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IBM TOUR Manned Spaceflight Control Center

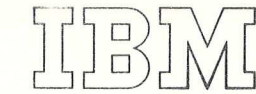
MANNED SPACEFLIGHT CONTROL CENTER
IBM
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Courtesy of
NATIONAL AERONAUTICS
AND
SPACE ADMINISTRATION
Manned Spacecraft Center



COURTESY OF THE
NATIONAL AERONAUTICS AND
SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER

INTERNATIONAL BUSINESS MACHINES CORPORATION



Federal Systems Division
16915 El Camino Real
Houston, Texas 77058

International Business Machines Corporation

HUdson 8-3300 (Code 713)

January 10, 1965

On behalf of the Federal Systems Division and NASA, I would like to welcome the members of all IBM activities in Houston to this Open House.

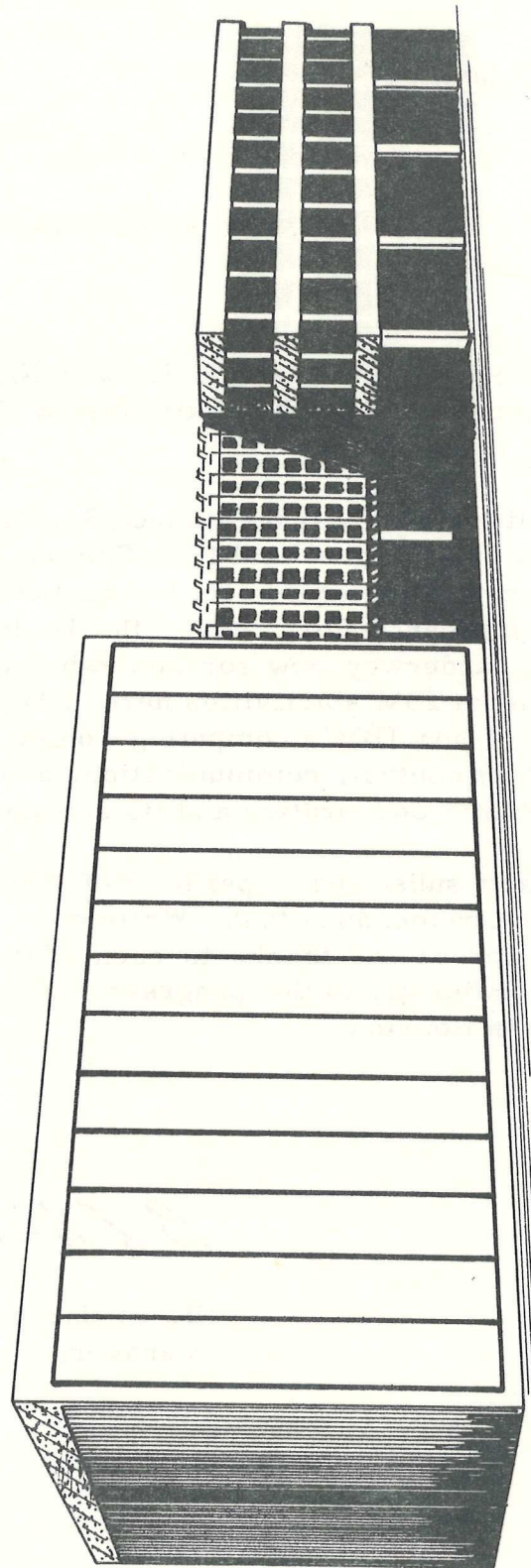
IBM's responsibility to NASA at the Manned Spaceflight Control Center is to provide and to operate the Real Time Computing Complex, as well as to design and provide the equipment for the Launch Trajectory Data System. This significant effort, under the leadership of James E. Hamlin, has been underway now for somewhat over two years. In addition to learning of IBM's activities here, I hope that you will gain an understanding of how IBM's computing complex is integrated with the large amount of control, communication, and display equipment provided by the Philco Corporation and its sub-contractors.

The completion and subsequent operation of the Manned Spaceflight Control Center is a tremendous task. While much remains to be done, I would like to express my thanks to each of the IBM'ers who have contributed so significantly to the progress made thus far on NASA's space effort here in Houston.



