow. A driving consideration in this assessment was the requirement for final integration operations and integrated preflight checkout tests to be conducted so that flight equipment is maintained in a class 100K clean environment (see Section 1.4.10). An operating arrangement where the entire mock-up was placed in a clean environment was selected over one in which only the interior would be controlled. The decision to place the complete mock-up in a clean environment was made because it allows a lower cost mock-up design, lower cost and more flight-representative thermal control equipment, improved personnel ingress and egress during integration operations, and simplified emergency egress during manned tests.

Primary considerations in the placement of the mock-ups in the clean room area involved: (1) simulataneous clean room utilization for both integration and checkout test operations, (2) minumum facility modifications, (3) utility availability and cable routing, and (4) stationary Orbiter and Spacelab mock-up emplacement to allow permanent utility connections.

A payload configuration representing a maximum length Spacelab arrangememt was considered, along with a shortened 1-G tunnel, for locating the Orbiter/Spacelab mock-ups. Scaled two-dimensional models of equipment were arranged in various configurations to arrive at feasible layouts in the existing clean room. Figures 5-1 through 5-3 depict three representative layouts of the major LSP mock-ups. Each of the arrangements could be accommodated with no modifications to the clean room area. However, considerable difficulty in mock-up reconfiguring, utility routing, and hardware movement was anticipated for these arrangements. Accommodation of Carry-on and Minilab experiments, and payloads of other possible JSC clean room users, would be limited in the existing clean room configuration during LSP Dedicated Laboratory checkout tests as indicated from inspection of the figures.

Figures 5-4 through 5-6 show typical LSP processing area layouts which could

BUILDING 36 SOUTH WING

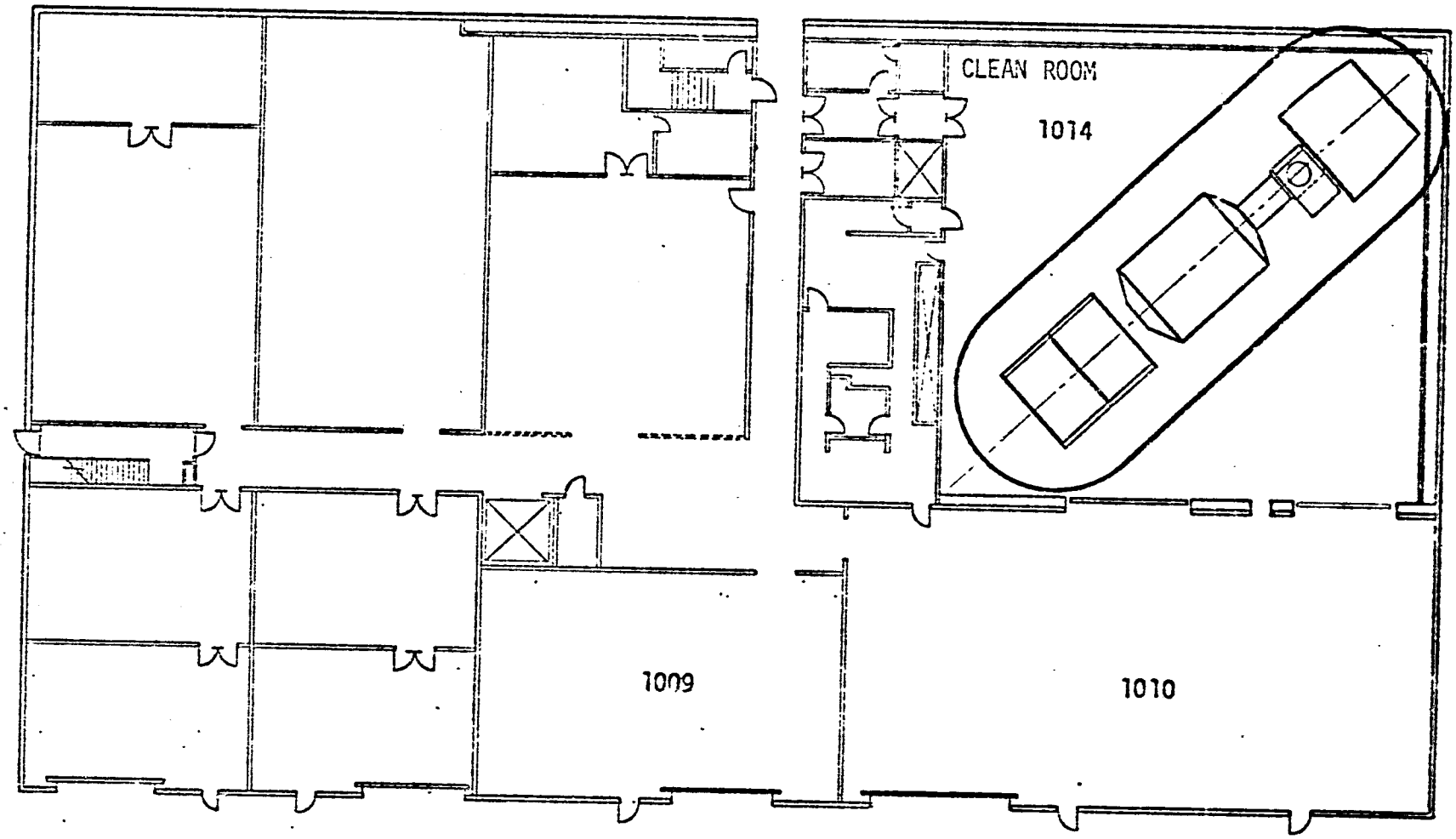

FIGURE 5-1: CLEAN ROOM LAYOUT--CONCEPT NO. 1, DIAGONAL MOCK-UP PLACEMENT (FULL LENGTH PAYLOAD)

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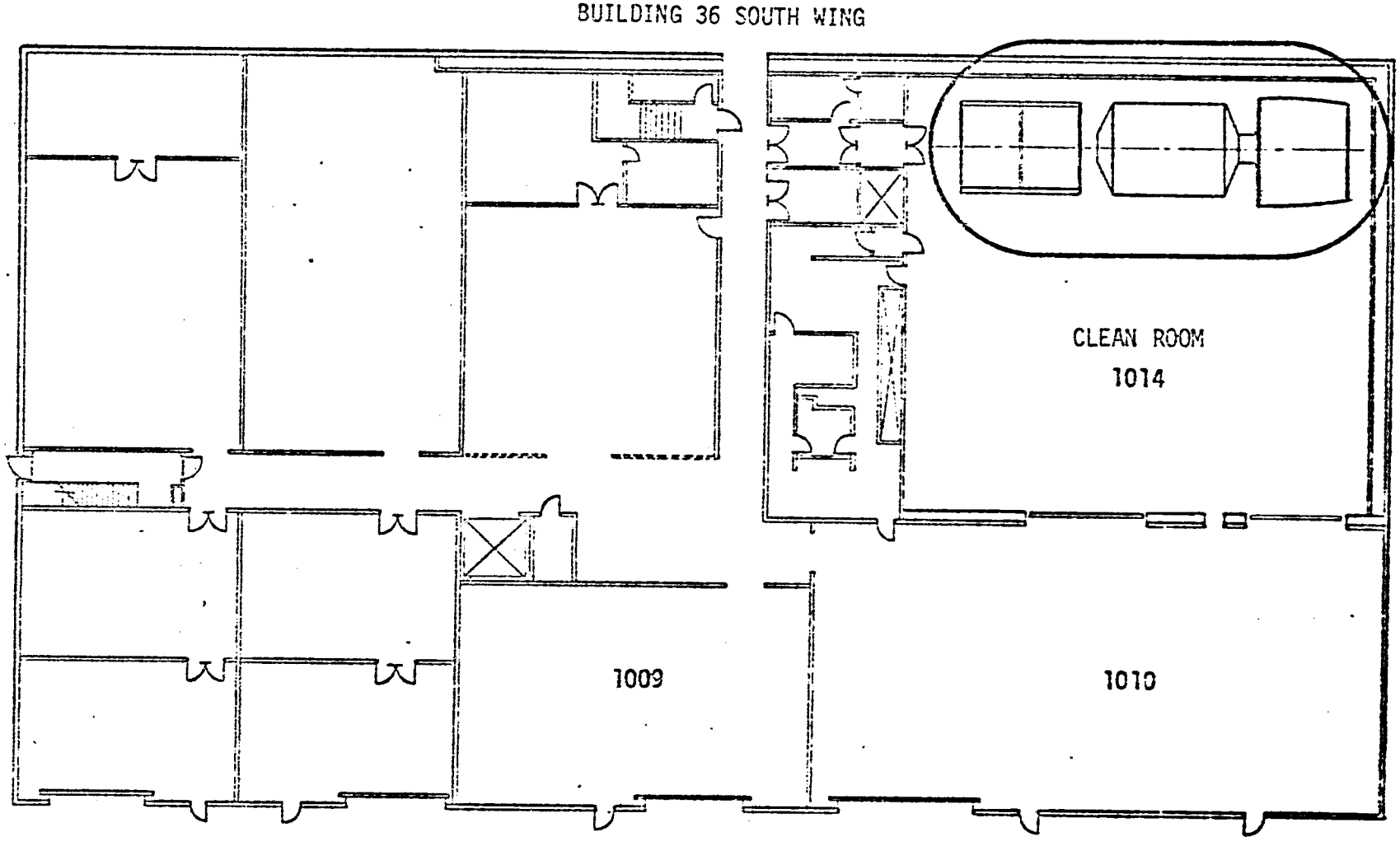

