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TM-5899/000/00
30 June 1977

IMPLEMENTATION PLAN TECHNICAL REPORT (CDRL A004)

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PRINCIPAL AUTHOR
SALLY C. BOWMAN (408) 737-8000

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SDC/ARC PROGRAM MANAGER, DR. E. LEVIN

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EXECUTIVE SUMMARY

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This initial Implementation Plan for the upgrade of the DARPA ARC describes the issues to be investigated during the summer of 1977. Resolution of these issues is required to produce the detailed design specifications on which a final implementation plan can be based. An integrated "ARC System Design" including a detailed development plan will be provided by 30 September 1977. ↗

1.0 INTRODUCTION

The initial Implementation Plan for the upgrade of the DARPA ARC describes the issues to be studied during the July, August and September 1977 period and is the precursor of the final plan to be submitted 30 September 1977. Consideration of the topics enumerated in Section 2 below and incorporation of the study results is necessary to produce detailed specifications from the top level specifications provided on 30 June (as CDRL A005 and CDRL A006 under Contract No. N00228-C-2070).

The results of the studies will be documented as described in Section 3. A design review will be held during the week of 19 September to obtain Government concurrence prior to commencing implementation.

2.0 TOPICS FOR DESIGN ANALYSIS FOR JULY - SEPTEMBER 1977

The issues noted below will be analyzed during the detailed design period of July through September 1977. These issues require resolution to develop detailed design from the top level design documented in the initial releases of the language and system software documents (CDRL A006 and CDRL A005, Contract No. N00228-77-C-2070).

1. Study the application of the top level design concept across the entire system from remote collection facilities, to the links, to remote computers (such as the NUC algorithm) as a single Illiac IV.
 - a. Evaluate the trade-offs associated with defining extensive existing processes such as the NUC algorithm as a single node in LINGO (the proposed network language).
 - b. Define the means of controlling and allocating second-tier hardware processors, such as the CHI and the SPS-81s.
2. Resolve the design issues associated with supporting multi-experiments such as SEANE, RUOP and ABF. Evaluate the support of multiple experiments provided by the language and by the Meta-Executive.
3. Provide a brief discussion of security issues based on physical decoupling of one or more hardware processors from the network.

4. Explore degraded operation due either to failure of a hardware element or to deliberate physical decoupling. Take into account such issues as failure detection and the spectrum of solutions including:
 - a. Notifying the director
 - b. Providing recommended solutions
 - c. Prespecified degraded operation
 - d. Application of priority
 - e. Partially automated failure procedures
5. Document the architectural study so far performed, including analysis of other architectures considered and a comparison of processors offered by other vendors.
6. Provide an analysis of the expandability of the proposed hardware configuration. Detail what is required to add an additional remote site, another processor to share the communication and data management load, or additional signal processors (such as FPS AP120s).
7. Provide further detail on the proposed facility and show how the upgrade schedule is compatible with the acquisition of new hardware elements.
8. Perform the detailed design of the inter-node communications protocol.
9. Select the operating system for the proposed hardware. Provide rationale. Show both the analyses performed and the selection criteria. Provide an estimate of the overhead required by the selected operating system.
10. Perform additional data flow analysis and loading studies including statement of assumptions made in such models. Include consideration of operating system overhead. Improve the Multi-Mix One Model for evaluating candidate configurations and, if necessary, develop additional models.
11. Synthesize scenarios of representative or generic classes of future experiments which stress various portions of the ARC. From these develop parametric performance envelopes and evaluate the capabilities of the proposed design (and expansions) with respect to such performance envelopes.
12. Consider further the "number crunching" elements of the network. Evaluate adequacy of current capability. Recommend additional capability if necessary. Recommend appropriate network topology.

13. Provide detail regarding retention of existing capability during evolutionary development.
14. Estimate the reliability of the proposed hardware configuration.
15. Analyze display requirements and incorporate into the system design those hardware and software elements necessary to support these requirements.
16. Design the Command Language necessary to:
 - a. Support interactive communication with the ARC system.
 - b. Support the experimenter in controlling and monitoring of experiments.
 - c. Assist the ARC Director in managing the resources of the ARC network.
17. Evaluate the adequacy of dynamic interaction with the proposed advanced system.

3.0 DELIVERABLES/SCHEDULE

The results of the studies and analyses are to be documented as an integrated CDRL (under Contract No. N00228-77-C-2105) entitled: "ARC System Design". The principle sections (which may appear as separate volumes, where appropriate) shall include the overall system design concept, detailed language specification, system software specification, proposed hardware and topology (including alternatives considered), facility modifications, system performance evaluation (based on such considerations as loading studies, performance envelopes, and reliability estimates, etc.) including interim capabilities and future growth potential, and the implementation plan. This last section (or volume) will contain detailed development schedules, resources required (personnel, facilities, equipment, machine time), associated costs, techniques and standards to be used (for code development, system integration, documentation, testing, overall management) and identification of major demonstrable milestones or interim capabilities.