B. L. Sarahan
Manager, Houston Operations

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MANNED SPACEFLIGHT CONTROL CENTER

INTRODUCTION TO THE MANNED SPACEFLIGHT CONTROL CENTER

The Manned Spaceflight Control Center (MSCC) is the hub of a vast global network of tracking and communications stations providing centralized control for all future NASA manned space flights. MSCC functions include full control of manned space flights from launch through recovery operations, technical direction of launch and space vehicle systems, flight dynamics, ground network support, life systems and flight crew activities. The four main systems that enable the MSCC to fulfill its missions are:

1. IBM Data Processing Systems of the Real Time Computer Complex (RTCC)
2. Communication System
3. Display and Control System
4. Simulation, Checkout and Training System (SCATS)

The MSCC has two wings interconnected by the lobby. This tour will be through the Mission Operations Wing (MOW) which contains all the technical equipment and facilities required to control and monitor a manned space flight. The MOW is equipped to control two simultaneous simulated missions or one actual and one simulated mission.

The Operations Support Wing (OSW), which is not a part of this tour, provides office space, laboratory facilities and technical support for the NASA-MSF Flight Operations Directorate. The lobby contains security control, dormitories and additional office and technical support areas.

STATION 1

LOBBY

This tour is conducted by RTCC personnel familiar with the overall operation of the MSCC and will have cognizant personnel at key stations to describe and explain the functions of the various equipment and facilities.

IBM REAL TIME COMPUTER COMPLEX (RTCC) ROOM 112

The RTCC is the computing and data processing system developed by IBM to support all manned spaceflight missions. The task of the RTCC is to process all computable data supporting actual and simulated missions.

Processing of all computable data means the acquisition of incoming spacecraft tracking data and telemetry information. This incoming data is computed, sorted, converted and the results disseminated for timely utilization at the MSCC, world-wide tracking stations, communications network and spacecraft. Processing includes preparing information for each phase of flight, acceptance and distribution of feedback control information and any additional work required for conveying necessary control data.

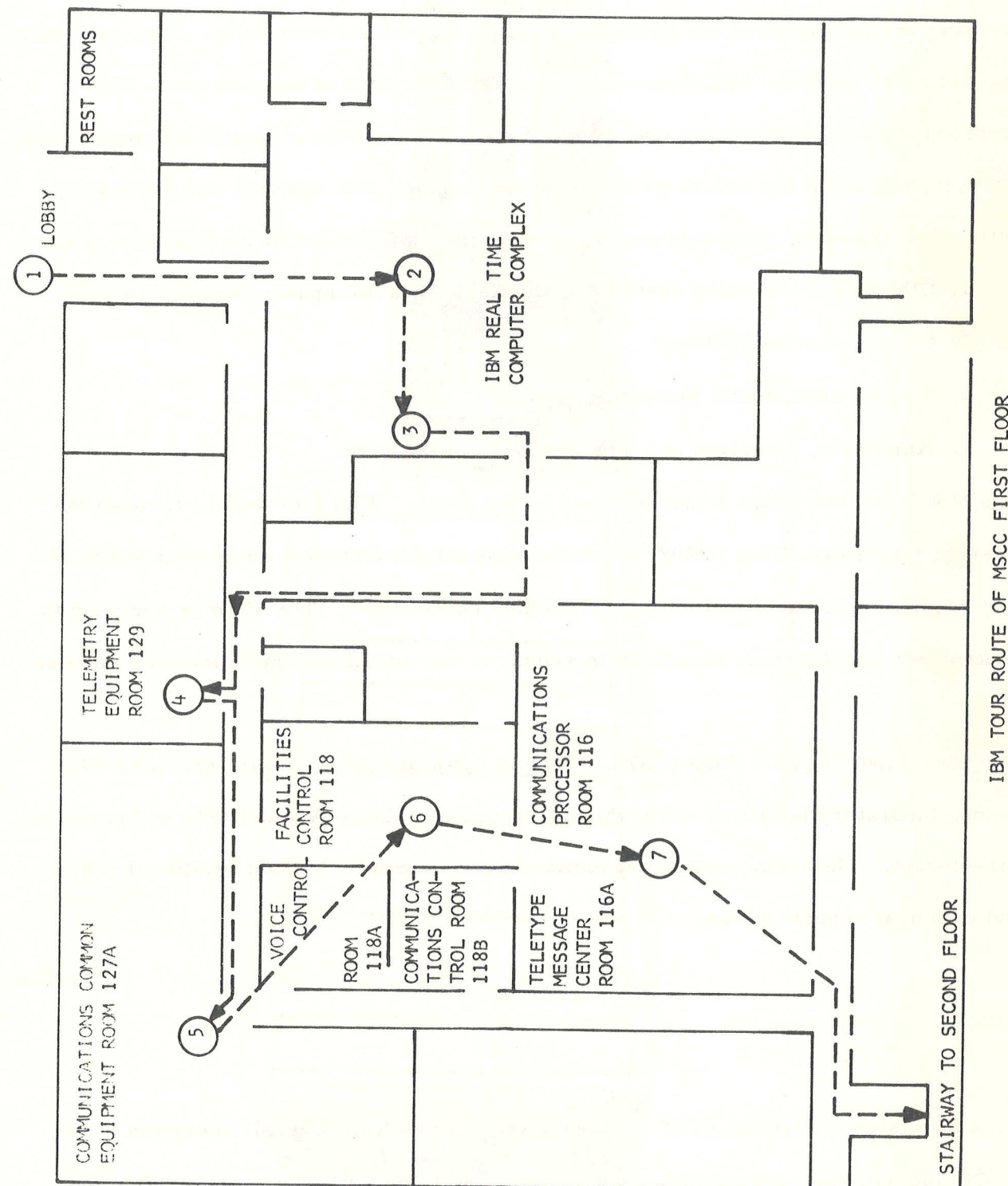
The RTCC contains four IBM 7094-II computers, and a fifth computer is to be installed. The complex includes the various associated card readers, magnetic tape recorders, consoles and maintenance equipment. Two 7094-II computers are used for each actual mission and two computers provide the necessary simulation of a future mission during the time an actual mission is in progress. The fifth 7094-II computer system will provide program preparation and support.