FIGURE 5-2: CLEAN ROOM LAYOUT--CONCEPT NO. 2, MOCK-UP PARALLEL EAST-WEST WITH 3 FT. TUNNEL

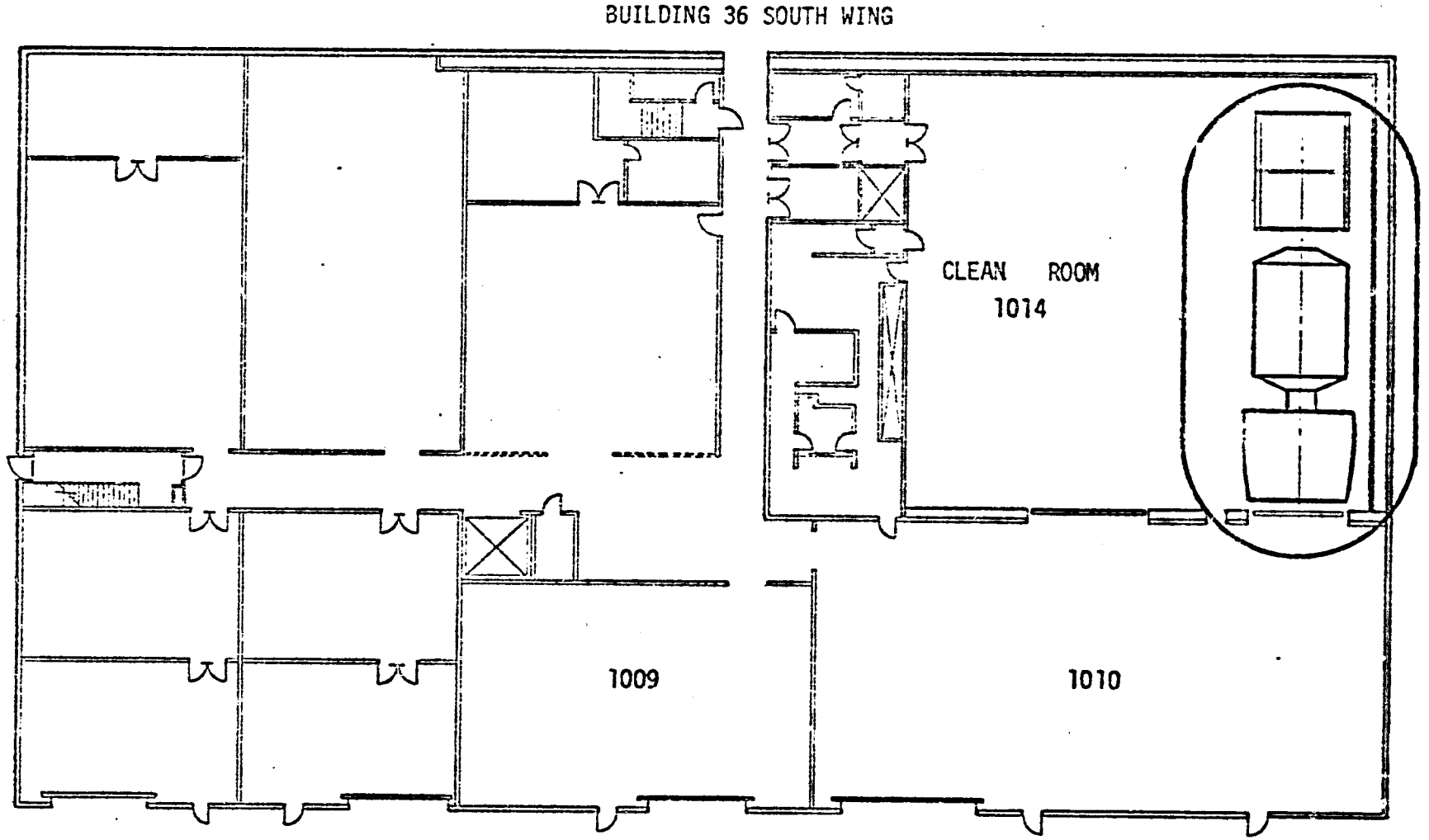

FIGURE 5-3: CLEAN ROOM LAYOUT--CONCEPT NO. 3, MOCK-UP PARALLEL NORTH-SOUTH WITH 3 FT. TUNNEL

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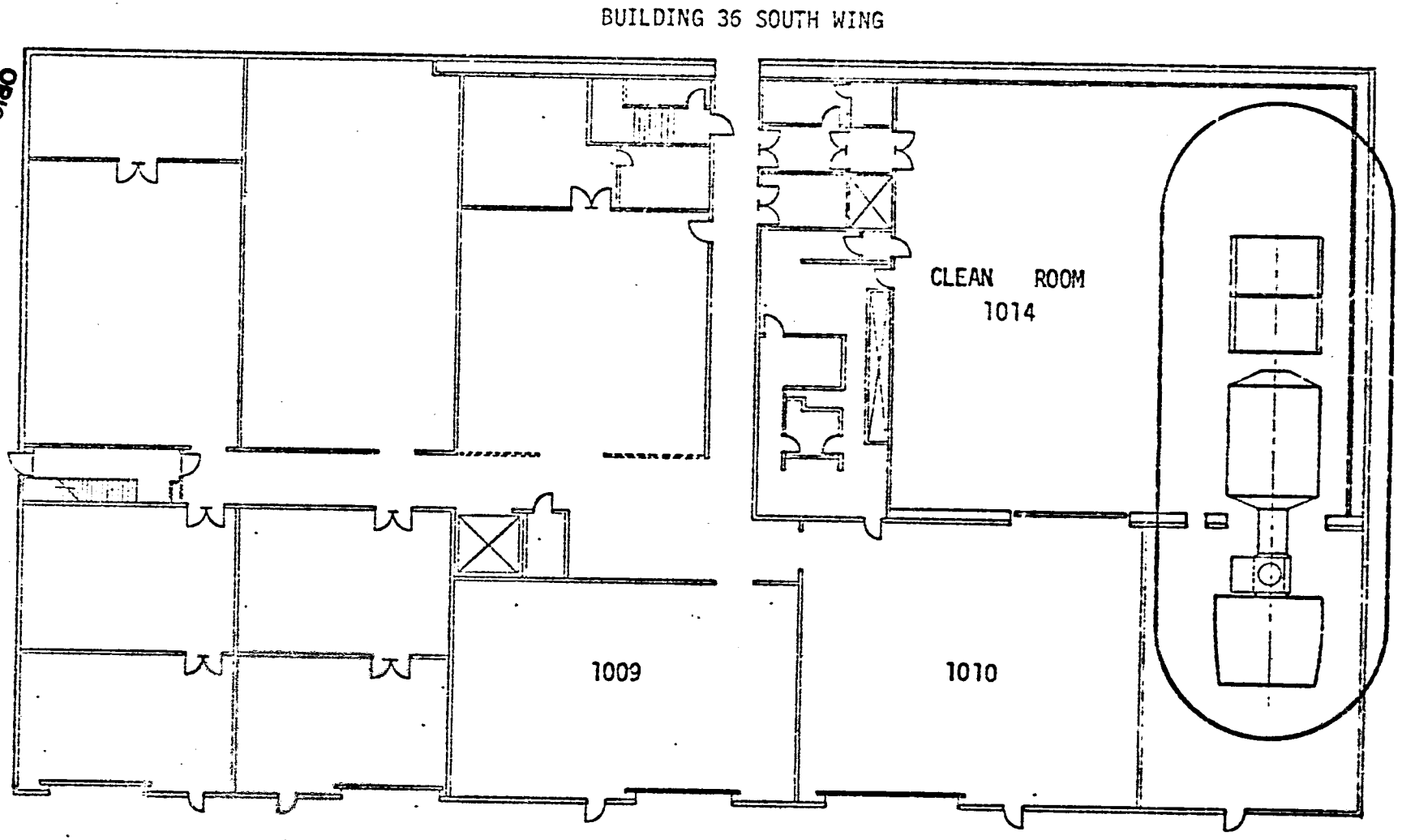

FIGURE 5-4: CLEAN ROOM LAYOUT--CONCEPT NO. 4, TUNNEL IN DOORWAY (MAXIMUM LENGTH CONCEPT)