A system design review is scheduled for the week of 19 September. Preliminary drafts of the major sections (or volumes) will be distributed prior to the design review. Changes based on comments received in response to the

preliminary drafts and from the design review will be incorporated into the final document to be issued on 30 September 1977.

4.0 MANAGEMENT

The detailed design work described above will be performed at the SDC Sunnyvale facility. Primary responsibility will be assigned to the manager of the System Development Branch. Development of the sample scenarios and analysis of the associated performance envelopes will be the responsibility of the System Applications Branch.

APPENDIX
ARC FACILITY PLAN

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1.0 FACILITIES REQUIREMENTS

The present configuration of the ARPA Research Center restricts the efficient use of the facilities in four major areas:

1. Operation of the ADP equipment
2. Maintenance of the ADP equipment
3. Availability of proper user areas
4. Provisions for growth

It is these areas that are addressed in the following multiphase ARC facility plan.

1.1 PHASE 0

The machine room is the first area to be addressed. As shown in the present configuration (see Figure A-1), it is the result of three years of development and equipment changes without the aid of an integrated configuration plan.

1.2 PHASE 1

The philosophy of Phase I ARC reconfiguration (see Figure A-2) is to provide:

1. Equipment locations according to type and function to minimize critical cable runs and maximize air conditioning efficiency.
2. An area tailored to efficient operation.
3. Positioning of equipment to afford proper access for maintenance.

New equipment requirements have not been established at this time and therefore are not addressed in this presentation. However, there is space provided for this type of expansion in Phase II.

1.3 PHASE II

This phase (see Figure A-3) addresses items 3 and 4 specified in Section 1.0 above, with provisions for adjustments to accommodate the philosophies of the items 1 and 2 as well. The addition of 2,800 sq. ft. of floor space in the form of a modular building group will provide space for a Display Room with peripheral User Areas and the Technical Library. The spaces previously occupied

FIGURE A-1 PHASEO ARC - PRESENT CONFIGURATION

- 1. SEL CPU
- 2. SEL TAPE DRIVES
- 3. SEL DISKS
- 4. SEL CONSOLE
- 5. PDP-10 CONSOLE/CPU
- 6. PDP-10 AMPLEX MEMORY
- 7. PDP-10 TAPE DRIVES
- 8. PDP-10 DISK DRIVES
- 9. PDP/SEL TERMINAL
- 10. MODCOMP III
- 11. MODCOMP II
- 12. SPS81
- 13. RAMTEK
- 14. CH
- 15. PDP PRINTER
- 16. SEL PRINTER
- 17. I-4 LINK
- 18. SLINK
- 19. PLJ
- 20. AIR COND
- 21. CO₂ FIRE EQUIP

