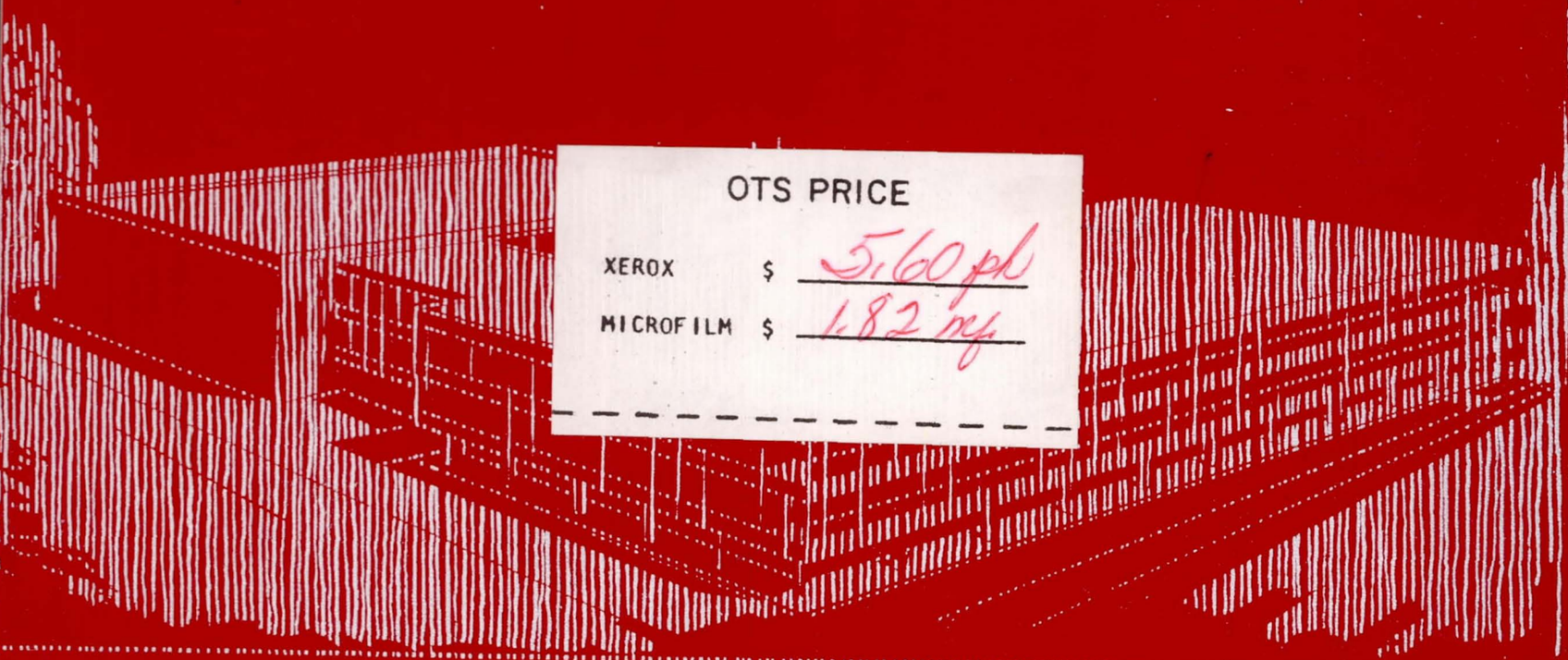
WDL-TR-E112

54 p

FACILITY REQUIREMENTS AND CRITERIA

CONTRACT NO. NAS-9-366:
DESIGN AND DEVELOPMENT STUDY
FOR MANNED SPACE FLIGHT OPERATIONS
CONTROL AND SUPPORT

Prepared for the NASA MANNED SPACECRAFT CENTER



HILCO ■ A SUBSIDIARY OF Ford Motor Company WESTERN DEVELOPMENT LABORATORIES

54p.

WDL Technical Report E112-3

FACILITY REQUIREMENTS
AND
CRITERIA

Contract Number NAS 9-366

7 September 1962

Submitted to the
NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
Houston, Texas

Submitted by: R. S. Cronhardt
R. S. Cronhardt, Manager,
Gemini/Apollo GOSS Department

Approved by: O. G. Schwede
O. G. Schwede
NASA/GOSS Program Manager

PHILCO CORPORATION
A Subsidiary of Ford Motor Company
Western Development Laboratories
Palo Alto, California

FOREWORD

The study presently being conducted by Philco WDL under Contract NAS9-366, "Design and Development Study for Manned Space Flight Operations Control and Support," comprises eight major areas, each of which is documented in a separate report. Although some of these areas of study may be further subdivided, they are reported in the same series of documents because of their inter-related nature. The eight report areas are described briefly in the following paragraphs.

1. Facility Requirements and Criteria – TR-E112
   This series of reports will document information pertaining to the overall configuration of the IMCC building, including overall building dimensions, allocation of space for major systems and subsystems, and primary and standby power and air-conditioning estimates for the required equipment.

2. Information Flow Plan (Gemini Rendezvous Operation) – TR-E114
   This series of reports will contain three major elements: (1) information flow requirements (2) information flow plan, and (3) operational concepts and procedures. These elements will be analyzed by mission phase, and by function. Mission phases include checkout, countdown, powered flight, and orbital operations with emphasis on rendezvous, reentry, and recovery. Major functions include flight dynamics, spacecraft systems, life support systems, network control, launch operations, and recovery operations. These reports will also discuss the manning required to perform these functions.

3. IMCC Systems and Performance Requirements – TR-E120
   This series of reports will delineate specifications for the mission control center systems for (1) Gemini rendezvous operations, (2) Manned Apollo earth orbital operations, and (3) Apollo lunar operations. This report series will also present specifications for the Integrated Mission Control Center in

support of all three operations mentioned above. The major systems discussed in these reports include communications, data handling, display/control, and simulation and checkout.

4. Information Flow Plan Development (Manned Apollo Missions)– TR-E121

This series of reports will contain (1) information flow requirements, (2) information flow plan, and (3) operational concepts and procedures for manned Apollo earth orbital and lunar missions. Information will be presented by mission phase and by function. The phases will include checkout, countdown, earth orbit, translunar flight, lunar orbit, lunar operations, trans-earth flight, reentry, and recovery. The functions will be the same as those for the E-114 series. Manning concepts will be discussed as they relate to control and support of these operations.

5. GOSS Performance Requirements – TR-E122

This series of reports will translate the information flow requirements into terms of the performance required of ground equipment to support Gemini rendezvous and manned Apollo missions. These reports will integrate information flow requirements to the end that like requirements for the different missions may be accommodated by the same classes of equipment. Also, the difference between mission requirements (for example, between earth and orbital and lunar missions), the impact on support requirements performance (within phases), and the transition between phases will be adequately taken into account in this series of reports.

6. IMCC Procurement Plan – TR-E125

This series of reports will contain procurement information for typical systems and subsystems which perform the functional operations within the IMCC, and will present scheduling information on long-lead-time items, and items requiring developmental effort. These reports are not intended to be complete procurement documents which, typically, include identification and characteristics of all the components. Rather, the reports

will provide data demonstrating the feasibility of achieving the target dates of the schedule.

7. IMCC Functional Checkout Plan – TR-E126

   This series of reports will contain the general plan for initial checkout of the IMCC systems after installation and prior to accpetance. The reports will also include documentation concerning the scheduling of checkouts (when the facility is in operation), and the intended use of the simulation and checkout system to facilitate this checkout. Personnel and equipment required specifically for systems checkout will be identified as part of the plan.

8. IMCC Functional Maintenance Plan – TR-E127

   This series of reports will discuss the maintenance plan for the IMCC operational systems, excluding facility maintenance. Procedures for preventive and routine maintenance during operation will be discussed, considerations of minimum interference to operations will be delineated, and information concerning logistics, spare parts, personnel, maintenance equipment, and similar items will be included.

This report, WDL-TR-E112-3, presents progress to date on the study area listed in Item 1 above.

CONTENTS

SECTION 1
INTRODUCTION

The Integrated Mission Control Center (IMCC) will house the personnel, equipment, and facilities necessary to exercise operational direction, technical management and operational support for manned space flight programs.

It is the purpose of this document to outline the requirements placed on the structure which houses the Integrated Mission Control Center and to set forth the basic criteria which must be documented to implement the technical equipment and operational areas within the building.

This document represents the third issue of Philco WDL Technical Report E-112. Previous issues [WDL-TR-E112, TR-E112-1 (never published) and TR-E112-2] contained descriptions of IMCC system concepts and functional requirements. These descriptions will be omitted in this and future issues of WDL-TR-E112 and are now included in WDL Technical Reports E114, E120 and E112.

Detailed building criteria previously set forth in WDL-TR-E112-2 are also omitted from this and future issues, and will be included in special reports by the architectural and engineering design group within Philco WDL, which is directly concerned with providing detailed criteria for the architectural and engineering design contractor via the appropriate NASA – MSC and Corps of Engineers channels.

SECTION 2
FACILITY DESCRIPTION

2.1 GENERAL

The Integrated Mission Control Center Facility has been designated Building No. 30 and will be located at the Clear Lake Site of the Manned Spacecraft Center. Building No. 30 will be a three-story structure consisting of a Mission Operations Wing, an Operational Support Wing and an interconnecting Lobby Wing. Building No. 48 is located adjacent to the Mission Operations Wing and will be designed to house electrical and mechanical facilities for the Mission Operations Wing. Figure 2.1-1 represents a site plan showing the approximate location of Buildings Nos. 30 and 48. The Mission Operations Wing will have a total floor area of approximately 113,000 square feet and will contain all technical equipment and facilities, and all operational areas required to support the mission control and monitoring functions of the IMCC.

The Operational Support Wing will have a total floor area of approximately 117,600 square feet and will contain the office, laboratory and technical support functions of the Flight Operations Division.

The Lobby Wing will provide an interconnection between the two main wings and will contain space for a lobby, security control, sleeping facilities and additional offices. This wing will contain a total floor area of approximately 14,000 square feet.