STATION 4

TELEMETRY EQUIPMENT ROOM 129

The telemetry equipment receives hundreds of different types of pulse code modulation information concerning the condition of the astronauts, spacecraft and booster in real time (as it is actually occurring) from the various remote sites and metering devices.

The information is decoded by IBM equipment in the RTCC and relayed to controller personnel, via control console television monitors, in the Mission Operations Control Room for analysis and effective control.



STATION 5
COMMUNICATIONS COMMON EQUIPMENT ROOM 127A

This room is the terminus for all the telephone, teletype and data circuits necessary to provide voice contact between any locations in the MSCC, and with outside connections to allow voice communications between any MSCC location and the NASA world-wide communication network.

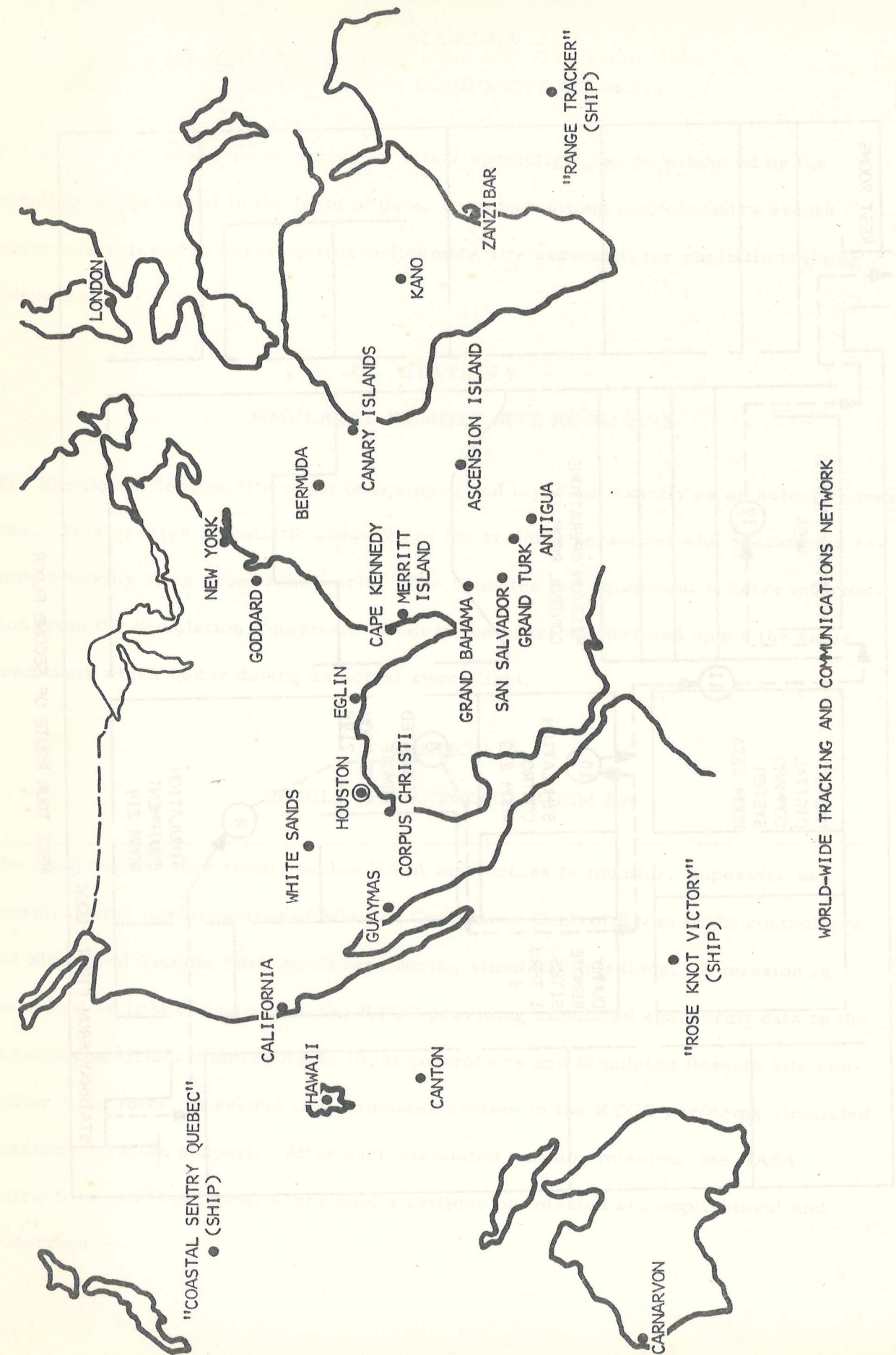
STATION 6
FACILITIES CONTROL ROOM 118

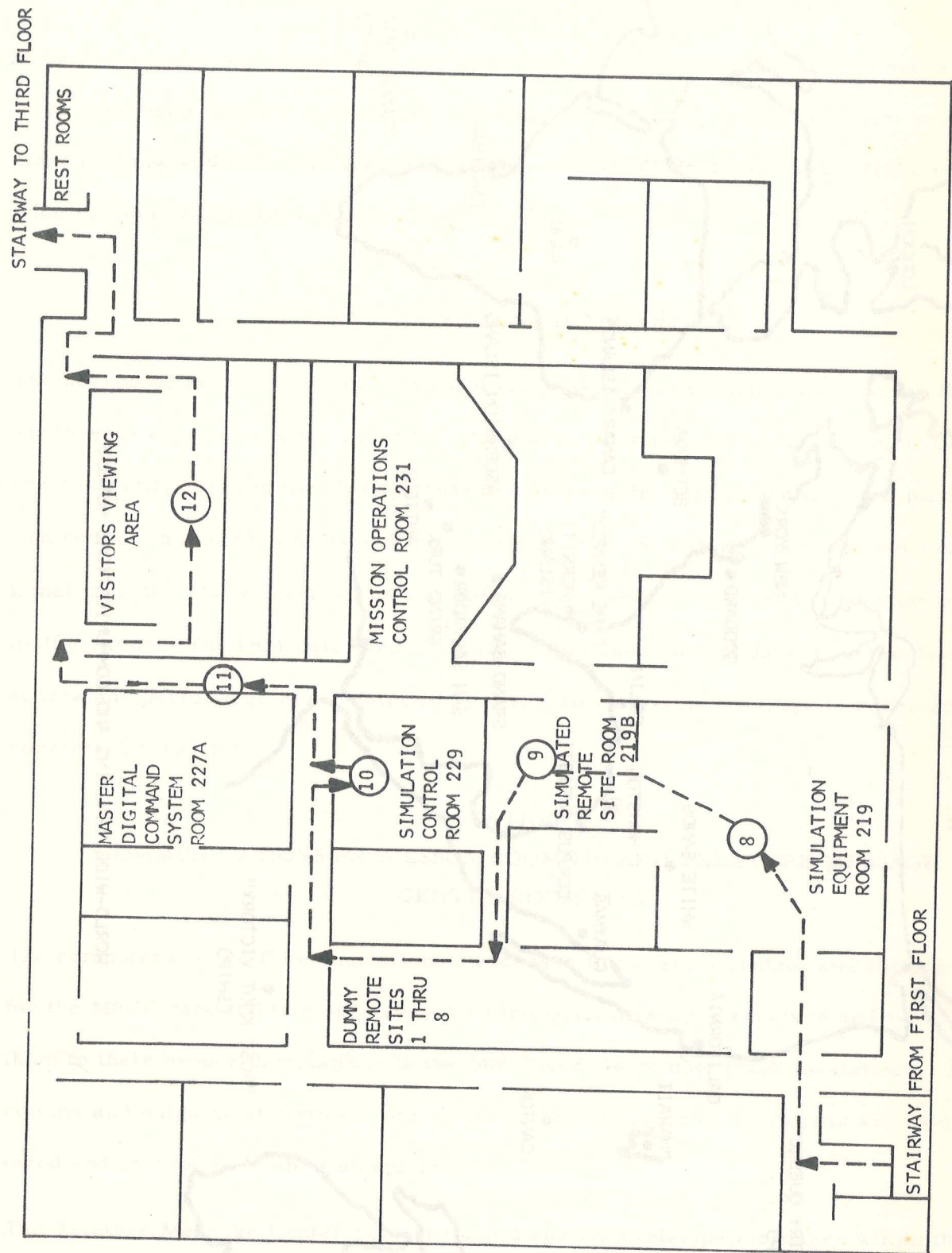
The personnel in the Facilities Control Room maintain a continual check on the NASA world-wide communications network. All voice, teletype, data and video circuits are constantly checked for clarity, quality and possible malfunctioning. If a malfunction occurs, an