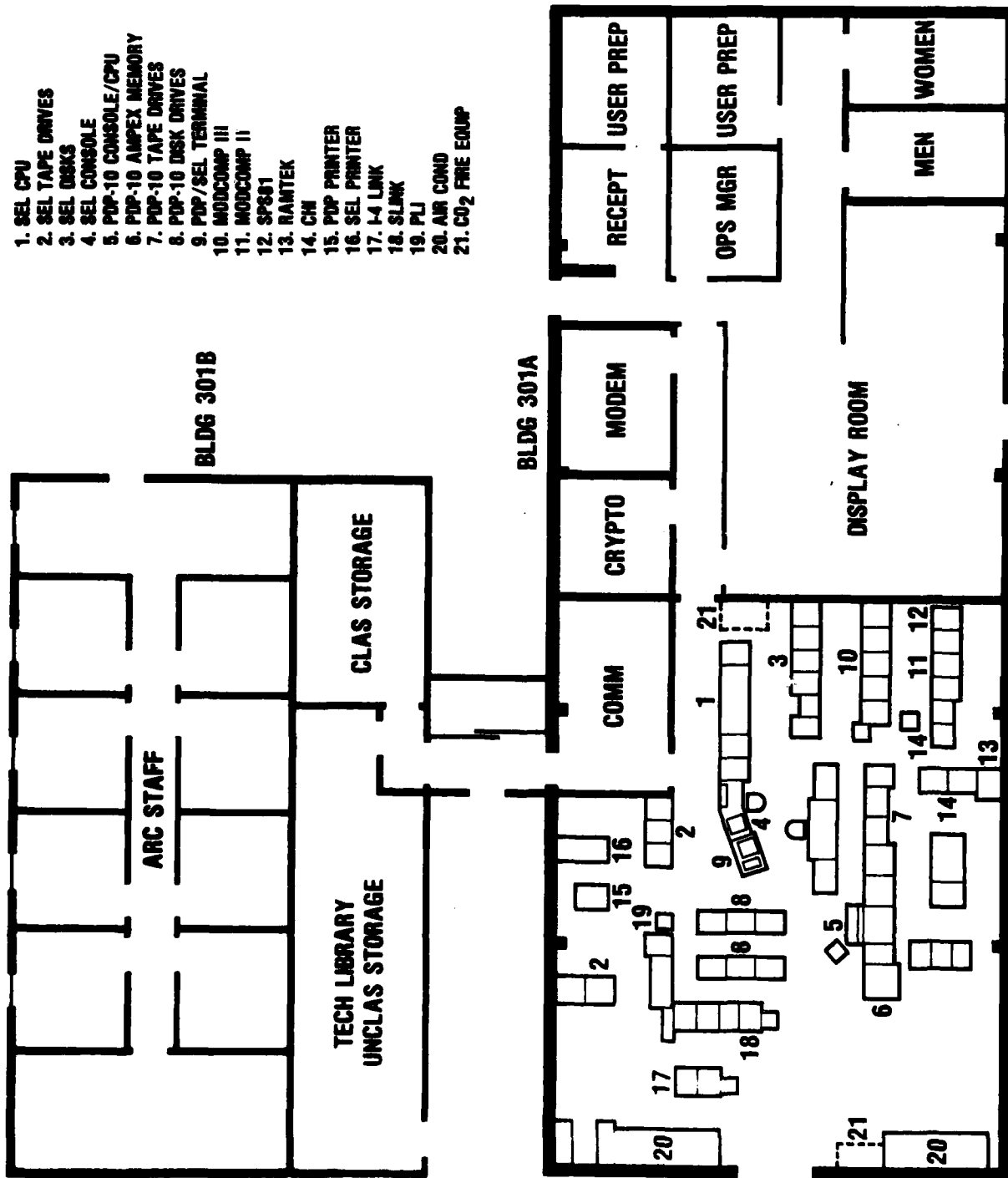


FIGURE A-2 PHASE I ARC RECONFIGURATION