BUILDING 36 SOUTH WING

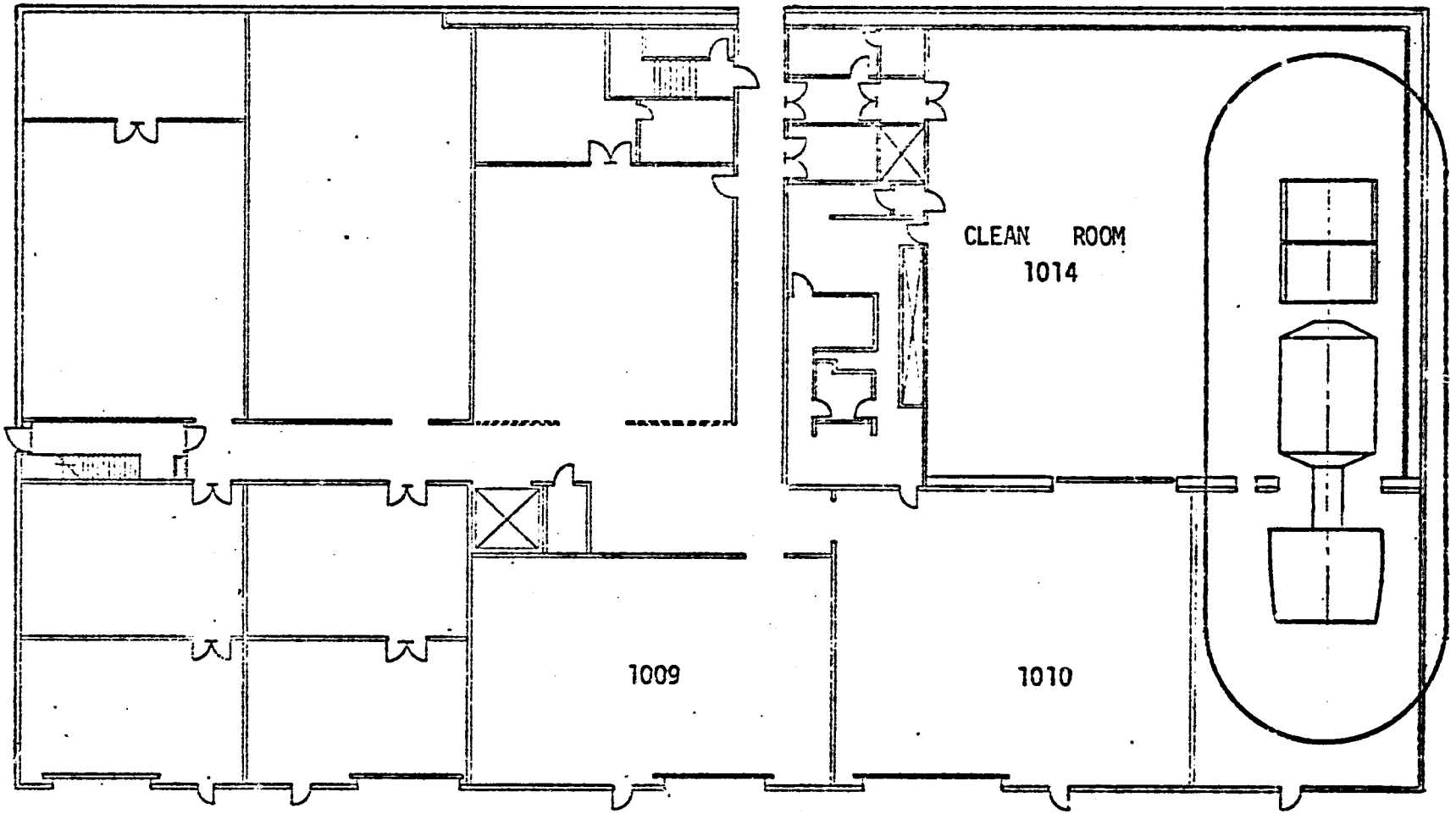

FIGURE 5-5: CLEAN ROOM LAYOUT--CONCEPT NO. 5, 1-G 72 IN. MODIFIED TUNNEL IN DOORWAY

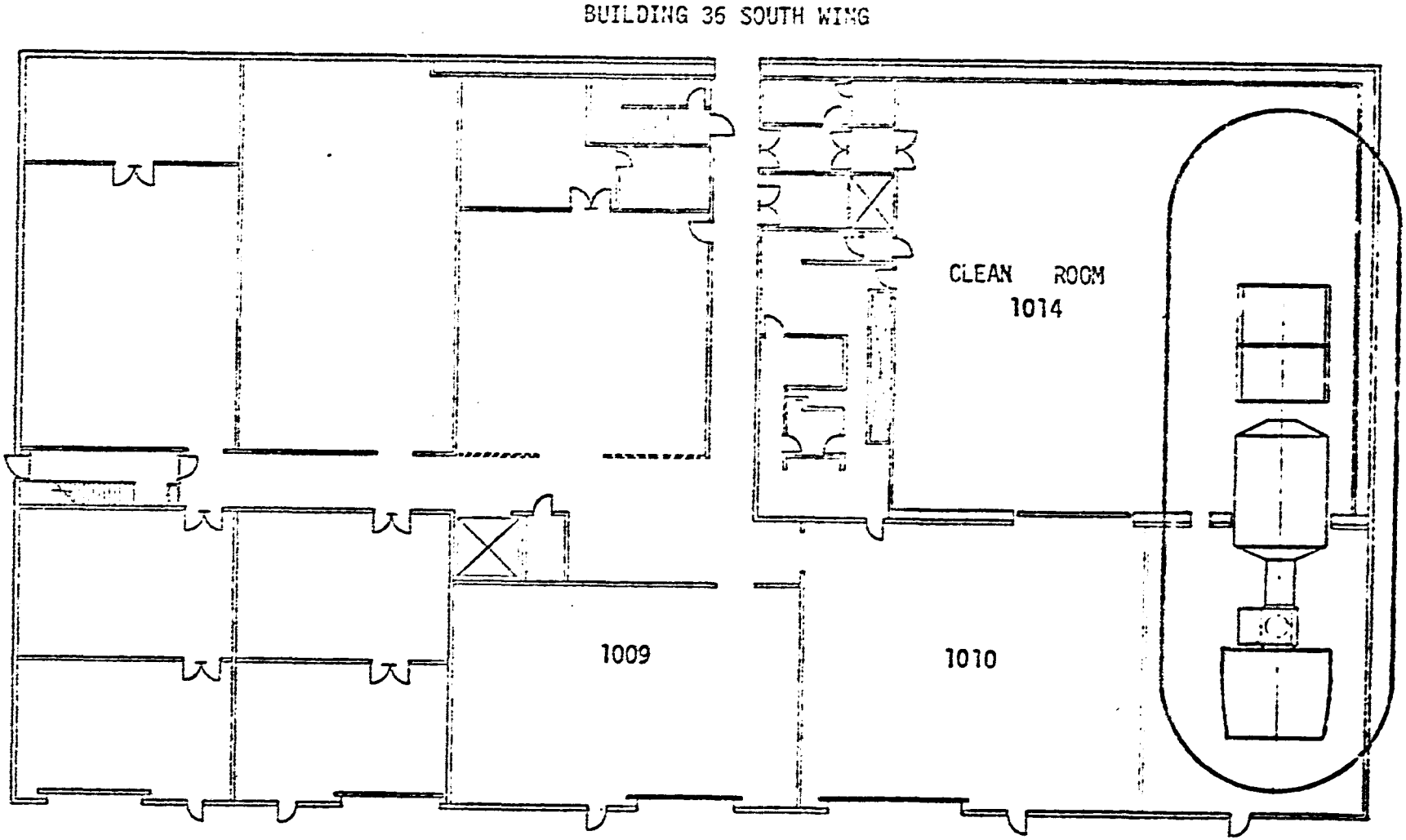

FIGURE 5-6: CLEAN ROOM LAYOUT-CONCEPT NO. 6, SPACELAB IN DOORWAY

accommodate either shared or dedicated operations in a modified clean room facility. The clean room is extended into a portion of Room 1010 to house the Orbiter cabin mock-up, tunnel and miscellaneous LSP support equipment. By removing the existing sliding door, the Spacelab tunnel or the Spacelab mock-up can be located in the doorway, thereby allowing adequate room in the original clean room area for additional activities. In the above configurations all cabling and utilities can be routed between the mock-ups and the doorway near the floor. An existing 0.9 x 2.1 m (3 x 7 ft) doorway allows personnel access to the Orbiter mock-up and test support equipment located in the clean room addition. A 1.8×10^3 Kg (two-ton) capacity monorail hoist allows equipment items to be lifted over the top of the mock-up for placement into the area in front of it. The hoist also allows aft flight deck equipment to be installed easily into the Orbiter mock-up if an access hatch is provided on top of the mock-up. Individual equipment items may be installed into and removed from the Spacelab mock-up in this manner if a top hatch is provided.

The layout shown in Figure 5-5 provides the most workable configuration relative to utility/hardline service, maintenance access and payload/experiment integration. The layout allows the mock-ups to remain stationary for all Life Sciences payload arrangements and for changeout of Spacelab components without disrupting other clean room activities. The layout assumes the use of dollies upon which integration activities occur. (Dolly wheel selection must be compatible with the existing clean room floor grid.) Integrated rack and floor sets are transferred from the dollies onto integration GSE mounted on a short set of alignment rails. The components are then moved into the Spacelab mock-up with the aid of a rack and floor set installation and removal GSE kit.

5.2.2 Shared Facility Layout

In the shared Integration Facility concept areas and equipment in Building 36 may be used jointly for operations related to Life Science payloads as well as for compatible payload operations of one or more other disciplines. The arrangement presented in this subsection limits Life Sciences operations to portions of the first two floors in Building 36, and with this concept several LSP functions must be located in other JSC buildings. Specific buildings needed and the availability of the necessary areas within these

buildings have not yet been determined. The shared facility concept allocates approximately 1580 m^2 (17,000 ft^2) within Building 36 for Life Science functions, housing only the mandatory payload integration/checkout operations and directly supporting equipment. It was assumed in the development of this concept that no portion of the third floor of Building 36 would be utilized by Life Sciences. LSP subfacilities were combined wherever possible in the formulation of layouts for this concept, and the resulting payload processing facility will require precise coordination and scheduling of activities to support the full operational era traffic model.

The floor plans shown in Figures 5-7 and 5-8 depict the suggested layout of a fully operational shared payload processing area based on usage projected from the Dunning Life Sciences Traffic Model. Circled numbers on the figures refer to required modifications to the facility as described in Table 5-1.

Shared Facility, Building 36, First Floor Shipping and receiving areas for this configuration are located in rooms with cargo doors to facilitate equipment movement into the facility. Individual racks, experiments and equipment will be removed from over-the-road transport vehicles and placed on in-building GSE transport dollies for movement through the cargo doors to receiving, inspection, storage and processing areas (reference Figure 5-7). Two truck loading pits are located adjacent to the shipping and receiving area to allow most items arriving by truck to be unloaded manually or with the aid of forklifts.

Complete rack and floor sets and other larger items arriving at the facility by truck (either from a nearby airfield of from over-the-road transport) will be handled in a different manner. Gross external contamination will be removed from the containers and transport vehicles outside the facility. The doors from Room 1010 to the clean room will be operationally held closed, and the exterior cargo door to Room 1010 will be opened. The shipment will be backed into Room 1010 and lifted off the transporter by the 18×10^3 Kg (20-ton) overhead crane. The transport vehicle will then pull out of the building and the cargo door will be closed. The shipment will remain inside the sealed shipping container until the environment in Room 1010 can be returned to the class 100K level. The canister may then be opened, and the cargo lifted out of its container and positioned on an in-building GSE transport dolly. The dolly may then be moved into the clean room, either by hand or

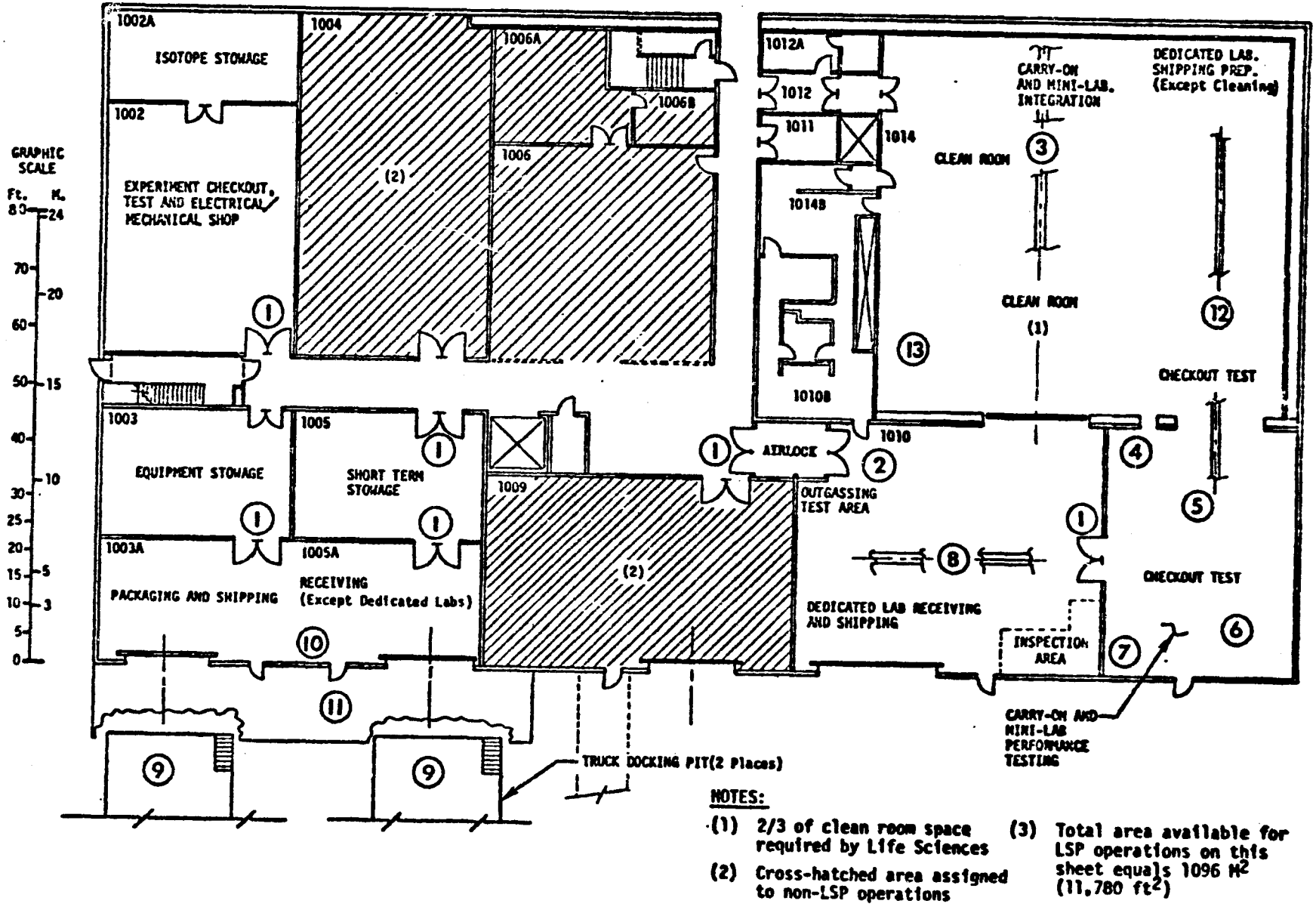

FIGURE 5-7: LIFE SCIENCES FACILITY LAYOUT, SHARED FACILITY OPERATIONS BUILDING 36, SOUTH WING, FIRST LEVEL

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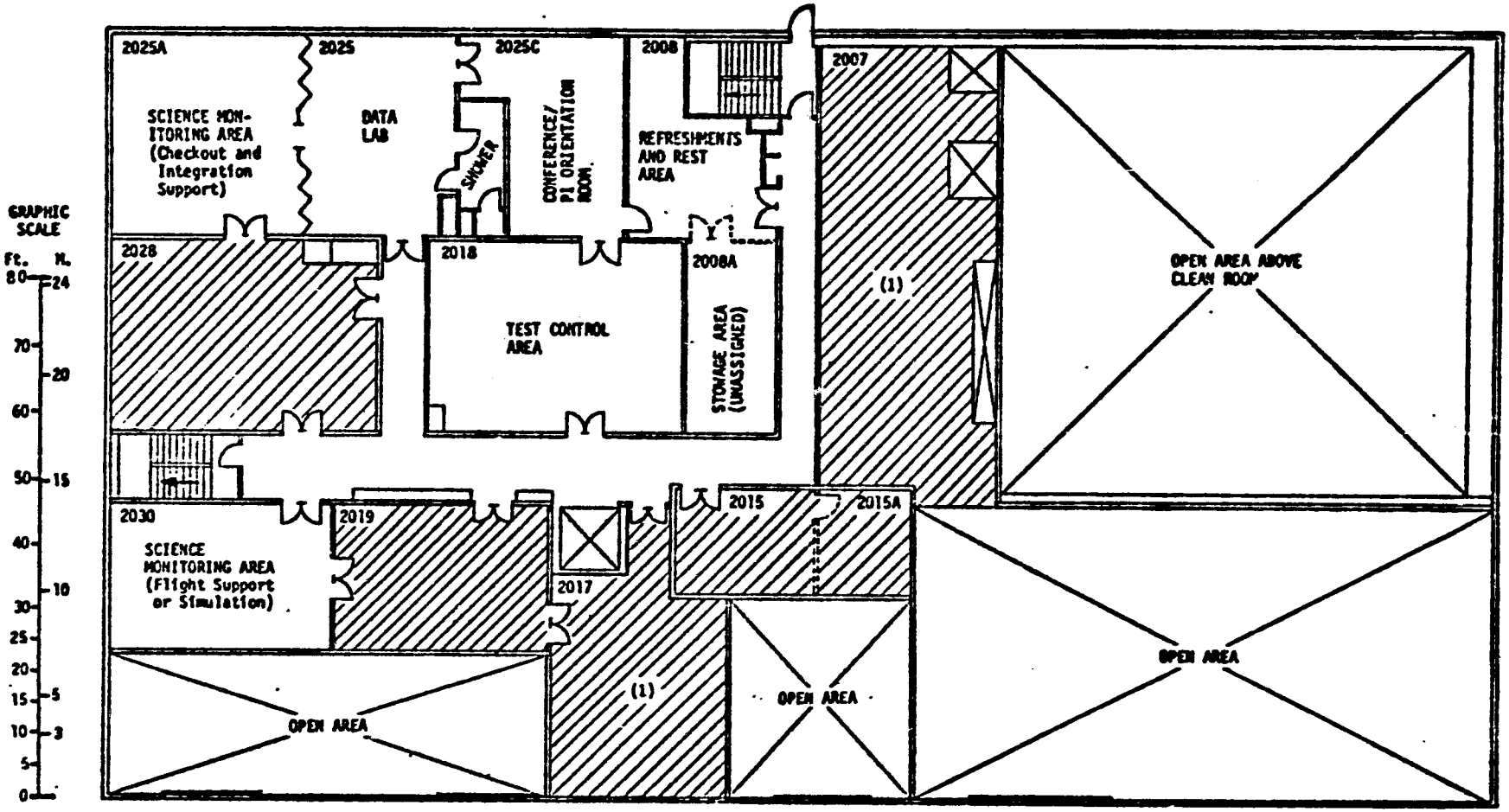