Building No. 48, the Emergency Power Building, will be a single-story structure of approximately 10,500 square feet and will contain all stand-by equipment for power generation, air-conditioning and interim and backup heating facilities for the Mission Operations Wing.

Architectural design of the IMCC Building No. 30 and its component wings, and the Emergency Power Building No. 48 will generally conform to the outline specifications for all structures at the Manned Spacecraft Center.

Figure 2.1-2 is a perspective view showing the general appearance of the Integrated Mission Control Center. Figures 2.1-3, 2.1-4 and 2.1-5 present overall floor plans for Building No. 30.

2.2 MISSION OPERATIONS WING

2.2.1 General

Space Allocation, electrical and mechanical criteria, and supporting criteria for the Mission Operations Wing are based on system analysis, preliminary system design, and equipment assumptions.

The total areas of the Mission Operations Wing is allocated as follows:

Floor	Length	Width	Area (square feet)
1st	224' – 0"	168' – 0"	37,632
2nd	224' – 0"	168' – 0"	37,632
3rd	224' – 0"	168' – 0"	37,632
			112,896

The following facilities are accommodated within this total floor space:

Communication Facilities
Data Processing Facilities
Mission Operation Facilities
Simulation and Checkout Facilities
Support Facilities

Each of these systems and facilities has unique requirements and must be given physical space in the Mission Operations Wing. Figures 2.2.1-1, 2.2.1-2, and 2.2.1-3 present floor plans for the Mission Operations Wing. Further description of operational spaces will be referenced to the preliminary room numbers as assigned on these figures.

In general, the communication and the data processing systems located on the first floor are information handling facilities which support the Mission Operation System. The Mission Operation System encompasses two identical mission control facilities which are located on the second and third floor of the Mission Operations Wing, permitting an operational mission to take place in one facility, while preparation, check-out, or simulation exercises are performed in the other.

Design criteria for the various areas within the Mission Operations Wing are governed by the following:

- Operational requirements
- Equipment quantity, density, weight and dimensions
- Equipment heat release, cooling and personnel comfort
- Cabling methods and requirements
- Special environmental requirements
- Equipment power requirements
- Personnel occupancy

In addition to these explicit requirements, there are certain additional needs which must be considered. These include human engineering and architectural design considerations, personnel traffic, necessary support facilities, and access to equipment and equipment areas for maintenance purposes. For a description of the various system and equipment functions which have led to the basic IMCC facility design, the reader is referred to Report No. WDL-TR-E120, entitled "IMCC System and Performance Requirements and Specifications." The following sections are devoted to descriptions of space allocations, structural, mechanical and electrical requirements, and criteria for the various facilities and functional systems contained in the Mission Operations Wing.

2.2.2 Communication Facilities

All equipment and operational areas for the communication facilities are located on the first floor of the Mission Operations Wing, as shown in Figure 2.2.1-1 in Room Nos. 116, 117, 118, 119, 122, 127, 128 and 130.

Space allocations and structural requirements for these rooms are given in Table 2.2.2-1. Mechanical Criteria are listed in Table 2.2.2-2. Electrical Criteria are ahown in Table 2.2.2-3.

2.2.3 Data Processing Facilities

Equipment and operational facilities for the data processing equipment are located on the first floor of the Mission Operations Wing, as shown in Figure 2.2.1-1, in Room Nos. 110, 111 and 112. Space allocations and structural criteria for these areas are given in Table 2.2.3-1. Mechanical criteria are listed in Table 2.2.3-2. Electrical criteria are shown in Table 2.2.3-3.

Table Nos. 2.2.3-2, and -3 indicate different power requirements and heat release figures for three data processing equipment complements which are discussed in Report No. WDL-TR-E120, "IMCC Systems and Performance Specifications." Section 4.3.5.1 of this report discusses three classes of computer equipment which are capable of satisfying the IMCC data processing requirements. Briefly, the three computer complements are described as:

Complement A – Nine computers of the IBM-7090, UNIVAC 1107 or PHILCO 211 class

Complement B – Five IBM-7094 computers

Complement C – Four CDC-3600 or PHILCO 212 computers

While it is not the purpose of this present report to discuss trade-offs between the three applicable data processing equipment complements described in WDL-TR-E120, it should be pointed out that facility requirements in terms of power and air conditioning load strongly favor the choice of computer complements B or C. While space is provided to house computer complex A in the data processing area, complexes B and C offer savings in space which would be available for system expansion.

2.2.4 Mission Operations Facilities

All equipment and operating areas associated with the mission operations facilities are located on the second and third floor of the Mission Operations Wing with the exception of the television terminal equipment room (Rm. 129) which is located on the first floor. The following list presents the areas allocated to the Mission Operations System:

Room 129 – Closed-circuit television terminal equipment and control room
Room 210 – Network support staff
Room 211 – Operations and procedures
Room 212 – Flight dynamics support area
Room 213 – Spacecraft systems support area
Room 214 – Life support systems and flight test support area
Room 216 – Display terminal equipment
Room 226 – Recovery communications
Room 227 – Recovery control No. 1
Room 228 – MOCR No. 1 conference and ready room
Room 230 – Summary display projection
Room 231 – Mission operations control room (MOCR) No. 1
Room 233 – Visitor's viewing area
Room 310 – Network support staff
Room 311 – Operations and procedures
Room 312 – Flight dynamics support area
Room 313 – Spacecraft systems support area
Room 314 – Life support systems and flight test support area
Room 316 – Display terminal equipment
Room 325 – Recovery communications
Room 326 – MOCR No. 2 conference and ready room
Room 327 – Recovery control No. 2
Room 329 – Summary display projection
Room 330 – Mission operations control room No. 2
Room 332 – Visitor's viewing area

Space allocations and structural criteria for the above rooms are given in Table 2.2.4-1. Mechanical criteria are listed in Table 2.2.4-2. Electrical criteria are shown in Table 2.2.4-3.

2.2.5 Simulation and Checkout Facilities

The primary equipment and operating areas associated with the simulation and checkout facilities are located in four rooms on the second and third floors of the Mission Operations Wing.

The room designations of these areas are listed below:

Room 219 – Simulation Equipment Area No. 1
Room 229 – Simulation Control Area No. 1
Room 324 – Simulation Equipment Area No. 2
Room 328 – Simulation Control Area No. 2

In addition to the above facilities, the simulation and checkout system also utilizes equipment in the data processing facilities, which have been described elsewhere. Tables 2.2.5-1, 2.2.5-2, and 2.2.5-3 list the space allocations and structural criteria, the mechanical criteria and the electrical criteria, respectively.

2.2.6 Operational Instrumentation Facility

An equipment and operational area for the operational instrumentation facility is located on the third floor of the Mission Operations Wing. Room No. 319 serves as a telemetry, tracking, and data equipment area for this facility. Structural, mechanical, and electrical criteria for Room No. 319 are summarized below:

Area	4,950 sq ft
Minimum vertical clearance	14 ft
Permanent equipment Load	2.93 lbs/sq ft
Maximum concentrated load	150 lbs/sq ft
Equipment heat release	442 MBH
Environmental criteria	W-70°F(±) S-75°F(±) 50% RF ±10%

Estimated occupancy	25 people
Equipment electrical load	130 kw, Category B

Since the associated antenna system has not been specified at this time, detailed structural, mechanical, and electrical criteria for the support of this system are not available. These requirements will be included in subsequent issues of this report.

2.2.7 Support Facilities

The equipment and operational areas of the support facilities are located in Room Nos. 114, 115, 220 and 225. Table 2.2.7-1 lists the functions of these rooms. The space allocations and structural, mechanical, and electrical criteria for these rooms are listed in Tables 2.2.7-2, 2.2.7-3, and 2.2.7-4, respectively.

2.2.8 Other Facilities

The remaining area in the Mission Operations Wing has been allocated to elevators, stairways, corridors, toilets, and mechanical equipment space, as shown in the floor plans, Figures 2.2.1-1, 2.2.1-2, 2.2.1-3. Structural, mechanical, and electrical criteria for these areas are to be determined by Architectural and Engineering Contractor.

2.3 OPERATIONAL SUPPORT WING

2.3.1 General

Electrical, mechanical, and structural criteria for the Operational Support Wing are not as specialized as those of the Mission Operations Wing and, consequently, the determination of the majority of this criteria is the responsibility of the cognizant architectural and engineering firm. Only special requirements of the Operational Support Wing are described in this section.

For reasons of simplicity the Operational Support Wing will be assumed to include the Lobby Wing. The total area of the Operational Support Wing may be broken down as follows:

Location	Length	Width	Area (sq ft)
Lobby Wing 1st, 2nd and 3rd floors	84'	56'	4,704
Operational Support Wing 1st, 2nd and 3rd floors	140'	280'	39,200
TOTAL Area (sum of all 3 floors of Lobby and Operational Support Wing)			131,712 sq ft

This area is divided primarily into laboratory and technical support facilities, office and administrative spaces, and miscellaneous facilities. Reference to Figures 2.1-3, 2.1-4, and 2.1-5 will show the proposed locations of these facilities as they are described in this section.

2.3.2 Laboratory and Technical Support Facilities

Generally, the laboratory and technical support facilities are located in the central sections of all three floors of the Operational Support Wing. Table 2.3.2-1 lists the area designations, their space allocations, and other specific architectural criteria. At this time, the only structural criteria imposed is that all areas must be capable of supporting a live load of 125 lbs per sq ft. Table 2.3.2-2 lists the mechanical criteria for these area, and Table 2.3.2-3, the electrical criteria.

2.3.3 Office Facilities

Office facilities are located around the perimeter of all three floors of the Operational Support Wing, and the second and third floors of the Lobby Wing. The total space allocation for office facilities is approximately 75,300 sq ft. The structural, mechanical and electrical criteria will be determined by the architectural and engineering contractor, except where such requirements interfere with the operational performance of the building. These requirements will be subject to review and approval by the Flight Operations Division.