alarm sounds and the communication is restored on another operational circuit. Varied test equipment aids in the timely location and correction of malfunctions. The IBM Data Control Units in this room accept data from the data source and perform an error detection function to insure the message is received correctly at the MSCC.

STATION 7
COMMUNICATIONS PROCESSOR ROOM 116 AND TELETYPE MESSAGE
CENTER ROOM 116A

The computers in the Communications Processor Room are a central switching point for the MSCC data and teletype network, sorting all messages received and routing them to their proper destinations in the MSCC and the remote tracking stations. Incoming and outgoing statistics, data, status and teletype communications are monitored and controlled by the Communications Processor.

The Teletype Message Center receives and dispatches teletype messages within the MSCC and between the MSCC and the global teletype network. The centralized control of teletype message transmission through the pneumatic tube system is in this room.





STATION 8

SIMULATION EQUIPMENT ROOM 219

Conditions that might occur during an actual spaceflight can be produced by the simulation equipment in the form of data, communications and telemetry events which are relayed to flight control and remote site personnel for realistic training purposes.

STATION 9

SIMULATED REMOTE SITE ROOM 219B

The Simulated Remote Site room is equipped and laid out exactly as an actual remote site. This creates a realistic atmosphere for training personnel who operate the remote tracking sites around the world. The consoles and equipment receive information from the Simulation Equipment Room in the exact manner and under the same conditions which occur during an actual spaceflight.

STATION 10

SIMULATION CONTROL ROOM 229

The equipment in this room enables NASA instructors to monitor, supervise and coordinate the performances of Mission Operations Control Room flight controllers and Simulated Remote Site controllers during simulated missions. A mission is simulated by IBM computers in the RTCC providing simulated spacecraft data to the Mission Operations Control Room flight controllers and Simulated Remote Site controller's consoles. A second IBM computer system in the RTCC performs simulated mission operation support. After each simulated training mission, the NASA instructors and flight controllers hold a critique on mission accomplishment and performance.