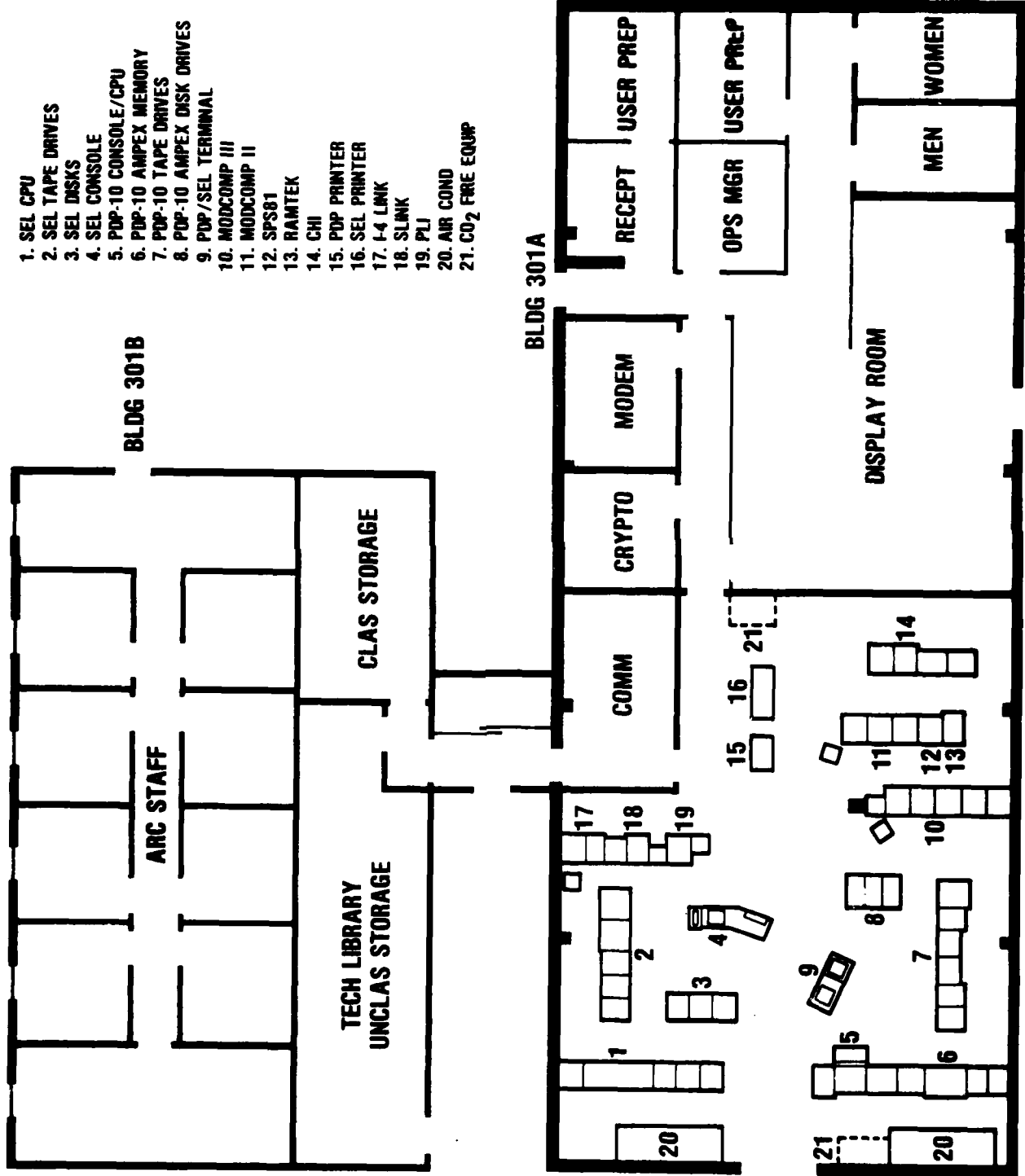
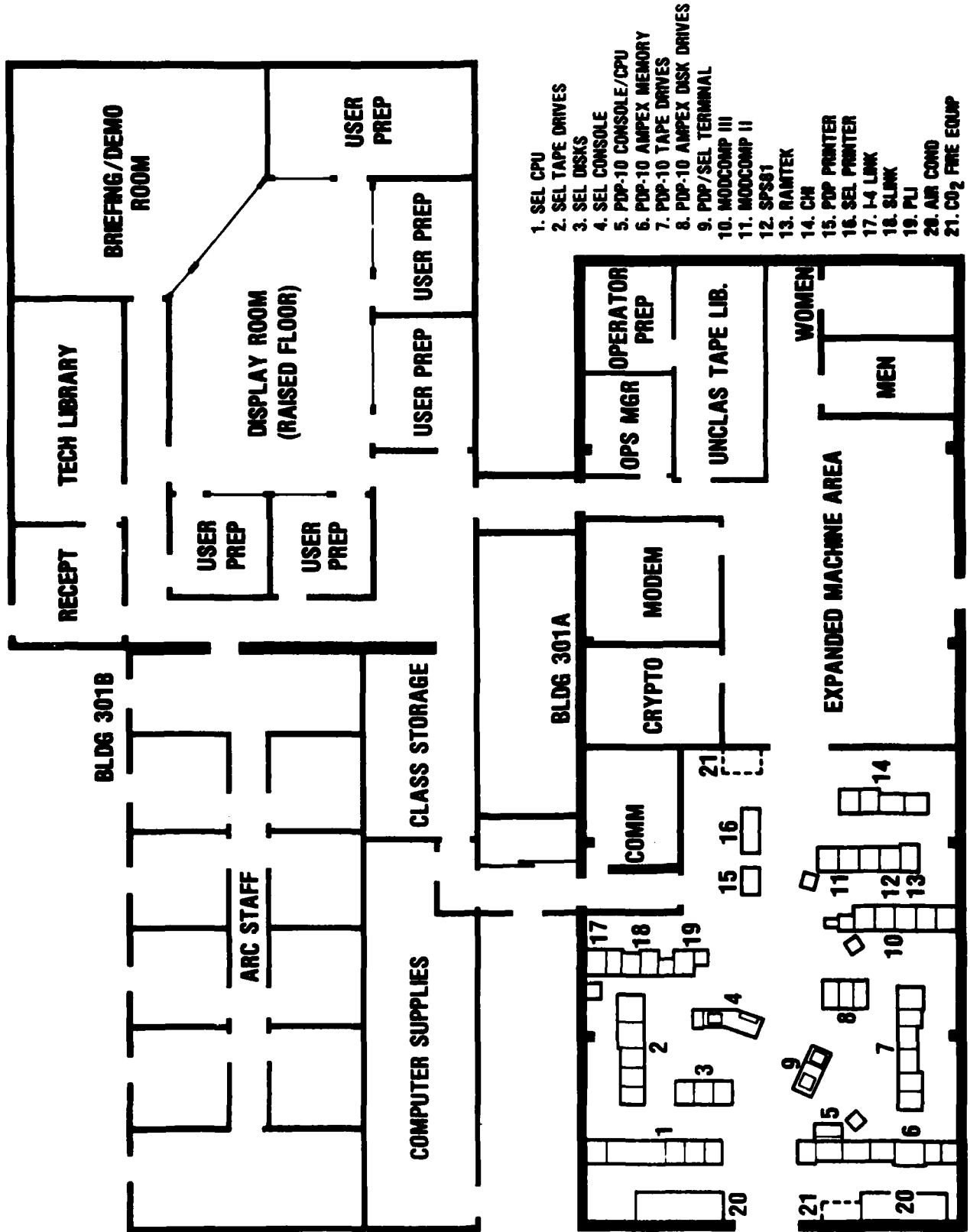