2.3.4 Miscellaneous Facilities

The remaining areas in the Operational Support Wing have been allocated to an entrance and security control area, a mission briefing and observation area, mechanical and electrical equipment rooms, washrooms and toilets, and traffic circulation corridors. With the exception of the mission briefing and observation area, requirements for these areas will be determined by the architectural and engineering firm, except where such requirements interfere with the operational performance of the building.

2.3.4.1 Mission Briefing and Observation Facility

The mission briefing and observation facility is located on the first floor of the Operational Support Wing. Its general appearance will be that of a theatre used for mission briefing and observation. The general design must conform to good architectural and engineering practices utilized in theatre design. Specific architectural, structural, mechanical and electrical criteria are listed below:

Space allocation	1,405 sq ft
Projection room height (min)	8 ft
Stage height (min)	12 ft
Screen size (min)	9 ft by 12 ft
Seating capacity (min)	150 persons
Illumination level	Dimmers 0—25 foot-candles
Environment requirement	W - 70°F±, S - 75°F± 50% RH±10%
Power required (projection room)	8 kw — 120/208 volts

2.4 EMERGENCY POWER BUILDING

The Emergency Power Building is designated Building No. 48. The building will be a single-story structure conforming in general appearance to the design criteria used for a small laboratory building at the Manned Spacecraft Center. The building will house the facilities of uninterruptible and standby power generation and the standby air-conditioning

and heating equipment. In addition, space will be provided for shop facilities, control facilities, miscellaneous equipment and an office.

Requirement for this building are summarized below:

Power generation, air-conditioning, and work space	9, 144 sq ft
Shop	352
Office and washroom	352
Control room	368
Battery room	144
	10, 360 sq ft
Length (overall)	140 ft
Width (overall)	74 ft
Height (overall)	26 ft
Minimum clearance	10 ft above tallest generator
Illumination Level	
Office, Shop & Control	50 ft candles at 30" above floor
Equipment Areas	30 ft candles at 30" above floor
Floor live load (min)	200 lbs/sq ft
Environmental Requirements	
Office, Shop & Control	W-70°F ±, S-75°F ±, RH 50% ±10%
Equipment Areas	Forced air ventilation
Fuel storage	20, 000 gallons diesel fuel
Access	Large overhead steel doors will be provided for equipment entrance and removal

SECTION 3
TABLES

This section contains summaries of structural, mechanical and electrical criteria in table format. Table numbers are referenced to the appropriate paragraph numbers in Section 2.

List of Tables

Table 2.2.2-1

SPACE ALLOCATIONS AND STRUCTURAL CRITERIA COMMUNICATIONS AREAS

Room No.	Function	Area (sq ft)	Vertical Clearance	Permanent Equipment Load* (lbs/sq ft)	Maximum Concentrated Load** (lbs/sq ft)	Special Structural Requirements
116	Voice & Intra-Facility Communication Equipment	3380	13'-0"	19.00	150.00	Removable Raised Floor 30" clear under
117	Data Transmission Terminal Equipment Room	1370	13'-0"	18.70	150.00	" "
118	Communication Control	1370	13'-0"	7.44	150.00	" "
119	Teletype Message Center	1518	13'-0"	4.21	150.00	" "
122	Battery Room	110	13'-0"	11.90	50.00	- -
127	Main Distribution Frame & Common Carrier Equipment	645	13'-6"	10.08	150.00	Removable Raised Floor 30" clear under
128	Telco Liaison & Maintenance	392	13'-6"	-	-	" "
130	Communication Processor	1315	13'-0"	23.38	204.00	" "

* Permanent Equipment Load = $\frac{\text{Total Equipment Weight}}{\text{Room Area}}$

** Concentrated Load = Greatest $\left(\frac{\text{Equipment Weight}}{\text{Base Area}}\right)$

Table 2.2.2-2

MECHANICAL CRITERIA – COMMUNICATION AREAS

Room No.	Function	Equipment Heat Release MBH	Environmental Requirement	Estimated Occupancy	Air Conditioning System Sound Control NC Level Average (db)
116	Voice & Intra-Facility Communication Equipment	68.0	W-70F(±)S-75F(±) 50% RH ± 10%	4–6	45
117	Data Transmission Terminal Equipment Room	54.5	" "	3	35
118	Communication Control	61.2	" "	4–5	35
119	Teletype Message Center	13.6	" "	6	45
122	Battery Room		Fume Exhaust	None	50
127	Main Distribution Frame & Common Carrier Equipment	13.6	W-70F(±)S-75F(±) 50% RH ± 10%	1–2	35
128	Telco Liaison & Maintenance	3.4	" "	5	35
130	Communication Processor	136.0	" "	5	35

Table 2.2.2-3

ELECTRICAL CRITERIA – COMMUNICATION AREAS

Room No.	Function	Equipment Power Required					Minimum Lighting Level†
		Category A*	Category B**				
			kw	v	cps	phase	
116	Voice & Intra-Facility Communication Equipment	-	20	120	60	single	50
117	Data Transmission Terminal Equipment	-	16	"	"	"	50
118	Communication Control	-	18	"	"	"	50
119	Teletype Message Center	-	4	"	"	"	50
122	Battery Room	-	3	"	"	"	20
127	Main Distribution Frame & Common Carrier Equipment	-	4	"	"	"	50
128	Telco Liaison & Maintenance	-	1	"	"	"	50
130	Communication Processor	40 kw, 120 v single phase					50

*Category A – Uninterruptible power, Voltage ±8%, Frequency ±0.6 cps (except during no-break switchover when 2 cps frequency droop is permissible for a period not to exceed 10 sec)

**Category B – 20-second interruptible power, Voltage ±10%, Frequency ±3 cps

†Foot candles at 30 inches above the floor.

Table 2.2.3-1

SPACE ALLOCATIONS AND STRUCTURAL CRITERIA – DATA PROCESSING AREAS

Room No.	Function	Area (sq ft)	Vertical Clearance (min)	Permanent Equipment Load (lbs/ sq ft)*	Maximum Concentrated Load (lbs/ sq ft)**	Special Structural Requirements†
110	Tape Storage & Auxiliary Equipment	560	13'-0"	23.38	204.00	Removable Raised Floor 30" clear under
111	Computer Control	266	13'-0"	23.65	96.00	"
112	Data Processing Area	12100	13'-0"	23.38	204.00	"

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* Permanent equipment load = $\frac{\text{Total Equipment Weight}}{\text{Room Area}}$

** Concentrated Load = Greatest $\frac{\text{Equipment Weight}}{\text{Base Area}}$

† Cable access, cooling ducts and plenum chambers

Table 2.2.3-2

MECHANICAL CRITERIA – DATA PROCESSING AREAS

Room No.	Function	Equipment Heat Release MBH	Environmental Requirement	Estimated Occupancy	Air Conditioning System Sound Control NC Level Average (db)
110	Tape Storage and Auxiliary Equipment	3.4	S. & W. 70F 50% RH ±10%	25	35
111	Computer Control	17.0	"	3	35
112	Data Processing Area	Complement A 2176			
		Complement B or C 1228.3	"	25	35

Table 2.2.3-3

ELECTRICAL CRITERIA – DATA PROCESSING AREAS

Room No.	Function	Power Requirement Computer Complement A	Minimum Lighting Level (foot-candle at 30" above floor)
110	Tape Storage and Auxiliary Equipment	1 kw, 120 v, 60 cps, single phase	80
111	Computer Control	5 kw, 120 v, 60 cps, single phase	50
112	Data Processing Area	540 kw, 208 v, 60 cps, three-phase 100 kw, 120 v, 60 cps, single phase	50

Room No.	Function	Power Requirement Computer Complement B or C	
110	Tape Storage and Auxiliary Equipment	1 kw, 120 v, 60 cps, single phase	80
111	Computer Control	5 kw, 120 v, 60 cps, single phase	50
112	Data Processing Area	300 kw, 208 v, 60 cps, three-phase 25 kw, 120 v, 60 cps, single phase	50

Note: All power listed is Category A. i.e., uninterruptible power; voltage ±8%, frequency ±0.6 cps (except during no-break switchover where 2 cps frequency droop for a period not to exceed 10 seconds is permissible)

Table 2.2.4-1

SPACE ALLOCATIONS AND STRUCTURAL CRITERIA – MISSION OPERATIONS AREAS

Room No.	Area	Vertical Clearance	Permanent Equipment Load*	Concentrated Load**	Special Structural Requirements
129	(112x28)=3136	13' - 0"	23.08	150.00	Removable raised floor 30" clear under
210	(40x28)=1120	13' - 0"	3.25	51.90	Removable raised floor 18" clear under
211	(28x20)=560	13' - 0"	3.57	51.90	Removable raised floor 18" clear under
212	(47x48)=2260	13' - 0"	2.39	51.90	Removable raised floor 18" clear under
213	(32x48)=1540	13' - 0"	5.99	152.00	Removable raised floor 18" clear under
214	(32x48)=1540	13' - 0"	5.14	152.00	Removable raised floor 18" clear under
216	(43x64)=2784	17' - 0"	33.83	150.00	Removable raised floor 18" clear under
226	(43x20)=860	13' - 0"	7.44	100.00	Removable raised floor 18" clear under
227	(47x43)=2020	13' - 0"	1.79	51.90	Removable raised floor 18" clear under
228	(24x48)=1152	13' - 0"	negligible	—	Removable raised floor 18" clear under

* Permanent Equipment Load = $\frac{\text{Total Equipment Weight}}{\text{Room Area}}$

** Concentrated Load = Greatest $\left(\frac{\text{Equipment Weight}}{\text{Base Area}}\right)$

Table 2.2.4-1 (Contd)