STATION 11
MASTER DIGITAL COMMAND SYSTEM ROOM 227A

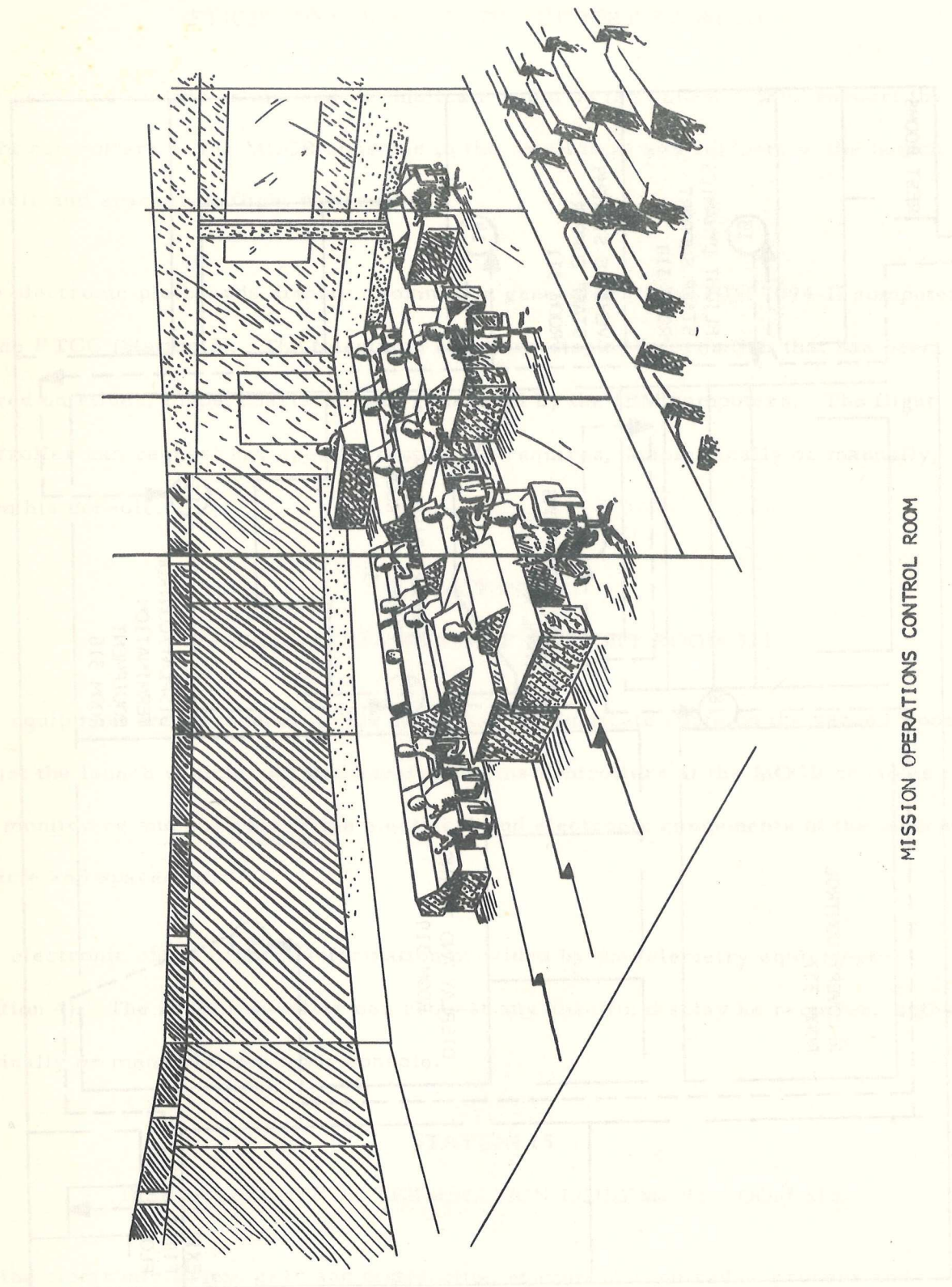
There are two Master Digital Command System (MDCS) units in the MSCC which form part of a world-wide spacecraft command network. The MDCS receives and reviews IBM computer generated commands from the RTCC and routes these coded commands through flight controllers to remote tracking sites via teletype lines. The remote sites relay the commands to the spacecraft.