FIGURE A-3 PHASE II ARC RECONFIGURATION



by the display equipment will be available for new equipment and/or the relocation of existing equipment as the need arises. Approximately 200 sq. ft. of this area will be set aside for transient equipment, such as that accompanying visiting experimentors. Additional air conditioning equipment is sized with these requirements in mind. In addition to ADP equipment space expansion, the Crypto and Modem Rooms will be enlarged and the Comm Area is again a complete room.

Further study is under way to enlarge the offices in Bldg. 301B. The solution to this problem may have some impact on the new structure and those areas in 301B designated for Computer Supplies and Classified Storage.

2.0 NEW FACILITY

The measures proposed thus far utilize modular construction and, in the case of some of the outlying structures used for support, run the spectrum from leased trailers to an abandoned ammunition bunker. These facilities have grown to support the ARC as it has matured and have served its needs. However, the Center is now ready for a permanent facility which is proposed in this section. The artists conceptions and engineering floor plan shown in Figures A-4 through A-7 represent a structure of 26,000 sq. ft. designed to house up to 80 people and all present ARC machines with provisions for growth.

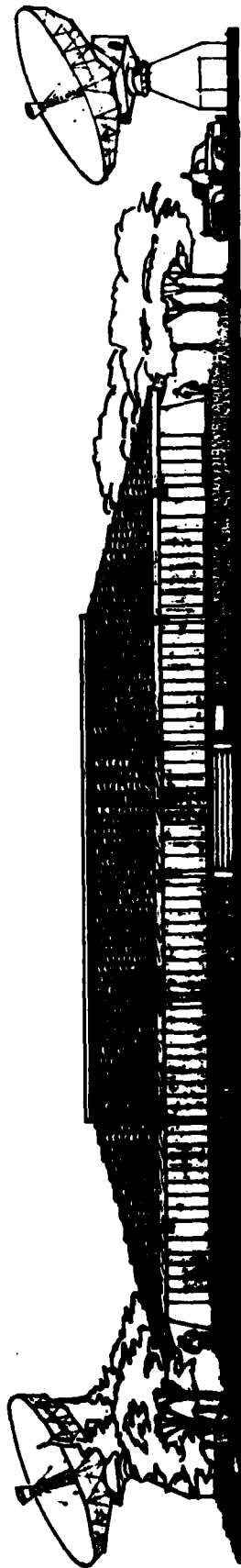
SDC is working with NAVELIX to produce the packages necessary to procure a structure of this type through the MILCON process. The overall exercise will span approximately three years with the completion of the structure in FY81.

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FIGURE A-4

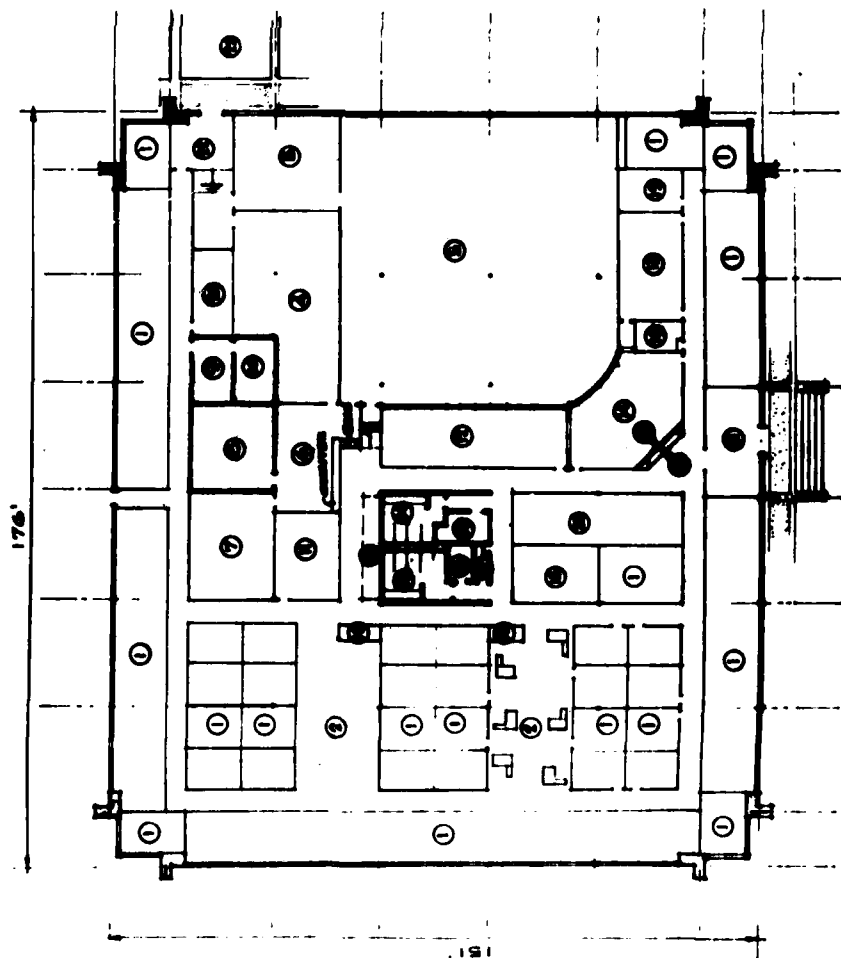
PROPOSED ARPA RESEARCH CENTER BLDG.