Room No.	Area	Vertical Clearance	Permanent Equipment Load*	Concentrated Load**	Special Structural Requirements
230	(27x64)=1730	17' - 0"	1.85	150.00	Removable raised floor 18" clear under
231	(46x64)=2940	17' - 0" less height of risers	6.22	51.90	Removable raised floor 18" clear under, risers above
233	(56x24)=1350	10' - 0" above risers	negligible	—	Risers
310	(40x28)=1120	13' - 0"	3.25	51.90	Removable raised floor 18" clear under
311	(20x28)=560	13' - 0"	3.25	51.90	Removable raised floor 18" clear under
312	(47x48)=2260	13' - 0"	2.39	51.90	Raised floor 18" clear under
313	(32x48)=1540	13' - 0"	5.99	152.00	Raised floor 18" clear under
314	(32x48)=2784	17' - 0"	5.14	152.00	Raised floor 18" clear under

*Permanent Equipment Load = $\frac{\text{Total Equipment Weight}}{\text{Room Area}}$

**Concentrated Load = Greatest $\left(\frac{\text{Equipment Weight}}{\text{Base Area}}\right)$

Table 2.2.4-1 (Contd)

Room No.	Area	Vertical Clearance	Requirement Equipment Load*	Concentrated Load**	Special Structural Requirements
316	(43x64)=2784	17' - 0"	33.83	150.00	Raised floor 18" clear under
325	(43x20)=860	13' - 0"	7.44	100.00	Raised floor 18" clear under
326	(24x48)=1152	13' - 0"	negligible	—	Raised floor 18" clear under
327	(47x43)=2020	13' - 0"	1.79	51.90	Raised floor 18" clear under
329	(27x64)=1730	17' - 0"	1.85	150.00	Raised floor 18" clear under
330	(46x64)=2940	17' - 0" less height of risers	6.22	51.90	Removable raised floor 18" clear under, risers above
332	(56x24)=1350	10' - 0" above risers	negligible	—	Risers

*Permanent Equipment Load = $\frac{\text{Total Equipment Weight}}{\text{Room Area}}$

**Concentrated Load = Greatest $\left(\frac{\text{Equipment Weight}}{\text{Base Area}}\right)$

TABLE 2.2.4-2

MECHANICAL CRITERIA - MISSION OPERATIONS FACILITIES

Room No.	Equipment Heat Release MBH	Environmental Requirements	Estimated Occupancy	Air Conditioning System Sound Control NC Level (db) Average
129	470.0	W-70°F(±)S-75°F(±) 50% RH ±10%	10	45
210	17.1	〃	10	40
211	10.2	〃	3	30
212	34.0	〃	20	30
213	17.1	〃	4	30
214	17.1	〃	10	30
216	409.0	〃	2	40
226	17.1	〃	6	40
227	51.0	〃	15	30
228	- -	〃	50	35
230	- -	〃	2	35
231	17.1	〃	15	30
233	3.4	〃	90	35
310	17.1	〃	10	40
311	10.2	〃	3	30
312	34.1	〃	20	30
313	17.1	〃	4	30
314	17.1	〃	10	30
316	409.0	〃	2	40
325	17.1	〃	6	40
326	- -	〃	10	35
327	51.0	〃	15	30
329	- -	〃	2	35
330	17.1	〃	15	30
332	3.4	〃	90	35

TABLE 2.2.4-3

ELECTRICAL CRITERIA - MISSION OPERATIONS FACILITY

Room No.	Equipment Power (KW) Required All Power is Category B 120V, 60 cps, 1 phase	Minimum Lighting Level (Foot Candle at 30" Above the Floor)
129	138	20 and 50
210	5	50
211	3	50
212	10	50
213	5	50
214	5	50
216	120	50
226	5	50
227	15	50
228	- -	50
230	- -	Dimmers 0 to 20
231	5	Dimmers 0 to 30
233	1	Dimmers 0 to 30
310	5	50
311	3	50
312	10	50
313	5	50
314	5	50
316	120	50
325	5	50
326	- -	50
327	15	50
329	- -	Dimmers 0 to 20
330	5	Dimmers 0 to 30
332	1	Dimmers 0 to 30

Table 2.2.5-1

SPACE ALLOCATIONS AND STRUCTURAL CRITERIA – SIMULATION AND CHECKOUT AREAS

Room No.	Area (sq ft)	Vertical Clearance (ft)	Permanent Equipment Load (lb/sq ft)*	Load** Conc.	Special Structural Requirements
219	2,772	13	4.34	150.0	Removable raised floor 18" clear under
229	480	13	2.54	51.9	Removable raised floor 18" clear under
324	1,848	13	4.34	150.0	Removable raised floor 18" clear under
328	480	13	2.54	51.9	Removable raised floor 18" clear under

---

* Equipment Load $= \frac{\text{Total Equipment Weight}}{\text{Room Area}}$

** Concentrated Load $= \text{Greatest} \left(\frac{\text{Equipment Weight}}{\text{Base Area}} \right)$

Table 2.2.5-2

MECHANICAL CRITERIA – SIMULATION AND CHECKOUT AREAS

Room No.	Equipment Heat Release MBH	Environmental Requirement	Estimated Occupancy	Air-Conditioning System Sound Control NC Level Average (db)
219	75.0	W-70°F(±) S-75°F ± 50% RH ±10%	2	40
229	6.8	[illegible]	2	35
234	61.2	[illegible]	2	40
328	6.8	[illegible]	2	35

Table 2.2.5-3

ELECTRICAL CRITERIA – SIMULATION AND CHECKOUT FACILITIES

Room No.	Equipment Power Required* (kw)	Lighting Level (ft-c at 30" above floor)
219	22	50
229	2	25
324	18	50
328	2	25

*All power is category B 120 v 60 cps 1 phase
voltage ±8%
Frequency ±3 cycles

Table 2.2.7-1

FUNCTIONAL AREAS – SUPPORT FACILITIES

Room Number	Function
114	Computer Complex Maintenance Area
115	Communication Maintenance
225	Meteorological Center
220	Display Equipment Maintenance

Table 2.2.7-2

SPACE ALLOCATIONS AND STRUCTURAL REQUIREMENTS SUPPORT FACILITIES

Room No.	Area (sq ft)	Vertical Clearance	Permanent Equipment Load* (lbs/ sq ft)	Maximum Concentrated Load** (lbs/sq ft)	Special Requirements
114	1064	13'-0"	10.77	140.00	none
115	1254	13'-0"	5.11	150.00	none
225	1848	13'-0"	†	150.00	none
220	2178	13'-0"	†	150.00	none

*Permanent Equipment Load = $\frac{\text{Total Equipment Weight}}{\text{Room Area}}$

**Maximum Concentrated Load = Greatest $\left(\frac{\text{Equipment Weight}}{\text{Base Area}}\right)$

†No Information Regarding Equipment

Table 2.2.7-3

MECHANICAL CRITERIA – SUPPORT FACILITIES

Room No.	Equipment Heat Release MBH	Environmental Requirements	Estimated Occupancy	Air-Conditioning System Sound Control Average (db)
114	17.1	W - 70°F (±) S - 75°F (±) 50% RH ± 10%	10	45
115	13.6	"	10	45
225	34.0	"	15	40
220	34.0	"	10	40

Table 2.2.7-4

ELECTRICAL CRITERIA – SUPPORT FACILITIES

Room No.	Power Required (kw)*	Lighting Level 30" above floor (foot candles)
114	10	50
115	10	50
225	10	50
220	10	50

*All power is category B 120 v 60 cps 1 phase

Table 2.3.2-1

SPACE ALLOCATIONS AND SPECIAL REQUIREMENTS
LABORATORY AND TECHNICAL SUPPORT FACILITIES
OPERATIONAL SUPPORT WING

Room No.	Name & Function	Area (sq ft)	Minimum Clearance	Special Requirements
1053	Machine Model Shop	1,848	10' – 0"	–
	Mission Documentation and Files Including:	4,224	10' – 0"	–
1059	Drafting Room	1,056		
1058	Reproduction	1,056		
1063 & 1064	Photo Lab	266		
1061 & 1062	Storage, Supply, Files & Vault	790	10' – 0"	
1060	Technical Support Laboratory	1,056	10' – 0"	–
2050	Operational Communication Laboratory	2,508	10' – 0"	–
2051	Operational Performance Laboratory	2,508	10' – 0"	raised floor 12" clear under
2062	Flight Control and Display Laboratory	2,376	10' – 0"	raised floor 12" clear under
2048	Technical Support Laboratory	812	10' – 0"	raised floor 12" clear under
2049	Data Automation Laboratory	1,102	10' – 0"	raised floor 12" clear under
3048 & 3049	Technical Support Laboratory	1,848	10' – 0"	raised floor 12" clear under

Table 2.3.2-1 (contd)

Room No.	Name & Function	Area (sq ft)	Minimum Clearance	Special Requirements
3051	Mission Development Computer Room #1	924	10' – 0"	raised floor 12" clear under
3050	Mission Development Computer Room #2	2,632	10' – 0"	raised floor 12" clear under
2052	Computer Laboratory	924	10' – 0"	raised floor 12" clear under

Table 2.3.2-2

MECHANICAL REQUIREMENTS

LABORATORY AND TECHNICAL SUPPORT FACILITIES

OPERATION SUPPORT WING

Room No.	Title	Equipment Heat Release MBH	Environmental Requirement	Estimated Occupancy	Air Conditioning System Sound Control NC Level Average (db)
2050	Operational Communication Lab.	17.0	W - 70°F(±) S - 75°F(±) 50% R. H.±10%	10	35
2051	Operational Performance Lab.	34.0	W - 70°F(±) S - 75°F(±) 50% R. H.± 10%	5	35
2062	Flight Control and Display Lab	--(1)	W - 70°F(±) S - 75°F(±) 50% R. H. ±10%	--(1)	35
2049	Data Automation Lab	--(1)	W - 70°F(±) S - 75°F(±) 50% R. H. ±10%	10	35
3051	Mission Development Computer Room #1	34	W - 70°F(±) S - 75°F(±) 50% R. H. ±10%	--(1)	35
3050	Mission Development Computer Room #2	204	W - 70°F(±) S - 75°F(±) 50% R. H. ±10%	--(1)	35
3052	Computer Laboratory	--(1)	W - 70°F(±) S - 75°F(±) 50% R. H. ±10%	5	35