NOTES:

(1) Cross-hatched areas assigned to non-LSP operations

(2) Total area available for LSP operations on this sheet equals 486 M^2 (5,230 ft^2)

FIGURE 5-8: LIFE SCIENCES FACILITY LAYOUT, SHARED FACILITY OPERATIONS BUILDING 36, SOUTH WING, SECOND LEVEL

TABLE 5-1

DESCRIPTION OF FACILITY MODIFICATIONS

IDENTIFICATION CODING	DESCRIPTION
1	Remove existing doors and install 3.0 m (188 in.) high by 2.4 m (96 in.) wide (double) doors to allow inbuilding transport of racks on GSE carts.
2	Relocate existing entranceway to corridor walk, fabricate 3.66 m (12.0 ft) by 2.99 m (9.8 ft) airlock and install second 3.0 x 2.4 m (118 x 96 in.) door to maintain cleanliness during personnel and small equipment item ingress/egress.
3	Install 9 x 10^3 Kg (10 ton) traveling crane full length (north-south) of clean room. It is anticipated that the existing crane mechanism controls and trackage in room 1010 could be utilized. Facility drawings indicate that the building structure will be able to support the crane loads. 7.6 m (25 ft) hook height required.
4	Extend slideing door track structure/mechanism on west side of large door opening; remove smaller (east) sliding door. Door may be stowed for possible future reinstallation.
5	Install ceiling and interior wall surfaces to maintain 100K clean room level.
6	Remove existing room 1010A walls and ceiling.
7	Install wall at designated location and finish both sides to maintain 100K class clean level. Install ductwork and blowers to connect room 1010 and mock-up areas to clean room air filtration system.
8	Replace existing 9 x 10^3 Kg (10 ton) traveling crane with 18 x 10^3 Kg (20 ton) unit. Hook height of 9.2 m (30 ft) required.
9	Install two truck docking pits including safety rails for cargo handling.
10	Remove existing wall between rooms 1003A and 1005A (between 1009 and 1005A for dedicated facility configuration).
11	Install 38.1 m (125 ft) long 4.0 m (13 ft) canopy over loading area.
12	Install 1.8 x 10^3 Kg (2 ton) traveling crane full length of Spacelab mock-up area [approx. 35 m (115 ft)]. Hook height 6.7 m (22 ft) required.
13	Refurbish/reactivate Building 36 clean room.

NOTE: The above list includes only the top level modifications required in each subfacility. Alternate routing of electrical utilities, minor structural modifications, air-conditioning ductwork relocation, suspended ceiling changes, etc., will be required at various locations dependent on the final facility design. All modifications will require detailed designs prior to execution.

with the aid of an electric powered tow motor through the large clean room cargo door.

In the layout indicated in Figure 5-7 storage areas are provided adjacent to receiving and shipping areas for short term holding of smaller items. A small electrical and mechanical shop is located in Room 1002 for experiment trouble shooting and repair, and also includes floor space which is usable for experiment checkout testing. A controlled storage area with provisions for isotope storage and with equipment needed for personnel protection, radiation surveys, and clean up of minor spills is located in Room 1002A.

A layout of the clean room area in which most final integration and check-out test activities will be accomplished is indicated in Figure 5-9. Life Science processing will require approximately 2/3 of the clean room area during shared operations. Figure 5-9 also shows an added non-load bearing partition across Room 1010. This wall, in conjunction with ducts added to the clean room air handling system, allows the clean room area to be increased without major building structural changes.

The LSP supporting subfacilities which would be located in other areas if the shared facility concept is implemented include: (1) facility maintenance, (2) flammability testing and (3) portions of experiment development, shipping, receiving, storage and PI offices. Floor space requirements for these remotely located areas have been defined (see Table 3-2), but the preparation of area layouts has been deferred until available space within specific buildings is designated.

Shared Facility, Building 36, Second Floor

As shown in Figure 5-8, approximately 486 m^2 (5,230 ft^2) of the 810 m^2 (8,700 ft^2) of usable area on the second floor of Building 36 will be needed for LSP operations with the shared facility concept. This area will house the test control areas for checkout tests conducted in the first floor clean room, the LSP data lab, and two science monitoring areas for support of tests and actual flights. As personnel will be on duty around the clock in the area in support of LSP flights and tests, an area was set aside in the layout for placement of several snack and refreshment vending machines. A conference room/PI briefing area is also located on this floor. The lack

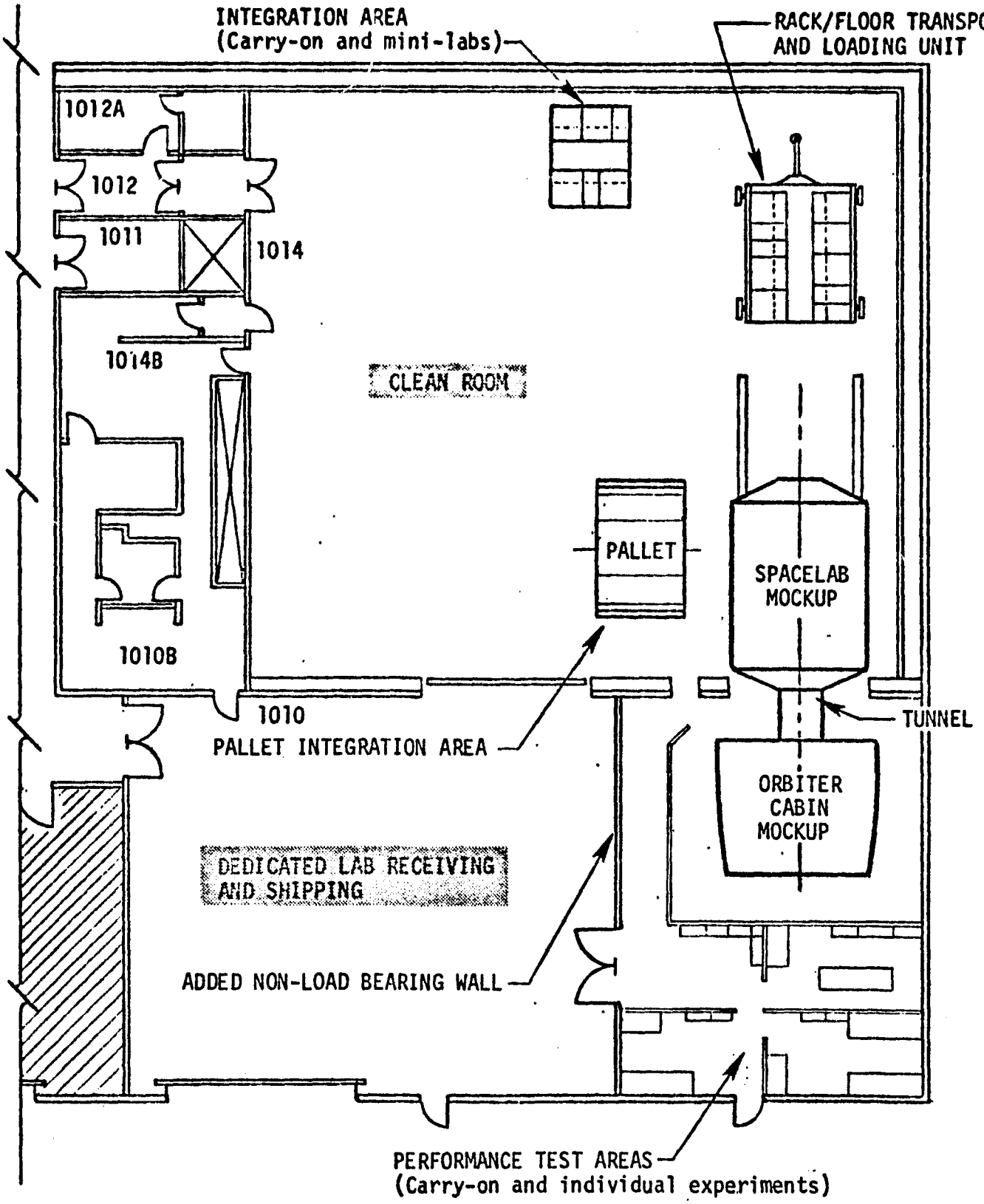

FIGURE 5-9: CONCEPTUAL LAYOUT OF LIFE SCIENCES PAYLOAD CHECKOUT TEST AREA, SHARED FACILITY OPERATIONS

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of rest room facilities on this floor was considered to be a minor disadvantage but one which was overshadowed by the operational advantages gained by the second floor control room, monitoring area, and data lab placement.

5.2.3 Dedicated Facility Layout

Payload processing tasks within Building 36 include those mentioned in Section 5.2.2, plus additional activities which are relegated to remote areas in the shared Integration Facility concept. The dedicated Integration Facility concept described in the following paragraphs provides a "full-up" capability for supporting all currently defined JSC LSP operations. The three levels of the Building 36 south wing contain approximately 3160 m^2 (34,000 ft^2) of usable floor area and can meet most JSC Life Science payload integration and testing requirements based on the Dunning traffic model (Reference 6). As in the shared facility concept, the one story 960 m^2 (10,300 ft^2) north wing of the building would be used primarily to provide office space for NASA personnel. The central Building 36 location contains all subfacilities required for LSP processing within the dedicated Integration Facility concept, with the exception of the general purpose laboratories currently existing in Building 37, and a portion of the LSP associated storage areas.

Dedicated Facility, Building 36, First Floor

The subfacility floor plan shown in Figures 5-10 through 5-12 depicts the suggested layout for a fully operational LSP Integration Facility based in Building 36. The payload/experiment receiving, packaging and shipping areas are located in rooms with existing cargo doors for obvious logistics advantage. The facility maintenance area is also located in an area with a cargo door. Facility and experiment equipment stowage areas are located adjacent to rooms containing cargo doors and are connected by large double doors to facilitate hardware transport and handling. Two truck loading pits are located adjacent to the shipping and receiving area to allow most items arriving by truck to be moved into the building with the aid of forklifts. Individual racks, experiments, and equipment items will then be placed on in-building GSE transport dollies (still with protective shipping covers intact) and moved to storage or clean room processing areas. Complete rack and floor sets and other larger items arriving at the facility