201-A-1
FRONT

FIGURE A-5

PROPOSED ARPA RESEARCH CENTER BLDG.



FLOOR PLAN

0 5 10 15 30

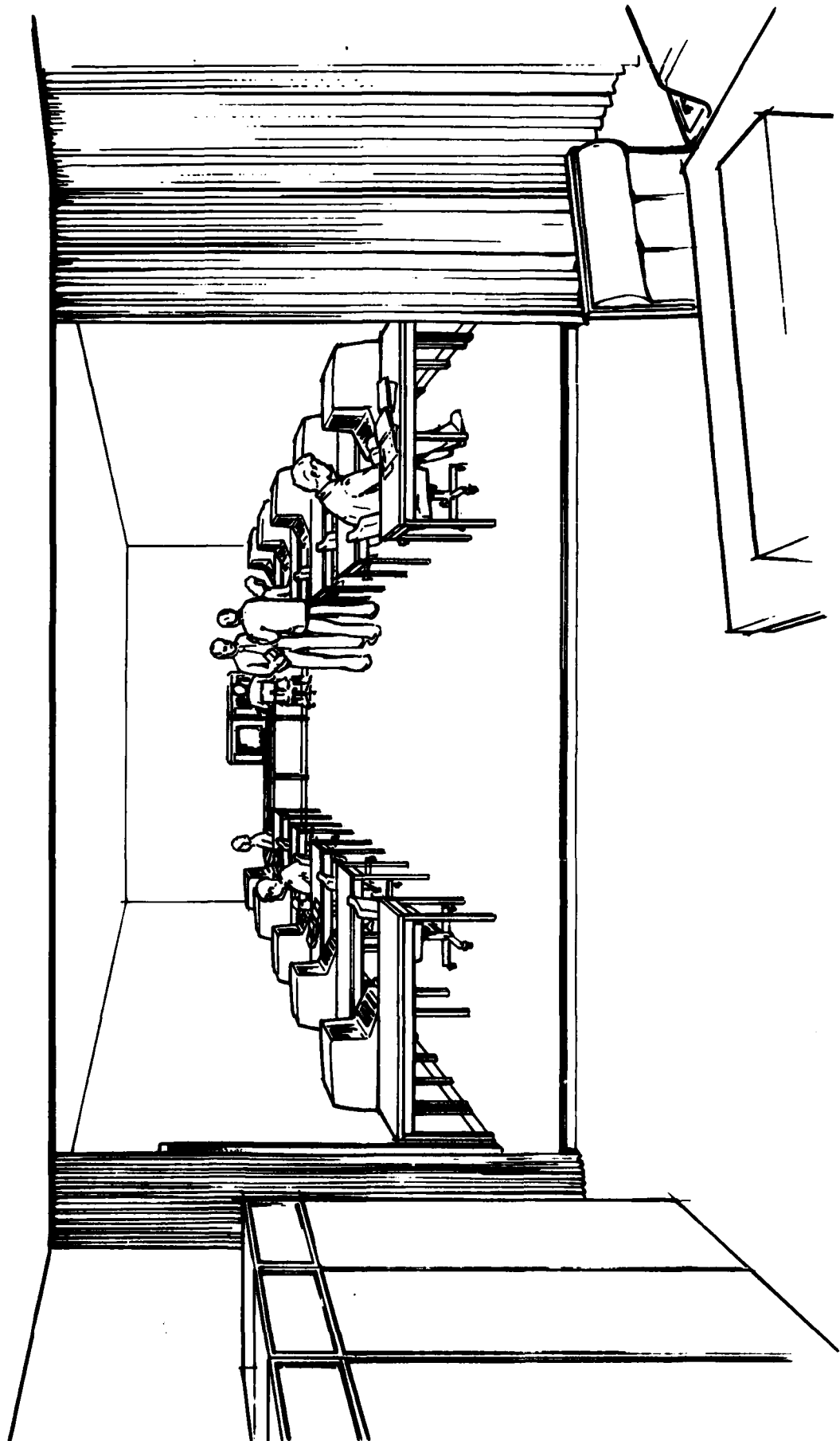