(1) Unknown at this time

Table 2.3.2-2 (Cont)

Room No.	Title	Equipment Heat Release MBH	Environmental Requirement	Estimated Occupancy	Air Conditioning System Sound Control NC Level Average (db)
1053	Machine Model Shop	68	W - 70°F(±) S - 75°F(±) 50% R.H. ±10%	3	45
1058 - 1064	Mission Documentation and Files	34	W - 70°F(±) S - 75°F(±) 50% R.H. ±10%	7	35

Table 2.3.2-3

ELECTRICAL REQUIREMENTS – LABORATORY AND TECHNICAL SUPPORT FACILITIES
OPERATIONAL SUPPORT WING

Room No.	Title	Power Required** (All Power Class C) kw	volt	phase	Minimum Lighting Level (ft-c at 30" above the floor)
2050	Operational Communications Laboratory	5	120	1	50
2051	Operational Performance Lab.	10	120	1	50
2062	Flight Control & Display Lab.	10			50
2049	Data Automation Laboratory	10			50
3051	Mission Development Computer Room No. 1	10	208	3	50
3050	Mission Development Computer Room #2	60	208	3	50
3052	Computer Laboratory	*			50
1053	Machine Model Shop	50	480	3	50
1058–1064	Mission Documentation And Files	10	120	1	50

*Unknown at this time
**Class C Power is commercial power (60 cps) with no backup provided

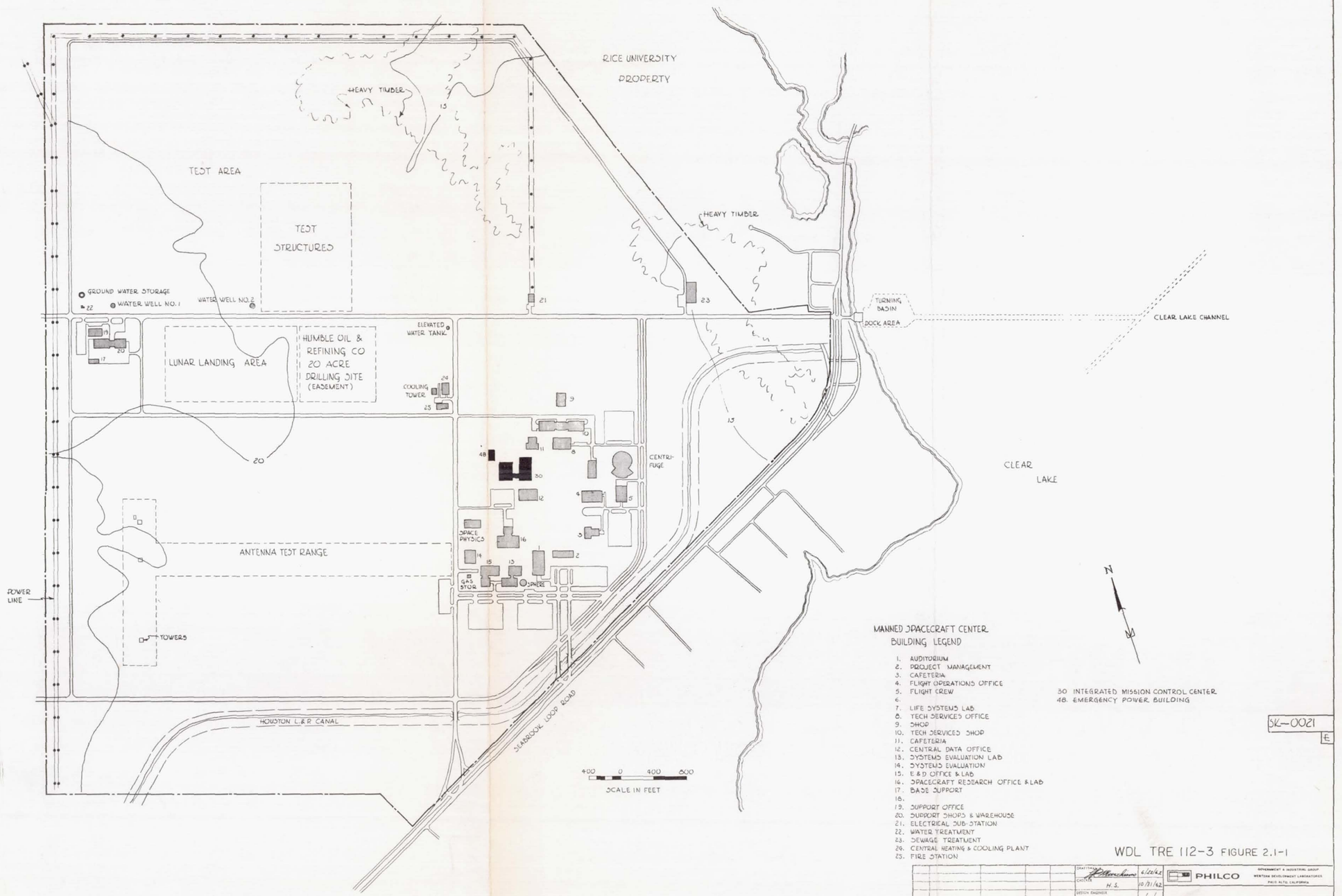
SECTION 4
FIGURES
DRAWINGS and SCHEDULES

This section contains drawings and schedules. Figure numbers are referenced to the appropriate paragraph numbers in Section 2.

List of Drawings and Schedules

Figure	
2.1-1	Site Plan
2.1-2	IMCC Perspective
2.1-3	IMCC Bldg. No. 30, First Floor Plan
2.1-4	IMCC Bldg. No. 30, Second Floor Plan
2.1-5	IMCC Bldg. No. 30, Third Floor Plan
2.1-6	Room Schedule - First Floor (MOW)
2.1-7	Room Schedule - Second Floor (MOW)
2.1-8	Room Schedule - Third Floor (MOW)
2.2.1-1	IMCC - MOW Bldg. No. 30 - First Floor Plan
2.2.1-2	IMCC - MOW Bldg. No. 30 - Second Floor Plan
2.2.1-3	IMCC - MOW Bldg. No. 30 - Third Floor Plan

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED
B		REVISED & REDRAWN	6-22-62	M
C		ADD TIMBER, POWER LINES, ELEVATIONS	7-11-62	M
D		RELOCATED IMCC	9-24-62	M
E		ADDED IMCC, EMERG. PWR. BLDG.	10-30-62	PMC



MANNED SPACECRAFT CENTER
BUILDING LEGEND

1. AUDITORIUM
2. PROJECT MANAGEMENT
3. CAFETERIA
4. FLIGHT OPERATIONS OFFICE
5. FLIGHT CREW
6.
7. LIFE SYSTEMS LAB
8. TECH SERVICES OFFICE
9. SHOP
10. TECH SERVICES SHOP
11. CAFETERIA
12. CENTRAL DATA OFFICE
13. SYSTEMS EVALUATION LAB
14. SYSTEMS EVALUATION
15. E & D OFFICE & LAB
16. SPACECRAFT RESEARCH OFFICE & LAB
17. BASE SUPPORT
18.
19. SUPPORT OFFICE
20. SUPPORT SHOPS & WAREHOUSE
21. ELECTRICAL SUB-STATION
22. WATER TREATMENT
23. SEWAGE TREATMENT
24. CENTRAL HEATING & COOLING PLANT
25. FIRE STATION

30. INTEGRATED MISSION CONTROL CENTER
48. EMERGENCY POWER BUILDING

SK-0021
E

WDL TRE 112-3 FIGURE 2.1-1

NOTES (UNLESS OTHERWISE SPECIFIED)

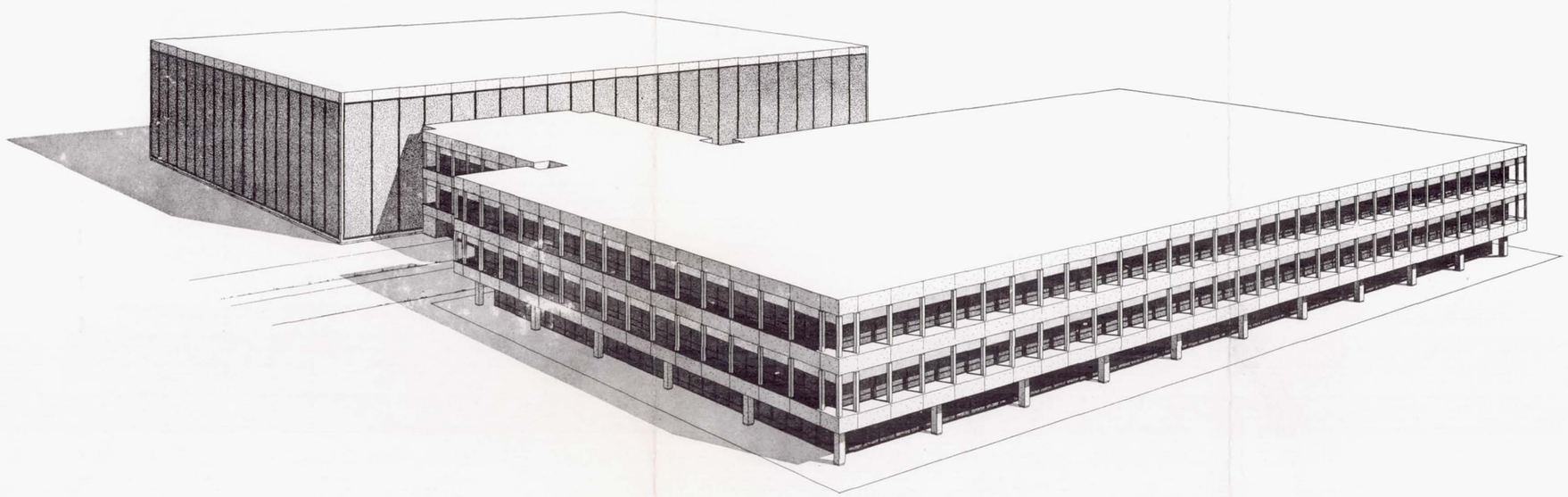
DRAFTSMAN	J. Marchan	6/26/62	PHILCO — GOVERNMENT & INDUSTRIAL GROUP, WESTERN DEVELOPMENT LABORATORIES, PALO ALTO, CALIFORNIA
CHECKER	H.S.	10/31/62	
DESIGN ENGINEER		/ /	
PROJECT ENGINEER		/ /	SITE PLAN
RELEASED		/ /	
		/ /	CODE IDENT NO. 11530 — SIZE E — SK-0021 E
			SCALE 1"=800' — WEIGHT — SHEET 1 OF 1