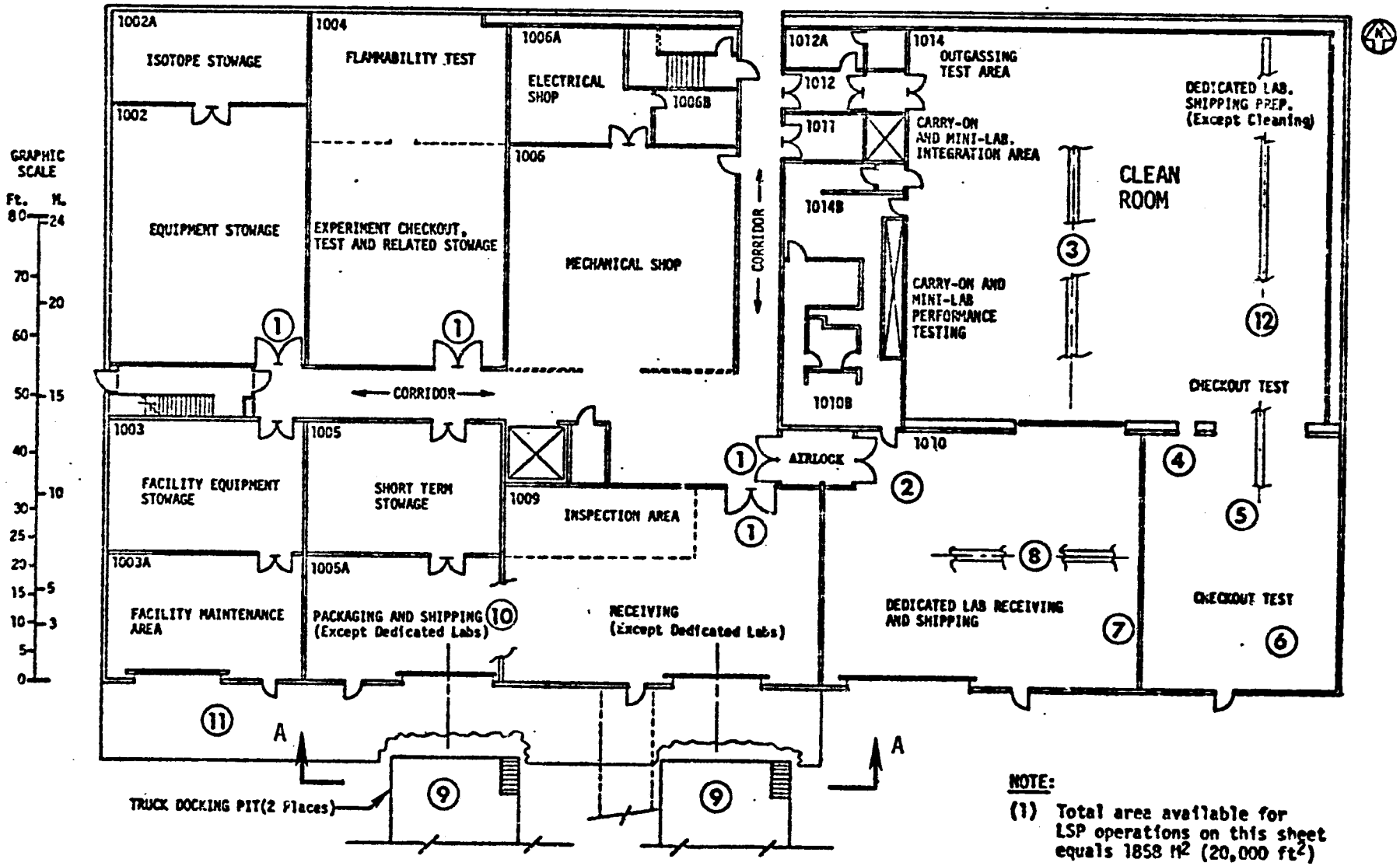

FIGURE 5-10: LIFE SCIENCES FACILITY LAYOUT, DEDICATED PROCESSING FACILITY, BUILDING 36, SOUTH WING, FIRST LEVEL

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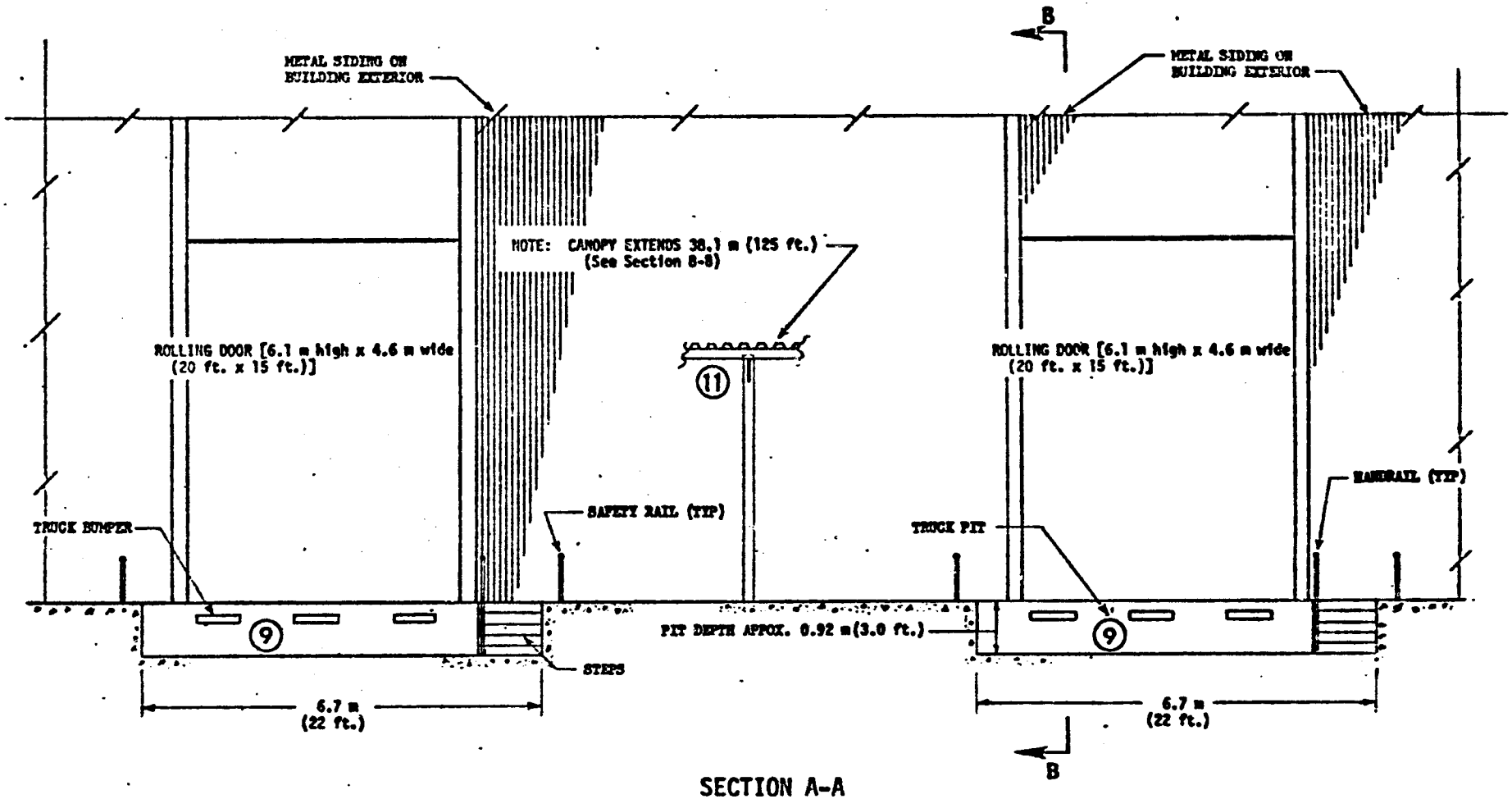
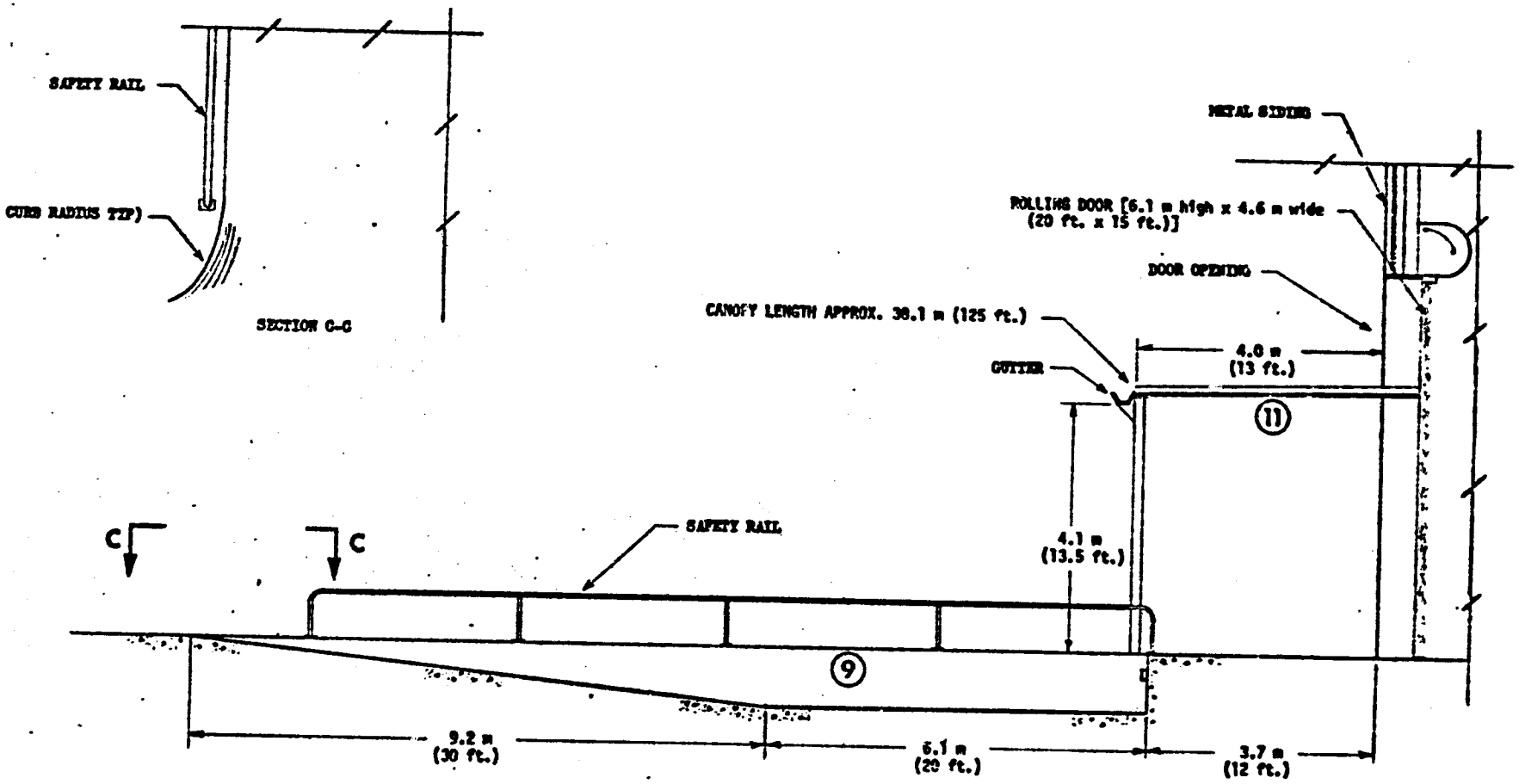


SECTION A-A

FIGURE 5-11: LIFE SCIENCES FACILITY LAYOUT, DEDICATED PROCESSING FACILITY, BUILDING 36, SOUTH WING, FIRST LEVEL



SECTION B-B

FIGURE 5-12: LIFE SCIENCES FACILITY LAYOUT, DEDICATED PROCESSING FACILITY, BUILDING 36, SOUTH WING, FIRST LEVEL

will be handled in a fashion similar to that described for the shared facility concept.

An experiment checkout and test subfacility is located in the immediate vicinity of the clean room area which permits intra-facility manual handling of most items of LS equipment. A flammability test area is provided within the non-clean room portion of the experiment checkout and test subfacility and is separated by a junior partition. Isotope stowage is provided in Room 1002A which is removed from the LSP primary traffic routes.

The mechanical shop remains in an area originally designed as a shop facility and contains basic workshop tools and metal working machines. The shop will remain enclosed by a woven wire barrier and tools added as required to support LSP operations. An electrical/electronic shop is located directly behind the mechanical shop area.

The north wing of Building 36 was originally designed to provide engineering, administrative and secretarial accommodations for NASA personnel and will remain in this configuration for Shuttle LSP activities. Some office space for Life Sciences experiment PI's may be available in the north wing; however, the majority of PI accommodations will be located on the second and third levels of the south wing.