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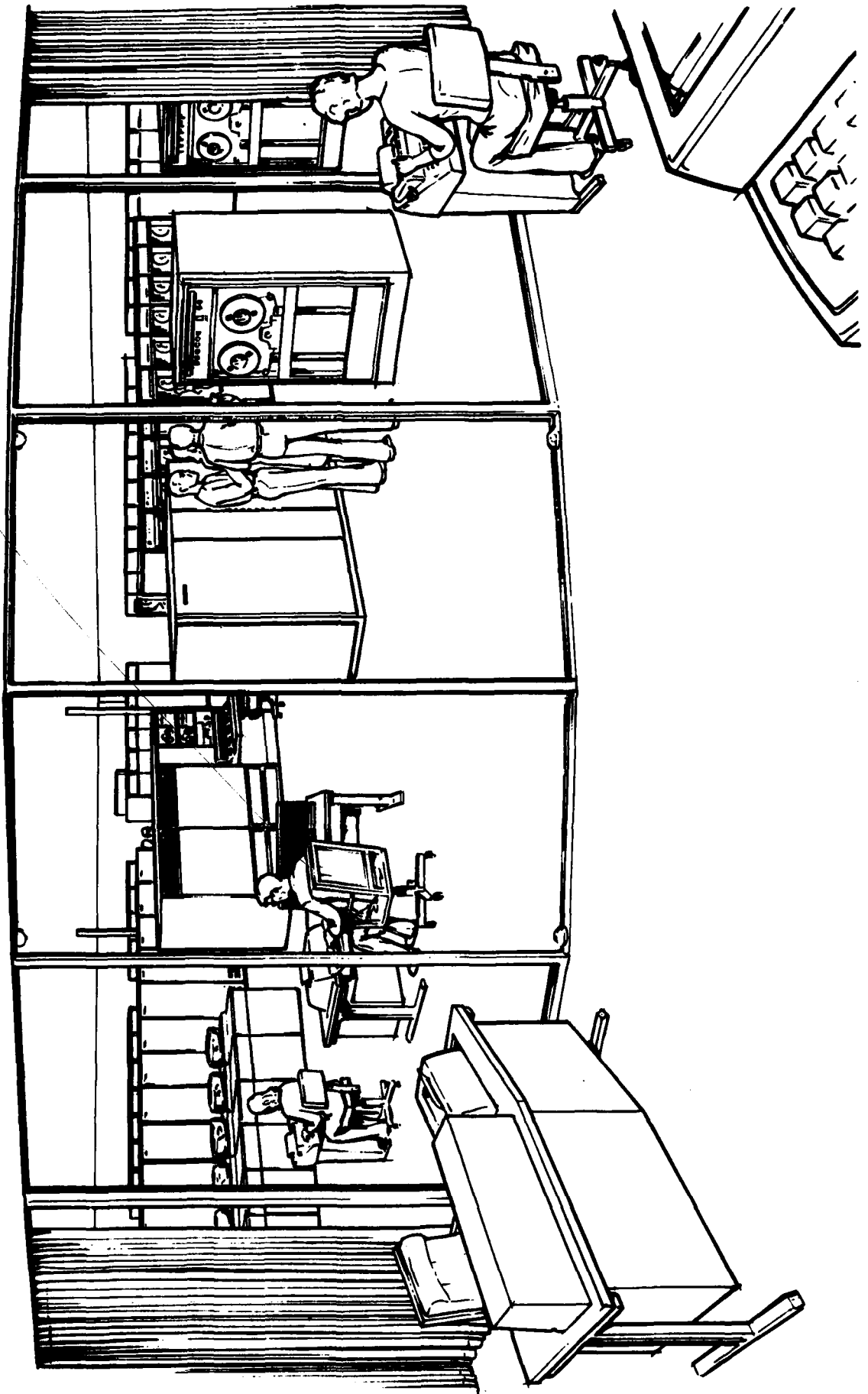
LEGEND