INTEGRATED MISSION CONTROL CENTER

MANNED SPACECRAFT CENTER

NATIONAL AERONAUTICS & SPACE ADMINISTRATION

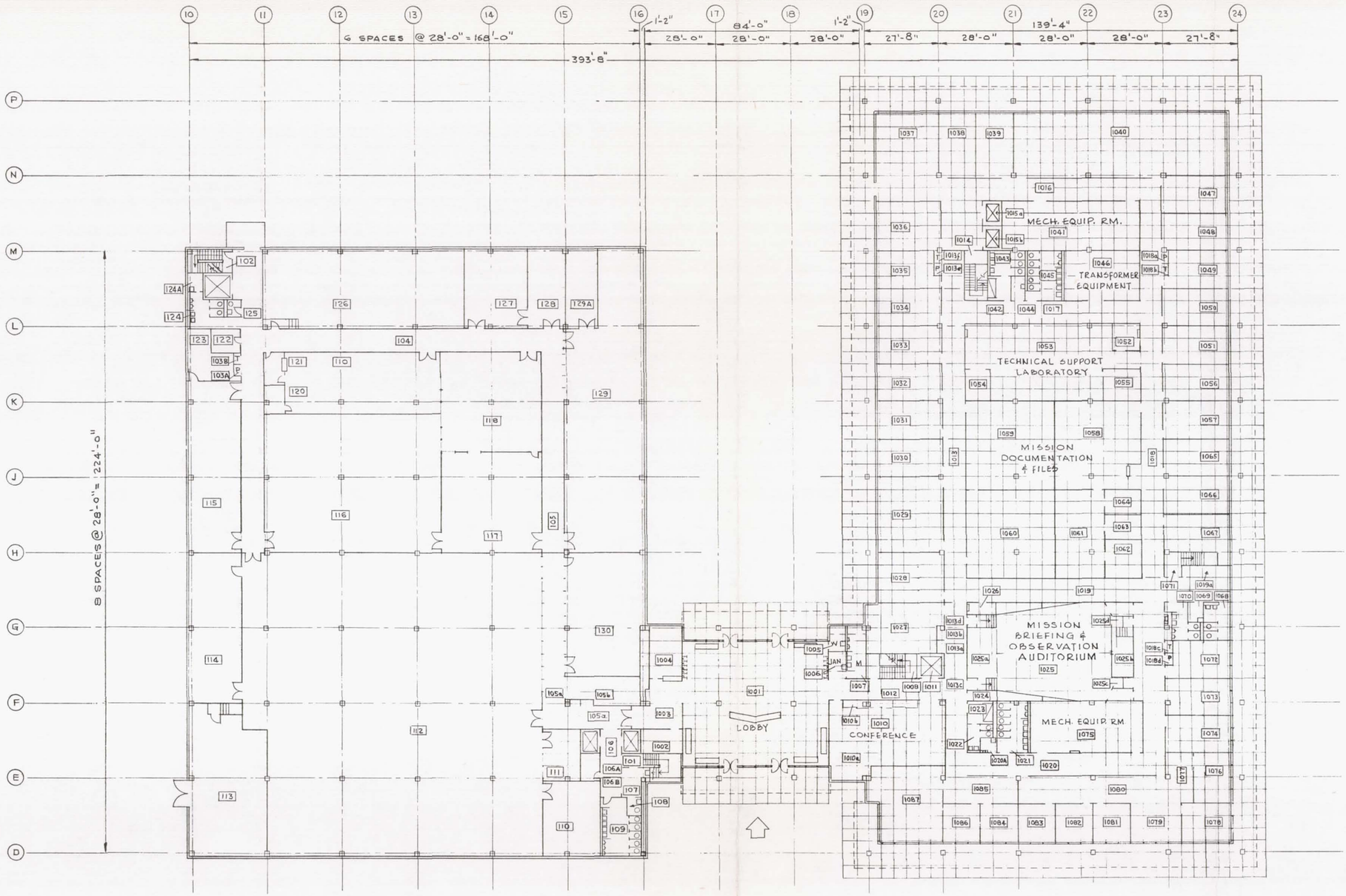
CLEAR LAKE, HARRIS COUNTY, TEXAS



SK-0055

WDL TRE 112-3 FIGURE 2.1-2

	9/17/62	PHILCO	
H.S.	10/31/62	IMCC PERSPECTIVE	
		CON IDENT NO 11530	SIZE E
			SK-0055
			WEIGHT SHEET OF



SK-1006

1" = 1'-0"

1' 0 4' 8' 12' 16' 20' 24'

WDL TRE 112-3 FIGURE 2.1-3

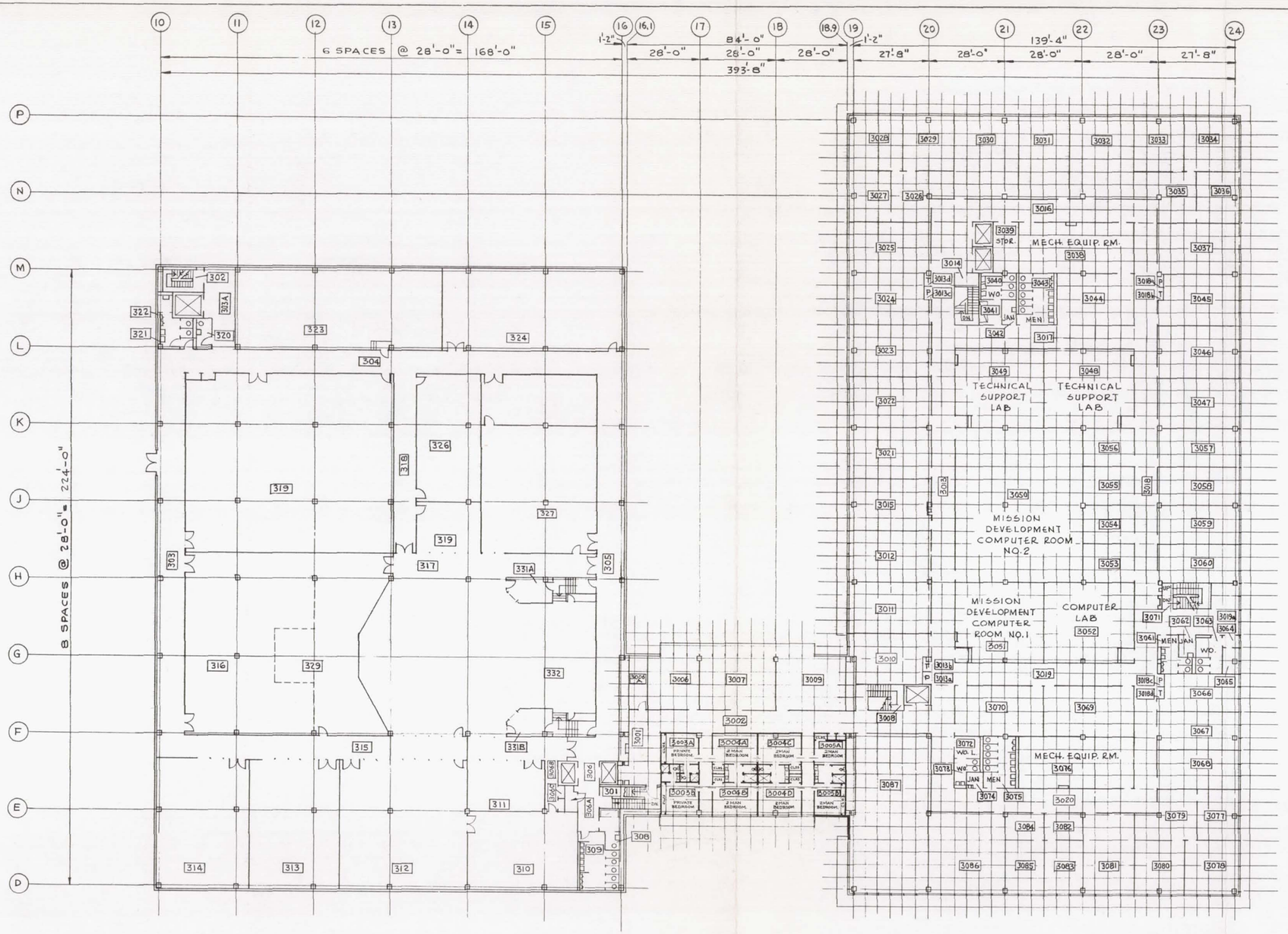
B. BAGEYEV 10 4 62	PHILCO — GOVERNMENT & INDUSTRIAL GROUP, WESTERN DEVELOPMENT LABORATORIES, PALO ALTO, CALIFORNIA	
H.S. 10 31 62	INTEGRATED MISSION CONTROL CENTER BUILDING NO. 30 FIRST FLOOR PLAN	
	11530 F SK-1006	
	1" = 1'-0" WEIGHT: SHEET 1 OF 1	

SK-1007

1/16" = 1'-0"

WDL. TRE 112-3. FIGURE 2.1-4

B. BAGEYEV	10 8 62	PHILCO	GOVERNMENT & INDUSTRIAL GROUP WESTERN DEVELOPMENT LABORATORIES PALO ALTO, CALIFORNIA
H.S.	10 31 62	INTEGRATED MISSION CONTROL CENTER BUILDING NO. 30 SECOND FLOOR PLAN	
		1130 F SK-1007	
		1/16"=1'-0"	