The south wing first level LSP subfacility layout attempts to economically use existing resources to accomplish JSC Life Sciences integration/test requirements through the 1991 time period. By initially configuring the support facility to identified long range requirements (rather than partial short term support) operational shutdowns can be minized during critical program phases. In addition to the total LSP integration and checkout test subfacility, all major operations requiring payload/experiment handling, modification and stowage are located on the first level of Building 36 to avoid equipment handling by elevator. Several of the rooms designated as LSP subfacilities in Figure 5-10 are not currently assigned to the JSC Life Sciences Directorate. However, many of the rooms are presently being used for stowage of Apollo and Skylab inactive equipment, were deactivated, or are being used as JSC co-op employee offices. It should be noted that the 100 class clean room is inactive and reactivation time for return to its most recent operating configuration has been estimated at approximately six months. A longer period will be required to implement the changes to the

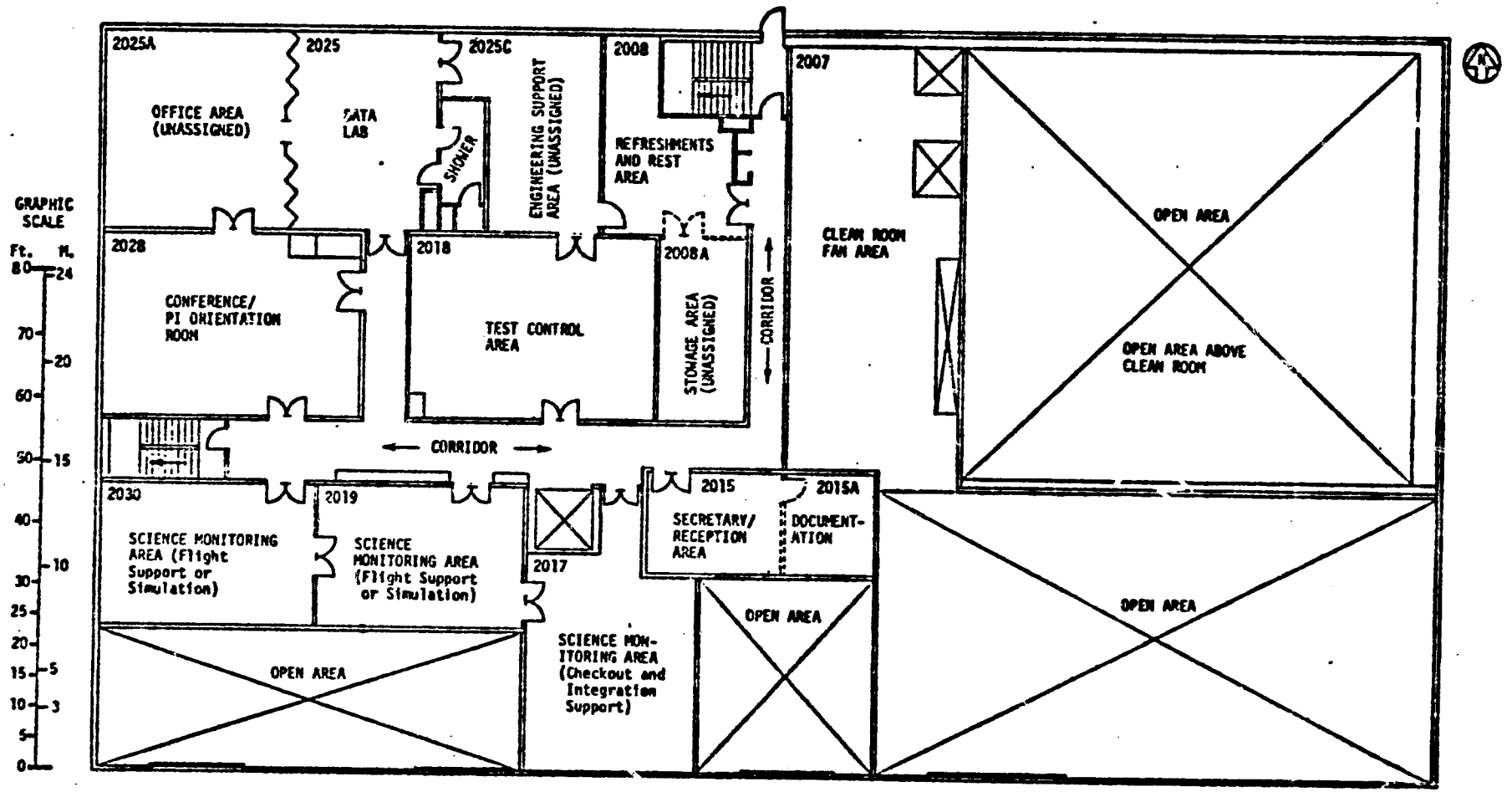
clean room recommended as a result of this survey. Several additional modifications will be required to configure the first floor of Building 36 (south wing) for LSP operations. The major modifications identified in Section 5.2.2 are also applicable to the dedicated facility design.

Dedicated Facility, Building 36, Second Floor

The second floor of Building 36 is designated to house the test control, science monitoring, and data laboratory subfacilities for all JSC LSP operations. A floor plan layout is shown in Figure 5-13. The science monitoring areas are located in adjoining rooms and can provide checkout, integration, test and flight support. The test control area is located directly across the corridor from the science monitoring areas. Additional subfacilities provided on the second level include the data laboratory (data management area), support equipment stowage, conference/PI orientation room and additional (unassigned) office space. A rest area with refreshments and a shower facility are provided on the second level. No major modifications are required on the second level for LSP operations. The level contains only about one half the usable floor area as the first floor. A cargo elevator is available for handling computers, control consoles and associated equipment used in the test control and science monitoring areas. The elevator may also be used to allow handicapped persons to access the second floor.

Dedicated Facility, Building 36, Third Floor

The third level of Building 36 appears best suited to provide office accommodations for the experiment PI's and supporting personnel during residence at JSC. The total third floor is currently configured as engineering offices and would not require modification other than partition removal to provide a conference room of sufficient capacity. A tentative layout of the area is shown in Figure 5-14. The third floor contains only approximately 35 percent of the usable area of the first floor, and about 36 persons can be accommodated with office space available. Rest room facilities are available on the third floor; however, the cargo elevator does not service the area, thus preventing access by some handicapped persons.



NOTE:

(1) Total area available for LSP operations on this sheet equals 808 M^2 (8,700 ft^2)

FIGURE 5-13: LIFE SCIENCES FACILITY LAYOUT, DEDICATED PROCESSING FACILITY, BUILDING 36, SOUTH WING, SECOND LEVEL

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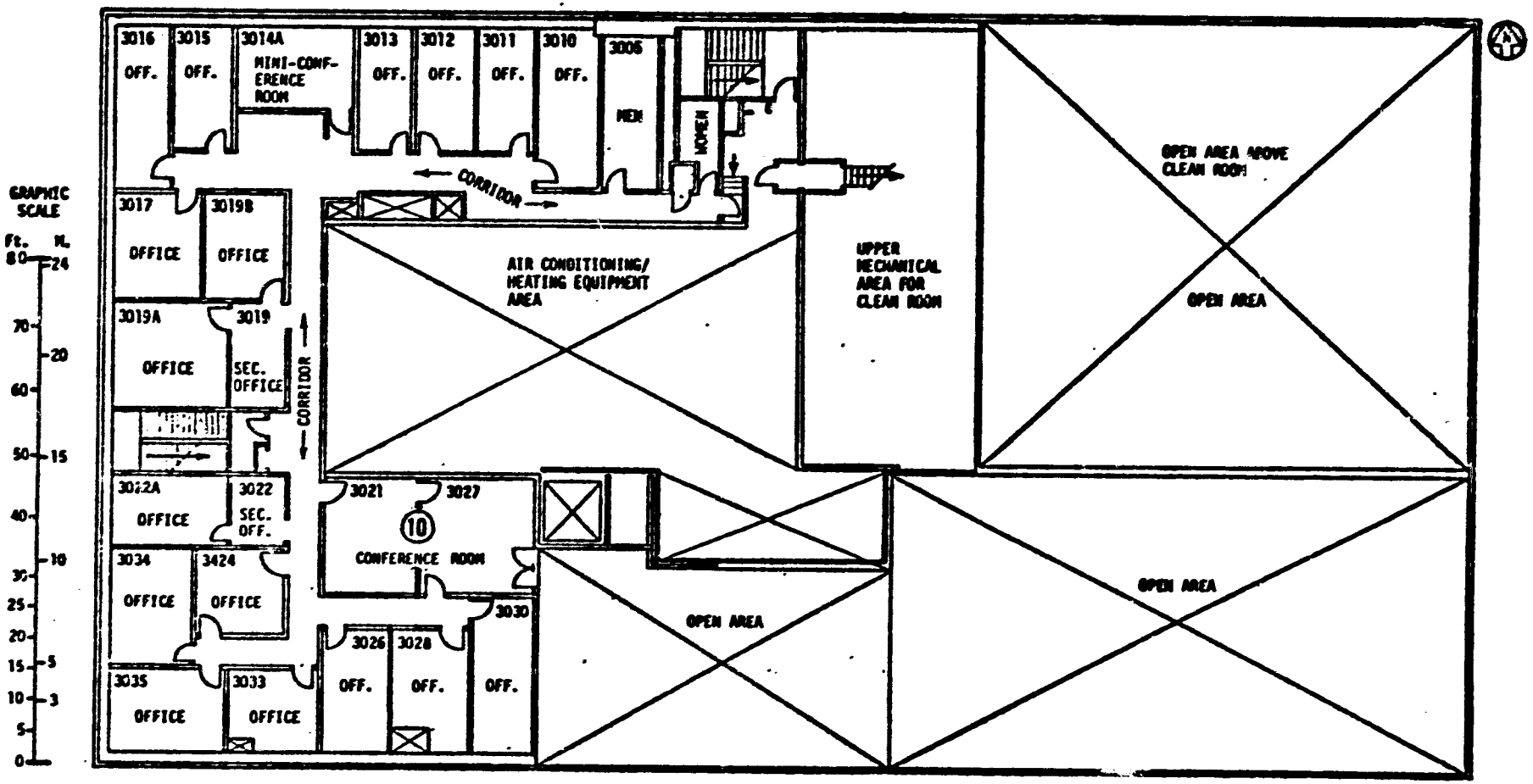

NOTE:

(1) Total area available for LSP operations on this sheet equals 492 M^2 (5,300 ft^2)

FIGURE 5-14: LIFE SCIENCES FACILITY LAYOUT, DEDICATED PROCESSING FACILITY, BUILDING 36, SOUTH WING, THIRD LEVEL

5.3 COMPARISON OF CANDIDATE DESIGN VERSUS REQUIREMENTS

Comparisons of the floor space accommodations provided by both Integration Facility designs versus the requirements identified in Section 3 are indicated in Tables 5-2 and 5-3. The shared Integration Facility design utilizes approximately three percent more total floor area than indicated from a summation of the individual subfacility requirements. The dedicated facility design requires about eight percent more. Inspection of Tables 5-2 and 5-3 shows that all subfacility area allocations are well matched to the theoretical area requirements. However, almost 30 percent of the proposed area for the shared facility design must be made available from outside the buildings surveyed.

Other than the necessary facility modifications described in Section 5.2, no major changes to Building 36 or its utility services are foreseen to accommodate the requirements of the subfacilities for either of the two configurations. It is anticipated, however, that certain additional electrical and other utility services will need to be rerouted as determined by the final selection and placement of equipment.

5.4 IMPLEMENTATION SCHEDULE

Schedules showing the required buildup for major elements of an LSP Integration Facility were prepared in the initial LSP study tasks, and implementation recommendations described in this section were formulated with the aid of the results of the previous effort (see Section 4.1 of Reference 2). The recommendations described in this section were formulated by evaluating the time-phased payload processing requirements of key subfacilities, as described in the following text, and are valid for either the shared or dedicated Integration Facility concept.

Initial items of CORE and experiment prototype hardware are expected to start arriving at the facility by about mid-1978. Shipping and Receiving subfacility activities will be very modest during 1978, with initial equipment shipments for only three payloads expected. Shipping and receiving activities will increase throughout 1979, reaching nominal operational era level by 1980. The projected buildup of Shipping and Receiving subfacility operations is shown in Figure 5-15.