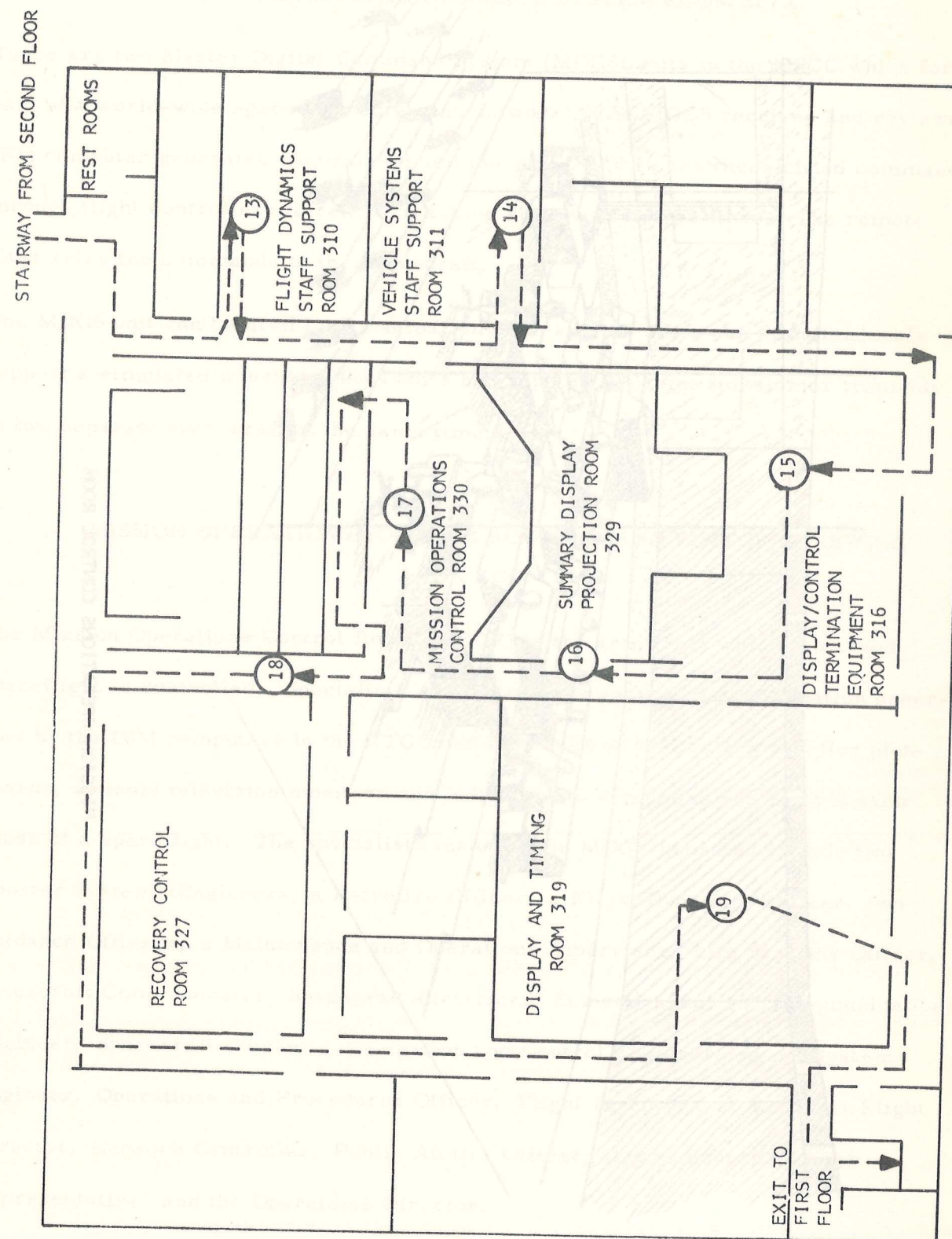
One MDCS unit can be used for an actual mission and the other can simultaneously support a simulated mission. Both units can support the same mission or transmit to two separate spacecraft at the same time.