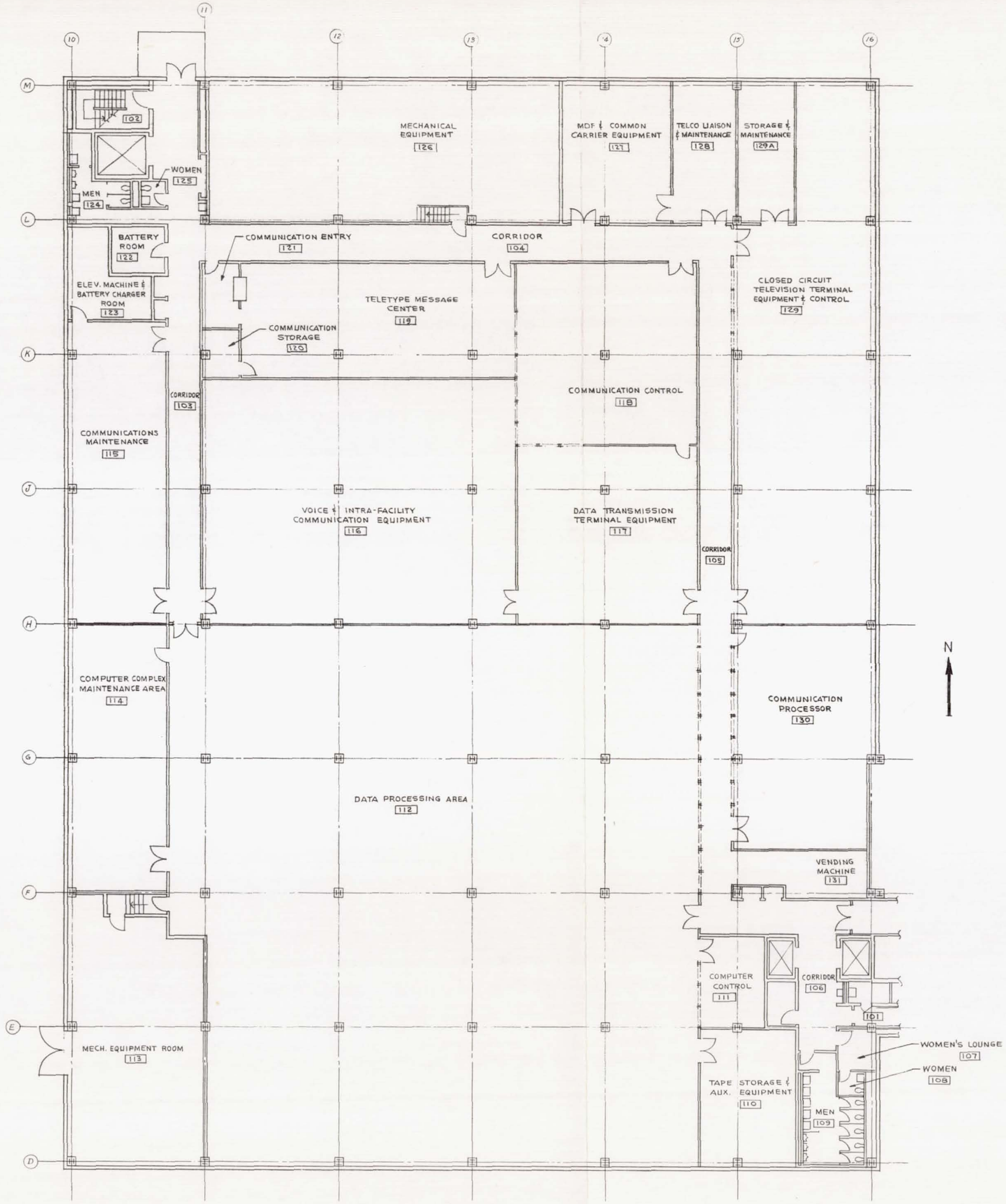
SK-1008

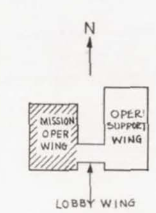
1/16" = 1'-0"

WDL. TRE 112-3 FIGURE 2.1-5

DRAFTSMAN B. BAGEYEV	10/9/62	PHILCO — GOVERNMENT & INDUSTRIAL GROUP, WESTERN DEVELOPMENT LABORATORIES, PALO ALTO, CALIFORNIA
CHECKER H.S.	10/31/62	INTEGRATED MISSION CONTROLCENTER
DESIGN ENGINEER	/ /	BUILDING NO. 30
PROJECT ENGINEER	/ /	THIRD FLOOR PLAN
RELEASED	/ /	CODE IDENT NO. 11530 — SIZE F — SK– 1008
	/ /	SCALE 1/16"=1'-0" — WEIGHT — SHEET OF

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED





KEY PLAN

SK-1027

WDL TRE 112-3 FIGURE 2.2.1-1

NOTES (UNLESS OTHERWISE SPECIFIED):

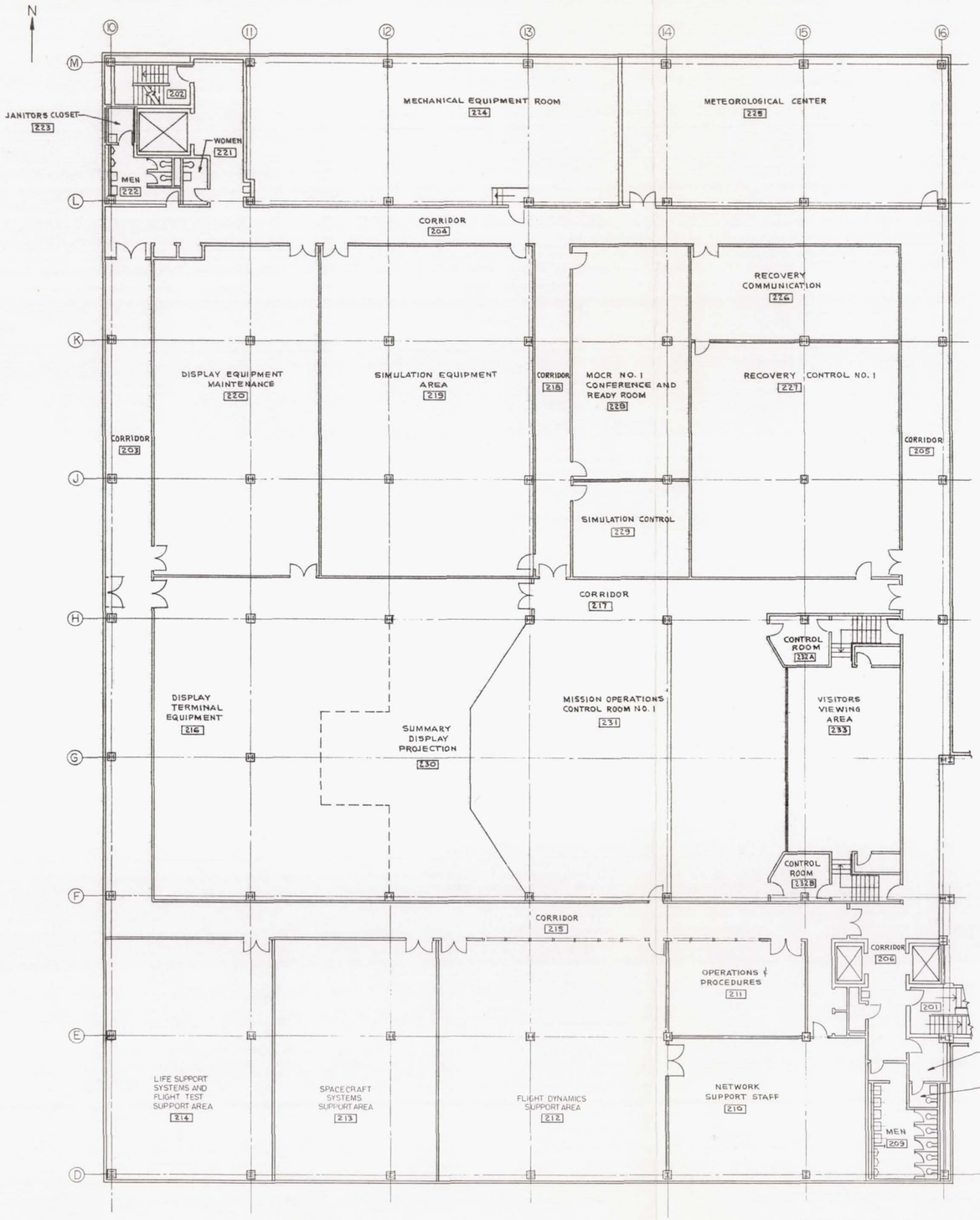
DRAFTSMAN B. BAGEYEV	10/30/62
CHECKER H.S.	10/31/62
DESIGN ENGINEER	/ /
PROJECT ENGINEER	/ /
	/ /
RELEASED	/ /
	/ /

PHILCO — GOVERNMENT & INDUSTRIAL GROUP, WESTERN DEVELOPMENT LABORATORIES, PALO ALTO, CALIFORNIA

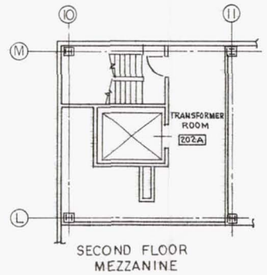
INTEGRATED MISSION CONTROL CENTER
MISSION OPERATIONS WING BUILDING NO. 30
FIRST FLOOR PLAN

CODE IDENT NO.	SIZE	
11530	E	SK – 1027
SCALE 1/8"=1'-0"	WEIGHT	SHEET OF

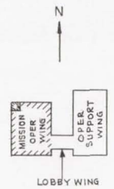
REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED



NOTES (UNLESS OTHERWISE SPECIFIED):