- ① OFFICES
- ② SECY. BAY
- ③ COMPUTER RM. - RAISED FLR.
- ④ COMPUTER STOR. & EQUIPT. - RAISED FLR.
- ⑤ STAGING & LAB. AREA - RAISED FLR.
- ⑥ COMPUTER CONTROL CTR. - RAISED FLR.
- ⑦ UNCLASSIFIED VAULT - RAISED FLR.
- ⑧ CLASSIFIED VAULT - RAISED FLR.
- ⑨ MODEM RM.
- ⑩ CRYPTO RM.
- ⑪ KEYPRUNCH
- ⑫ TERMINAL DISPLAY AREA - RAISED FLR.
- ⑬ BRIEFING RM.
- ⑭ DISPLAY AREA - RAISED FLR.
- ⑮ CONF. RM - OFFICE AREA
- ⑯ PROJ. BTH. - RAISED FLR.
- ⑰ DISPLAY CASE
- ⑱ DISPLAY BOARDS
- ⑲ MISC. STOR.
- ⑳ STOCKRM. - OFFICE SUPPLIES
- ㉑ MAIN LOBBY
- ㉒ LOADG. DOCK
- ㉓ MEN RESTRM.
- ㉔ WOMEN RESTRM.
- ㉕ WOMEN LOUNGE
- ㉖ JANITOR CLOSET
- ㉗ TELEPHONE CLOSET
- ㉘ VENDING AREA
- ㉙ DOC. & REFERENCE LIB.

FIGURE A-6 **ARPA RESEARCH CENTER**
 PROPOSED BUILDING



**FIGURE A-7 ARPA RESEARCH CENTER
PROPOSED BUILDING**



3.0 COST SCHEDULE AND COST ESTIMATES

Figure A-8 depicts the proposed schedules for Phase I and II. The associated budgetary cost estimates appear in Tables A-1 and A-2. Figure A-9 shows the schedule for Phase III and the budgetary costs are shown in Table A-3.

TABLE A-1 PHASE I BUDGETARY COSTS

<u>EQUIPMENT</u>	<u>COST</u>	<u>TIME</u>	<u>VENDOR</u>
SEL-85	\$ 1,600	1 WEEK	SEL
PDP-10	3,000	3 DAYS	TYMSHARE
ADJUNCT EQUIPMENT	- - -	1 WEEK	SDC PERSONNEL
SIGNAL CABLE FABRICATION	2,000	4 MANWEEKS	JOB SHOP ASSEMBLERS
POWER CABLE REWORK	1,500	2 DAYS	PUBLIC WORKS LABOR
A/C REWORK (ATTIC)	3,000	1 WEEK	PENN. TRANE
VERIFY/BASELINE SYSTEM	- - -	1 WEEK	SDC PERSONNEL (OMO)
TOTAL PHASE I COSTS	\$11,100	2 WEEKS	

TABLE A-2 PHASE II BUDGETARY COSTS

<u>ITEM</u>	<u>COST</u>
48' x 60' MODULAR FACILITY	\$150,000
ADDITIONAL A/C (30 TONS)	30,000 *
301-A INTERNAL MODIFICATION (CRYPTO AND MODEM ROOMS, ETC.)	15,000
ADDITIONAL POWER TRANSFORMER	15,000 *
ADDITIONAL POWER PANELS	3,000 *
FIRE PROTECTION SYSTEM MODIFICATION	5,000 *
TRANSIENT SUPPRESSION FILTERS	<u>7,000</u>
TOTAL PHASE II COSTS	\$225,000

* REQUIRED ONLY IF ADDITIONAL COMPUTER EQUIPMENT IS PROCURED.

FIGURE A-9 ARC FACILITY PLAN SCHEDULE

<u>PHASE III</u>	<u>FY 78</u> <u>(Oct)</u>	<u>FY 79</u> <u>(Oct)</u>	<u>FY 80</u> <u>(Oct)</u>	<u>FY 81</u> <u>(Oct)</u>
GOVERNMENT APPROVAL CYCLE (INCLUDES SITE PLANS AND SPECIFICATION AND ENGINEERING DRAWINGS)	_____ (2 YEARS)			
CONTRACTOR SELECTION			(3 mo)	
NEW FACILITY CONSTRUCTION				(9 mo)

TABLE A-3 PHASE III BUDGETARY COSTS

<u>ITEM</u>	<u>COST</u>
BASIC BUILDING	\$ 611,248
INTERIOR	186,032
FURNITURE	130,000
OFFICE A/C	80,000
OFFICE ELECTRICAL	80,000
COMPUTER ROOM	276,000
RAISED FLOOR A/C	
ELECTRICAL	
EXTERIOR	30,000
LANDSCAPING PARKING	
TOTAL PHASE III COSTS	<u>\$1,393,280</u>