TABLE 5-2

COMPARISON OF ACCOMMODATIONS VS. REQUIREMENTS - SHARED LSP INTEGRATION FACILITY

Subfacility	PROPOSED DESIGN			REQUIREMENTS		Remarks
	Location Building/Room	Space m^2	(ft^2)	Space m^2	(ft^2)	
Shipping and Receiving	36/1003A, 36/1005A, part of 36/1010 and 36/1014, dock area	361*	(3,880)	300	(3,250)	119 m^2 (1280 ft^2) of 36/1010 used. 36/1014 space used on "as required" basis, * includes outside dock
Special Requirements/Items Holding Area	TBD (experiment dependent)	90 (TBD areas assumed)	(950)	90	(950)	
Equipment Storage	36/1003 plus other TBD areas	36/1003 74 TBD areas 591	(797) (6,353)	665	(7,150)	
Experiment Test/Checkout Lab	Part of 36/1002 and 36/1014	99	(1,065)	80	(850)	Assume one-half of 36/1002 and 28 m^2 (310 ft^2) of new walled area in 36/1010 is used for checkout
Experiment Development Lab	Part of 36/1002 - plus other TBD areas in Bldg. 37	36/1002 70 TBD areas 97	(755) (1,045)	165	(1,800)	Assume one-half of 36/1002 is used for development
Clean Room Integration Area	Part of 36/1014	179	(1,928)	230	(2,500)	Area is 2/3 of 36/1014 area less 95 m^2 (1019 ft^2) for mock-up
Orbiter/Spacelab Mock-up	Part of 36/1014 and new walled area in 36/1010	207	(2224)	345	(3,700)	Area is 22.3 m (73.4 ft) by 9.2 m (30.3 ft)

TABLE 5-2 (continued)

COMPARISON OF ACCOMMODATIONS VS. REQUIREMENTS - SHARED LSP INTEGRATION FACILITY

Subfacility	PROPOSED DESIGN			REQUIREMENTS		Remarks
	Location Building/Room	Space m^2	(ft^2)	Space m^2	(ft^2)	
Data Lab	36/2025	68	(728)	55	(600)	
Test Control/Flight Support Area	36/2018, 36/2025A, 36/2030	268	(2,878)	195	(2,100)	
Facility Maintenance Area	Assume all necessary support from Buildings 325, 327 and 329	145 (assumed)	(1,550)	145	(1,550)	
General Purpose Scientific Lab	37/lab areas, 36/1002A	2,185	(23,495)	2,000	(21,500)	
Office and Meeting Room Space	36/112, 36/20256, 37/1-36, other TBD areas	listed areas 133 TBD areas 677	(1,436) (7,264)	810	(8,700)	
	TOTAL	5,242**	(56,348)	5,080	(54,650)	** includes 1596 m^2 (17,162 ft^2) located in remote areas which are TBD

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TABLE 5-3

COMPARISON OF ACCOMMODATIONS VS. REQUIREMENTS - DEDICATED LSP INTEGRATION FACILITY

Subfacility	PROPOSED DESIGN			REQUIREMENTS		Remarks
	Location Building/Room	Space m^2	(ft^2)	m^2	(ft^2)	
Shipping and Receiving	36/1009, 36/1005A, part of 36/1010 and 36/1014, dock area	517*	(5,556)	300	(3,250)	119 m^2 (1280 ft^2) of 36/1010 used. 36/1014 space used on "as required" basis. *Includes outside dock.
Special Requirements/Items Holding Area	TBD (experiment dependent)	90 (assumed)	(950)	90	(950)	
Equipment Storage	36/1002, 36/1005, 36/1014, outside	653	(7,022)	665	(7,150)	93 m^2 (1,000 ft^2) of 36/1010 used for integrated payload storage
Experiment Test/Checkout Lab	36/1004, 36/1014	161	(1,730)	80	(850)	Includes 28 m^2 (300 ft^2) in clean room
Experiment Development Lab	36/1006, 36/1006A, 36/1006B	192	(2,070)	165	(1,800)	
Clean Room Integration Area	36/1014	235	(2,534)	230	(2,500)	
Orbiter/Spacelab Mockup	36/1014	278	(2,992)	345	(3,700)	
Data Lab	36/2025	68	(728)	55	(600)	Existing raised floor
Test Control/Flight Support Area	36/2018, 36/2017, 36/2019, 36/2030	309	(3,320)	195	(2,100)	

TABLE 5-3 (continued)

COMPARISON OF ACCOMMODATIONS VS. REQUIREMENTS - DEDICATED LSP INTEGRATION FACILITY

Subfacility	PROPOSED DESIGN			REQUIREMENTS		Remarks
	Location Building/Room	Space m^2	(ft^2)	Space m^2	(ft^2)	
Facility Maintenance Area	36/1003, 36/1003A	148	(1,594)	145	(1,550)	
General Purpose Scientific Lab	37/lab areas, 36/1002A	2,185	(23,493)	2,000	(21,500)	
Office and Meeting Room Space	36/third floor, 36/112, 37/1-36, 36/2028	656	(7,060)	810	(8,700)	
	TOTAL	5492	(59,049)	5,080	(54,650)	

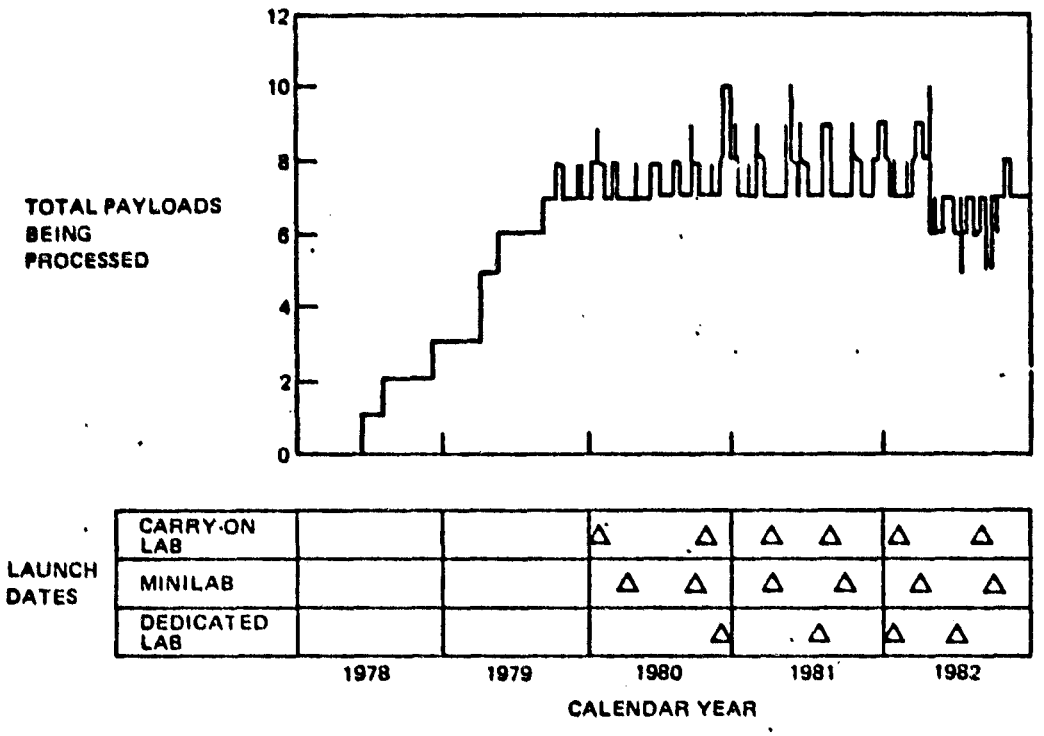

FIGURE 5-15: RECEIVING AND SHIPPING SUBFACILITY PROCESSING REQUIREMENTS

The projected buildup of activities for the Experiment Modification and Test Lab from Reference 2 is shown in Figure 5-16. No direct parallel subfacility was used in this survey, but the activities of the Experiment Modification and Test Laboratory were apportioned among the Experiment Test and Checkout Lab, the Experiment Development Lab, and the Clean Room Integration area. The activities of these subfacilities are projected to build up as indicated in Figure 5-16, with some initial capability required in 1979, increasing to full operational capability by 1981. It is felt that with careful scheduling the number of payloads to be processed simultaneously by these subfacilities could be reduced 20 to 30 percent from that indicated in the figure.

The Orbiter/Spacelab integrated payload checkout test processing requirements as determined in Reference 2 are illustrated in Figure 5-17. Time is included in this figure for facility modification, payload checkout and equipment removal. Although the Orbiter/Spacelab mock-up scheduling is critical, it appears feasible and has been assumed for this survey that a single mock-up can satisfy the needs of the Integration Facility. Initial operational capability of the mock-up should be implemented by late 1979. The recommended Integration Facility implementation schedule is summarized in Figure 5-18.

5.5 COSTING

Cost estimates for the major facility modifications are shown in Table 5-4. No significant cost differential was identified for either the shared or dedicated Integration Facility concept. Cost estimates are limited to Building 36 modifications, as modifications to other buildings are expected to be minor in comparison. Also included in Table 5-4 are equipment costs developed in Section 3.4. The costs shown in the table are non-firm, rough order-of-magnitude, preliminary engineering estimates. The following conditions and assumptions were used to arrive at the cost figures:

a) Orbiter/Spacelab mock-ups and subsystems, and automated test equipment costs are not included as these items will require additional preliminary design engineering analyses of functions to be provided prior to costing. Data lab computer equipment is assumed to be leased.

b) Cargo lift trailers (transport aircraft GSE), vans, forklifts, and movable cranes are available at no cost from existing government equipment.