SECOND FLOOR MEZZANINE



KEY PLAN

SK-1028

WDL TRE 112-3 FIGURE 2.2.1-2

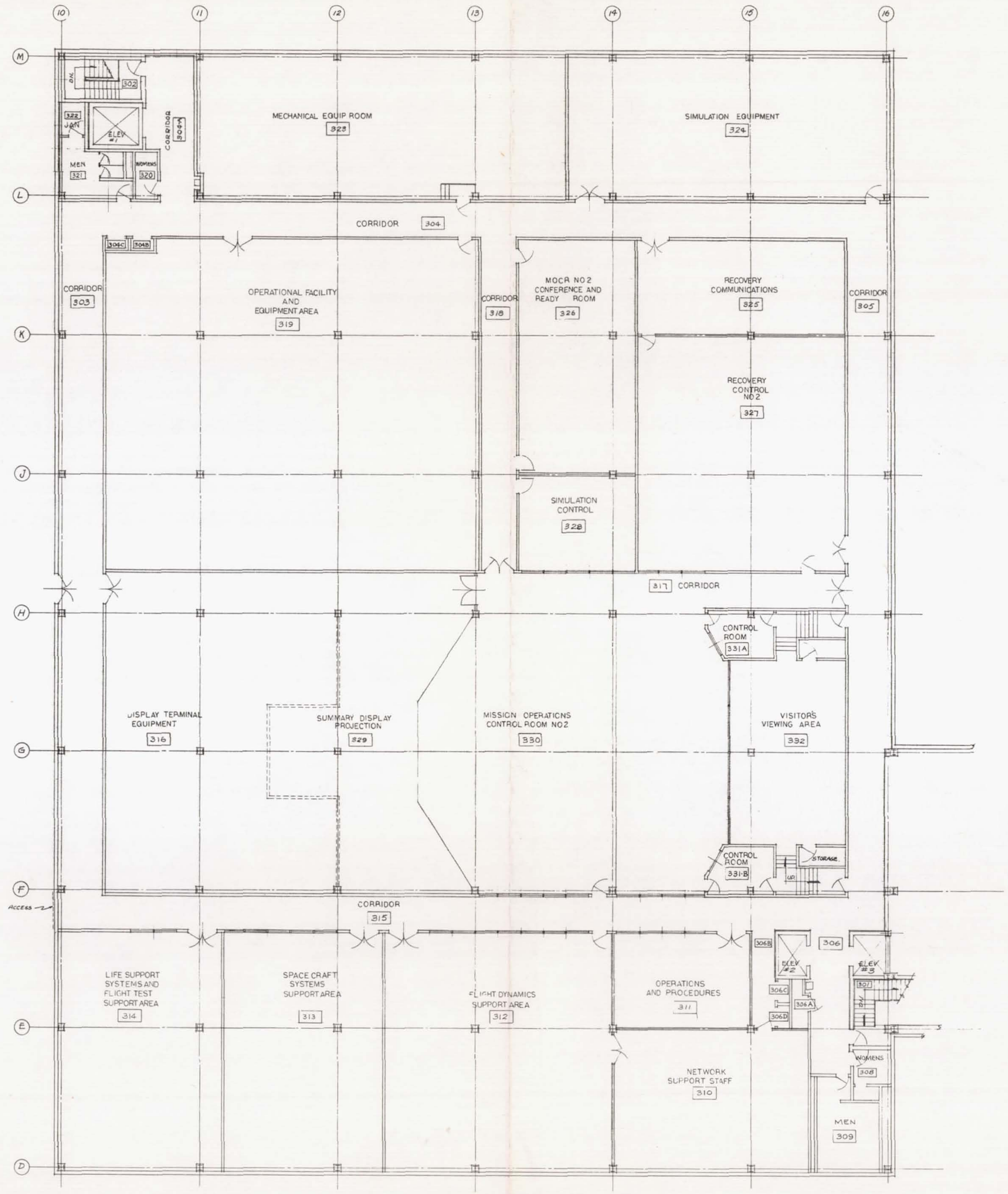
										DRAFTSMAN B. BAGEYEV	10/20/62
										CHECKER H.S.	10/31/62
										DESIGN ENGINEER	/ /
BASIC NO.	NEXT ASSY		USED ON		NEXT ASSY	FINAL ASSY				PROJECT ENGINEER	/ /
APPLICATION					QTY REQD						/ /
UNLESS OTHERWISE SPECIFIED					MATERIAL					RELEASED	/ /
DO NOT SCALE DRAWING		X FRACTIONS ±									
DIMENSIONS ARE IN INCHES		DECIMALS (.XX) ±									
REMOVE BURRS & SHARP EDGES		FOOTAGES (.XXX) ±									
√ INDICATES SURFACE REQUIRED		ANGLES ±									

PHILCO — GOVERNMENT & INDUSTRIAL GROUP, WESTERN DEVELOPMENT LABORATORIES, PALO ALTO, CALIFORNIA

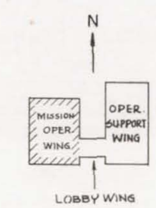
INTEGRATED MISSION CONTROL CENTER
MISSION OPERATIONS WING BUILDING NO. 30
SECOND FLOOR PLAN

CODE IDENT NO.	SIZE	SK-1028
11530	E	

SCALE 1" = 1'-0" WEIGHT SHEET OF



THIRD FLOOR PLAN
SCALE 1/8"=1'-0



KEY PLAN

REVISIONS				
SYM	ZONE	DESCRIPTION	DATE	APPROVED

SK—1029

NOTES (UNLESS OTHERWISE SPECIFIED):

WDL TRE 112-3 FIGURE 2.2.1-3

DRAFTSMAN H Mack	10/30/62
CHECKER H.S.	10/31/62
DESIGN ENGINEER	/ /
PROJECT ENGINEER	/ /
	/ /
RELEASED	/ /
	/ /

PHILCO — GOVERNMENT & INDUSTRIAL GROUP, WESTERN DEVELOPMENT LABORATORIES, PALO ALTO, CALIFORNIA

INTEGRATED·MISSION·CONTROL CENTER.
MISSION·OPERATIONS·WING·BLD'G. NO 30
THIRD FLOOR PLAN.

CODE IDENT NO.	SIZE	
11530	E	SK — 1029
SCALE 1/8"=1'-0	WEIGHT	SHEET OF

DASH NO.	NEXT ASSY	USED ON	NEXT ASSY	FINAL ASSY
	APPLICATION		QTY REQD	

UNLESS OTHERWISE SPECIFIED: DO NOT SCALE DRAWING; DIMENSIONS ARE IN INCHES; REMOVE BURRS & SHARP EDGES. TOLERANCES: FRACTIONS ±; DECIMALS .XX ±; DECIMALS .XXX ±; ANGLES ±. ✓ INDICATES SURFACE ROUGHNESS. MATERIAL; SPEC; FINISH.

Figure 2.1-6

Room Schedule - First Floor (MOW)

ROOM NO	NOMENCLATURE
101	Stairway
102	Stairway
103	Corridor
104	Corridor
105	Corridor
106	Corridor
107	Women's Lounge
108	Women's Toilet
109	Men's Toilet
110	Tape Storage & Auxiliary Equipment
111	Computer Control
112	Data Processing Area
113	Mechanical Equipment Room
114	Computer Complex Maintenance Area
115	Communication Maintenance
116	Voice & Intra Facility Communication Equipment
117	Data Transmission Terminal Equipment
118	Communication Control
119	Teletype Message Center
120	Communication Storage
121	Communication Entry
122	Battery Room
123	Elevator Machine & Battery Charger Room
124	Men's Toilet
125	Women's Toilet
126	Mechanical Equipment
127	Main Distribution Frame & Common Carrier Equipment
128	TELCO Liaison & Maintenance
129	Closed Circuit TV Terminal Equipment & Control
129A	TV Storage & Maintenance
130	Communication Processor
131	Vending Machine

Figure 2.1-7

Room Schedule - Second Floor (MOW)

ROOM NO.	NOMENCLATURE
201	Stairway
202	Stairway
202A	Mezzanine Transformer Room
203	Corridor
204	Corridor
205	Corridor
206	Corridor
207	Women's Lounge
208	Women's Toilet
209	Men's Toilet
210	Network Support Staff
211	Operations and Procedures
212	Flight Dynamics Support Area
213	Spacecraft Systems Support Area
214	Life Support Systems and Flight Test Support Area
215	Corridor
216	Display Terminal Equipment
217	Corridor
218	Corridor
219	Simulation Equipment Area
220	Display Equipment Maintenance
221	Women's Toilet
222	Men's Toilet
223	Janitor's Closet
224	Mechanical Equipment Room
225	Meteorological Center
226	Recovery Communications
227	Recovery Control No. 1
228	Mission Operations Control Room No. 1 Conference and Ready Room
229	Simulation Control
230	Summary Display Projection
231	Mission Operations Control Room No. 1
232A	Control Room
232B	Control Room
233	Visitor's Viewing Area

Figure 2.1-8

Room Schedule - Third Floor (MOW)

ROOM NO	NOMENCLATURE
301	Stairway
302	Stairway
303	Corridor
304	Corridor
305	Corridor
306	Corridor
308	Women's Toilet
309	Men's Toilet
310	Network Support Staff
311	Operations and Procedures
312	Flight Dynamics Support Area
313	Spacecraft Systems Support Area
314	Life Support Systems and Flight Test Support Area
315	Corridor
316	Display Terminal Equipment
317	Corridor
318	Corridor
319	Operational Instrumentation Facility Equipment Area
320	Women's Toilet
321	Men's Toilet
322	Janitor's Closet
323	Mechanical Equipment Room
324	Simulation Equipment Area
325	Recovery Communications
326	Mission Operations Control Room No. 2 Conference and Ready Room
327	Recovery Control No. 2
328	Simulation Control
329	Summary Display Projection
330	Mission Operations Control Room No. 2
331A	Control Room
331B	Control Room
332	Visitor's Viewing Area

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		108