STATION 12
MISSION OPERATIONS CONTROL ROOM 231 AND VISITOR'S VIEWING
AREA ROOM 233

The Mission Operations Control Room (MOCR) is the area from which a manned spaceflight is controlled. Specialists at each console analyze the information generated by the IBM computers in the RTCC and displayed on the large projection plotboards, console television monitors and indicators to determine and control each phase of a spaceflight. The specialists manning the MOCR consoles include two Booster Systems Engineers, a Retrofire Officer, a Flight Dynamics Officer, two Guidance Officers, a Maintenance and Operations Supervisor, Life Systems Officer, Spacecraft Communicator, Spacecraft Electrical, Environmental and Communications Engineer, Spacecraft Guidance, Navigation and Control Engineer, Agena Systems Engineer, Operations and Procedures Officer, Flight Director and Assistant Flight Director, Network Controller, Public Affairs Officer, Department of Defense Representative, and the Operations Director.

Authorized spectators and the press can observe the performance of a mission from the visitor's viewing area. A duplicate MOCR and associated support equipment is located on the third floor and provides the capability of dual mission control.





IBM TOUR ROUTE OF MSCC THIRD FLOOR

STATION 13

FLIGHT DYNAMICS STAFF SUPPORT ROOM 310

The personnel in this room, and its duplicate room on the second floor, support the flight controllers at the MOCR consoles in the monitoring and analysis of the launch vehicle and spacecraft flight pattern.

The electronic plotboards display information generated by the IBM 7094-II computers in the RTCC (Station 3). The television monitors display information that has been stored on slides, maps, charts or data generated by the IBM computers. The flight controller can request any specific display he requires, automatically or manually, from his console.

STATION 14

VEHICLE SYSTEMS STAFF SUPPORT ROOM 311

The equipment and personnel in this area, and its duplicate room on the second floor, assist the launch vehicle and spacecraft systems controllers at the MOCR consoles in the monitoring and analysis of the electrical and electronic components of the launch vehicle and spacecraft.

The electronic chart records information provided by the telemetry equipment (Station 4). The flight controller can request any specific display he requires, automatically or manually, from his console.

STATION 15

DISPLAY/CONTROL TERMINATION EQUIPMENT ROOM 316

All the electronic switch gear and distribution equipment required to process and distribute visual information to the various television monitors, projectors, plotboards and consoles is housed in this area.

STATION 15 (Continued)

The equipment in this room includes the Computer Input Multiplexer which routes display requests from the MOCR consoles to the IBM 7094-II computers in the RTCC (Station 3). The Digital Display Driver Subchannel Data Distributor relays display information from the IBM computers to the illuminated indicators on the consoles and to various other electronic equipment. The Plotting Display Subchannel Data Distributor receives data generated by the IBM computers in the RTCC and directs this data to the rear-screen projectors (Station 16) and the electronic plotboard projectors (Station 13).

The Relative Time Accumulator sends time display information to the consoles and the large time displays over the MOCR projection plotboards. The Video Switching Matrix and related equipment collects television displays throughout the MSCC and distributes them to the console television monitors and the ceiling mounted television monitors. The hard copy equipment allows flight controllers to automatically photograph displays on the console television monitors for historical documentation of a mission.

STATION 16

SUMMARY DISPLAY PROJECTION ROOM 329

Display information received from the Display/Control Termination Equipment (Station 15) is projected onto the large MOCR projection plotboards, using the rear screen projection method. The rear screen projection method utilizes the reflection of projected light beams off the mirrors and onto the back of the transparent screens for viewing by personnel in the MOCR.

STATION 17

MISSION OPERATIONS CONTROL ROOM 330

This MOCR is identical to the one on the second floor in staffing and equipment. The task and function of each MOCR is identical and both can operate simultaneously on the same mission or each on a separate mission.

STATION 18

RECOVERY CONTROL ROOM 327

The equipment in the Recovery Control Room provides a centralized facility for directing the operation of the task forces engaged in recovering astronauts and retrieving space vehicles. This control center can be switched to support either MOCR, depending on mission requirements. The switchgear is housed in the Display and Timing Room (Station 19).

STATION 19

DISPLAY AND TIMING ROOM 319

The television display generating equipment and central timing source for all electronic equipment in the MSCC is in this room. The television display generating systems contain television standards conversion equipment, digital-to-television conversion systems and video tape facilities.

Displays generated by this television conversion and tape recording equipment are relayed to both Display/Control Termination Rooms. The video tape facility has an intermediate and permanent storage capability to provide television sequences for future use by NASA or release to news media for public viewing.

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