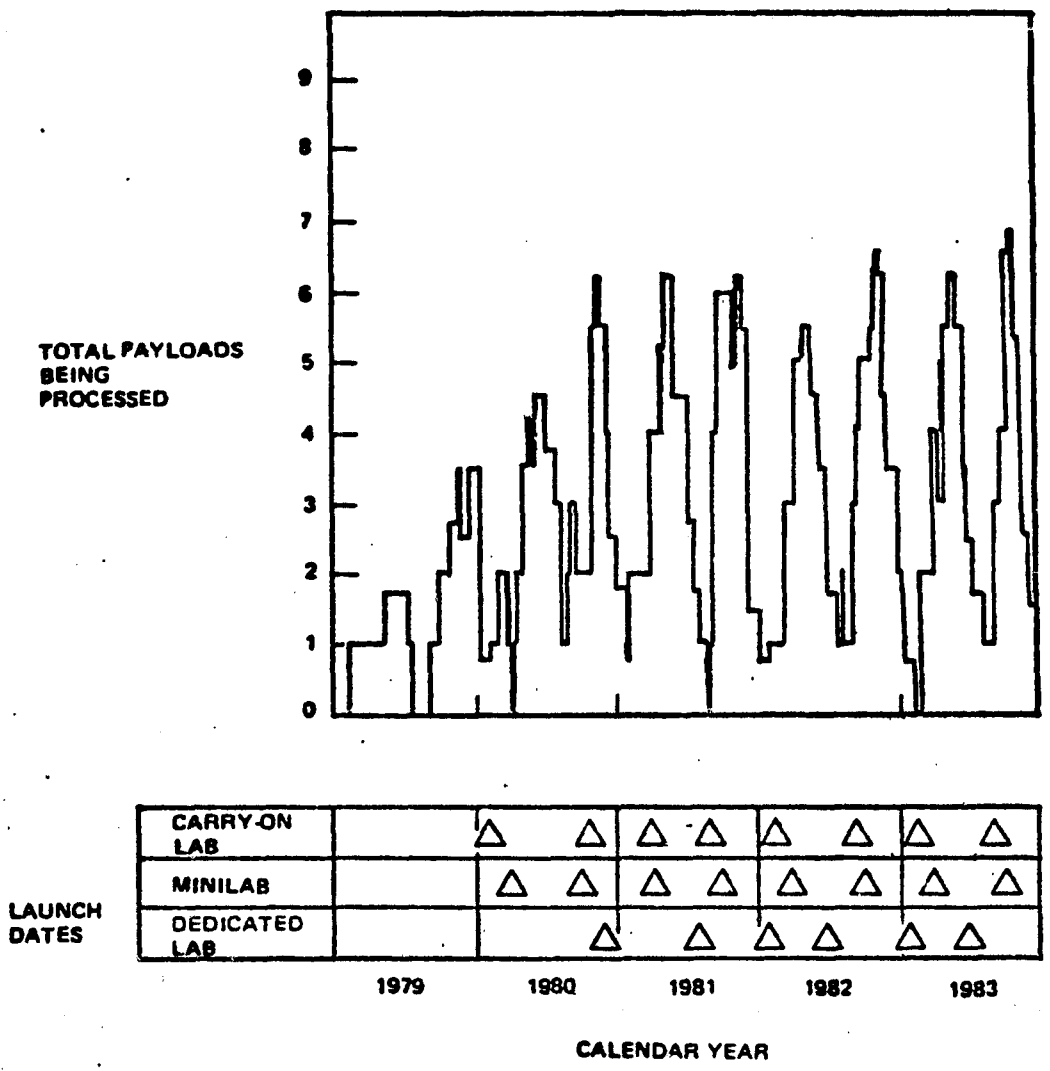

FIGURE 5-16: EXPERIMENT MODIFICATION AND TEST LABORATORY PROCESSING REQUIREMENTS

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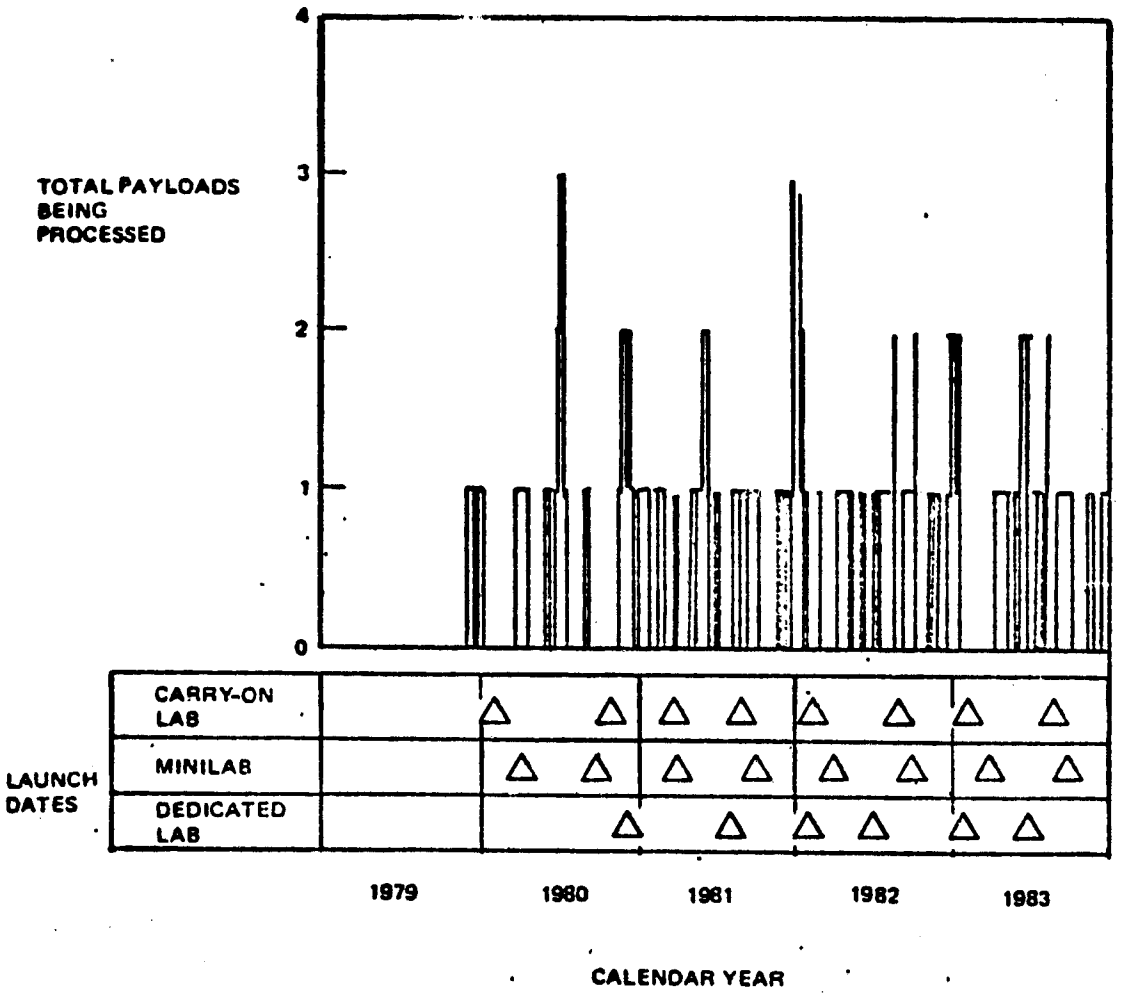
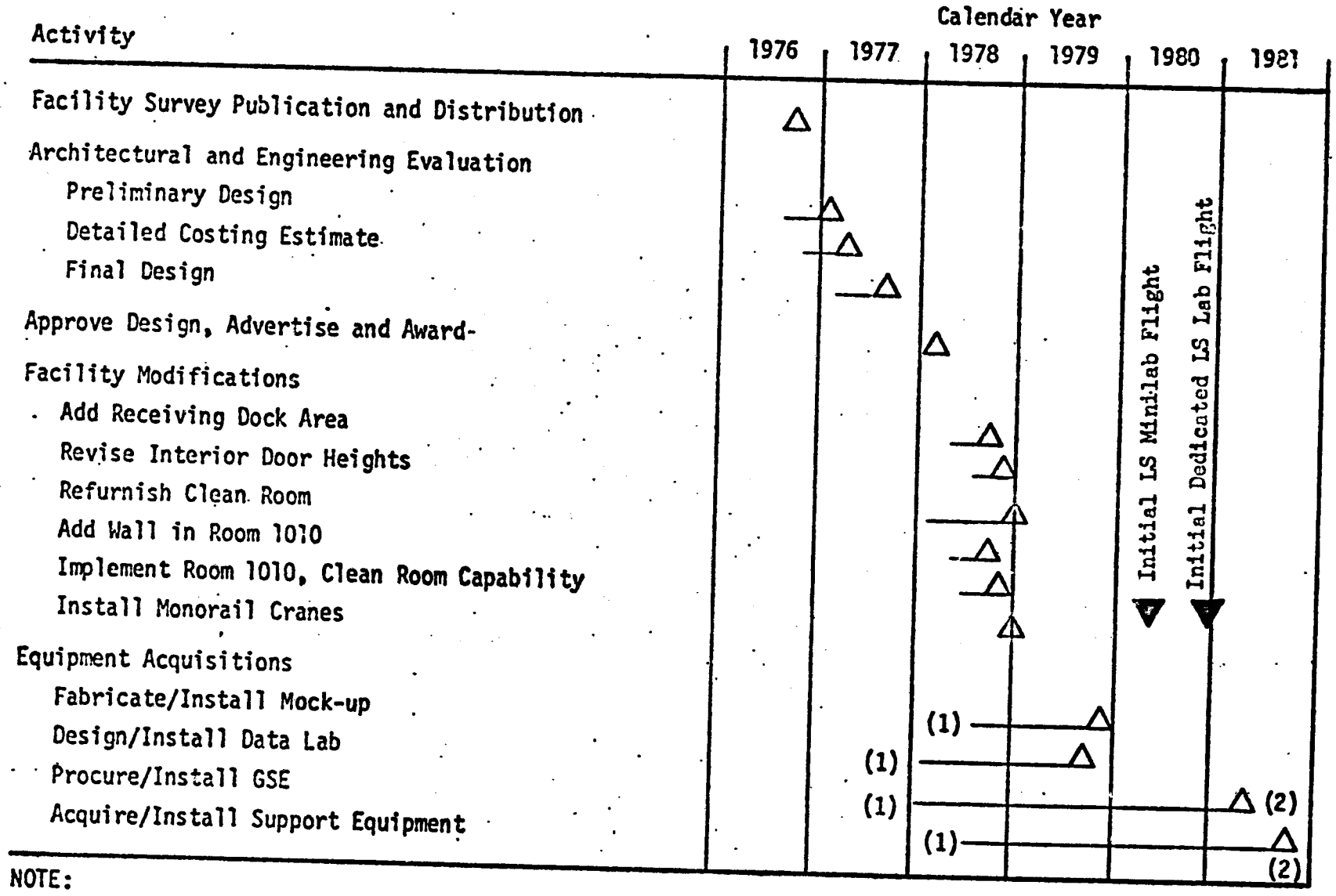


FIGURE 5-17: PAYLOAD CHECKOUT TEST PROCESSING REQUIREMENTS



NOTE:

(1) Existing capability, upgraded as required, to be used prior to implementation of operational era capability.

(2) Items acquired and installed as needed to support actual payload requirements.

FIGURE 5-18: INTEGRATION FACILITY IMPLEMENTATION SCHEDULE

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TABLE 5-4

INTEGRATION FACILITY ROUGH ORDER OF MAGNITUDE COST DATA (1)

MODIFICATIONS TO BUILDING 36

• Enlarge Interior Doors	$ 2.3K
• Add Airlock to Room 1010	4.5K
• Install 9 x 10^3 Kg (10 Ton) Crane	10.5K
• Remove Door and Track	4.0K
• Refurbish Room 1010	13.0K
• Remove walls	2.4K
• Install wall and modify room 1010	14.0K
• Install 18 x 10^3 Kg (20 Ton) Crane	12.0K
• Build Truck Cargo Pits	31.0K
• Install Canopy over Pits	12.5K
• Install 1.8 x 10^3 Kg (2 Ton) Crane	7.5K
• Refurbish Clean Room	21.0K
	$134.7K

EQUIPMENT COSTS (2)

• NASA/ESA GSE	$ 0.77 million
• Other GSE	0.94 million
• Other Support Equipment	.33 million
	$ 1.94 million
TOTAL	$ 2.07 million

NOTE

(1) See text for conditions and assumptions used in determining ROM cost estimates.

(2) Development costs, where applicable, not included.

c) No costs are assessed for the use of scientific lab equipment.

d) Certain experiment-dependent Specimen Facility costs are not included. Examples are waste/dead animal disposal facilities, data monitoring equipment, and holding units.

e) Design, development, set-up, and interface connection and verification costs are not included.

Section 6
CONCLUSIONS AND RECOMMENDATIONS

6.1 CONCLUSIONS

The current JSC facility accommodations are suitable for use as a Life Science Payloads Integration Facility with relatively minor modifications. Life Science Payload equipment receiving and shipping, test integration, checkout, test monitoring and in-flight science support activities may be accommodated in Building 36. Sufficient area also exists in the building for office accommodations needed by NASA employees, contractor personnel and visiting PI's. The Life Science laboratories which are currently being centrally located into Building 37 should be capable of supporting the laboratory requirements of the Integration Facility. Crewmember and test subject medical examination support for payload activities can be provided by existing accommodations in Building 8.

The preliminary, rough order-of-magnitude (ROM) cost estimates for facility modifications to convert Building 36 for LSP operations are estimated at $135,000. Costs of GSE needed to process experiment and Spacelab flight hardware are projected to be slightly in access of $1.7 million. Other Integration Facility support equipment costs are estimated at $330,000. Costs for design, development, verification, utility support and equipment interface connections are not included in these figures. Costs for mock-up structures and subsystems, computerized test monitoring equipment, specialized items of stowage/holding equipment are also not included due to current lack of design details.

The Integration Facility should be capable of performing initial receiving and experiment processing activities as early as 1978. A phased build up to full operational capability should be completed by 1981.

6.2 RECOMMENDATIONS

The following recommendations are made as a result of the facility survey:

a) The JSC Life Science Directorate should take necessary steps to ensure that the required facility areas as indicated in this survey are made available for LSP processing in the Space Shuttle era.

b) The recommended Integration Facility design should be submitted to JSC Facilities Engineering personnel or to an Architectural and Engineering (A&E) consultant for more detailed facility modification costing and schedule information.

c) Additional survey effort should be expended to determine the parametric impacts on Integration Facility requirements resulting from an altered Life Science traffic model.

d) The top level subfacility requirements indentified by this survey should be expanded to include an additional level of detail for all subfacilities. Particular emphasis is needed to define the Spacelab and Orbiter structural configurations and subsystems necessary to imitate the functions of flight hardware during test, training, interface verification and simulations.

e) A make/buy cost effectiveness analysis should be performed for each item of NASA/ESA GSE applicable to Integration Facility activities. The specific capabilities of NASA/ESA GSE items should be compared to more detailed Integration Facility requirements than was possible within the scope of this survey. Particular emphasis should be placed on the characteristics of in-building transporters, dollies, and flight hardware handling equipment. For GSE components where a "make" decision is reached, preliminary design of long lead time and high complexity items should be initiated. Preliminary procurement actions should be initiated for "buy" category GSE.

Section 7

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