NPS Form 10-900
(7-81)

United States Department of the Interior
National Park Service

For NPS use only
received
date entered

National Register of Historic Places Inventory—Nomination Form

See instructions in *How to Complete National Register Forms*
Type all entries—complete applicable sections

1. Name

historic Apollo Mission Control Center

and/or common Mission Control Center

2. Location

street & number Lyndon B. Johnson Space Flight Center ___ **not for publication**

city, town Houston ___ **vicinity of** **congressional district**

state Texas **code** 48 **county** Harris **code** 201

3. Classification

Category	Ownership	Status	Present Use	
___ district	X public	___ occupied	___ agriculture	___ museum
X building(s)	___ private	___ unoccupied	___ commercial	___ park
___ structure	___ both	___ work in progress	___ educational	___ private residence
___ site	**Public Acquisition**	**Accessible**	___ entertainment	___ religious
___ object	___ in process	X yes: restricted	X government	X scientific
	___ being considered	___ yes: unrestricted	___ industrial	X transportation
		___ no	X military	X other: Space Exploration

4. Owner of Property

name National Aeronautics and Space Administration (NASA)

street & number

city, town Washington ___ **vicinity of** **state** D.C. 20546

5. Location of Legal Description

courthouse, registry of deeds, etc. National Aeronautics and Space Administration (NASA)

street & number Real Property Management Office Code NXG

city, town Washington **state** D.C. 20546

6. Representation in Existing Surveys

title None **has this property been determined eligible?** ___ yes ___ no

date ___ federal ___ state ___ county ___ local

depository for survey records

city, town **state**

7. Description

Condition		Check one	Check one
X excellent	___ deteriorated	___ unaltered	X original site
___ good	___ ruins	X altered	___ moved date _____
___ fair	___ unexposed		

Describe the present and original (if known) physical appearance

The Apollo Mission Control Center is in Building 30 at the Lyndon B. Johnson Manned Space Flight Center in Houston, Texas. The three-story structure consists of a mission operations wing (MOW), operations support wing (OSW), and an interconnecting lobby wing. The MOW contains systems and equipment required to support the mission control function. The OSW contains offices, laboratory, and technical support areas for the flight operations directorate. The lobby wing provides additional office space and dormitory facilities utilized by flight controlers during space flights of extended duration. The mission control center is supported by an emergency power building that houses standby electrical power and air-conditioning systems in the event that primary sources fail.

Principal systems on the first floor are the real time computer complex and the communications systems. These systems support the dual mission facilities and systems on the second and third floors. The communications system provides the interface between the mission control center in Houston and the manned space flight network and the launch site.

Principal areas on the second floor are the mission operations control room (MOCR), the staff support rooms (SSR), the simulation facilities, and the master digital command system. The MOCR is the principal command and control center, staffed with key mission operations teams responsible for overall management of the flight.

Principal areas on the third floor are the MOCR, the SSR, the recovery control room, the meteorological area, and the display and timing area. The MOCR and SSR are exact duplications of the areas on the second floor.

The recovery control room, the meteorological area, and the display and timing areas support the dual mission facilities and systems on the second and third floors.

The MOCR on the second floor is the principal command and decision area in the MCC. Critical information related to spacecraft, launch vehicle, and ground systems, as well as aeromedical parameters from the worldwide stations, ships, and aircraft, is processed and displayed within the MOCR. Based on an analysis of this continuous flow of information, personnel in this room must assess the spacecraft flight status and progress, and then, in time-critical periods, determine the continuation, alteration, or termination of the space flight.

This is an ongoing NASA facility and is currently being modified to accommodate flights of the shuttle. The third floor of the facility has been turned over to the Air Force and is in the process of being converted into a secure area from which Air Force shuttle flights will be monitored. The second floor of the facility housing the mission control operations room is being divided into two rooms to accommodate increasing numbers of shuttle flights.[1]

Footnotes

Harry Butowsky, et. al., Man in Space Reconnaissance Survey (Denver, National Park Service, 1981), pp. 57-8.

8. Significance

Period	Areas of Significance—Check and justify below				
___ prehistoric	___ archeology-prehistoric	___ community planning	___ landscape architecture	___ religion	
___ 1400–1499	___ archeology-historic	___ conservation	___ law	___ science	
___ 1500–1599	___ agriculture	___ economics	___ literature	___ sculpture	
___ 1600–1699	___ architecture	___ education	___ military	___ social/ humanitarian	
___ 1700–1799	___ art	X engineering	___ music	___ theater	
___ 1800–1899	___ commerce	___ exploration/settlement	___ philosophy	___ transportation	
X 1900–	X communications	___ industry	___ politics/government	X other (specify) Space Exploration	
		___ invention			

Specific dates 1965-Present **Builder/Architect** NASA

Statement of Significance (in one paragraph)

The Apollo Mission Control Center is significant because of its close association with the manned spacecraft program of the United States. This facility was used to monitor nine Gemini and all Apollo flights including the flight of Apollo 11 that first landed men on the moon. After the end of the Apollo Program this facility was used to monitor manned spaceflights for Skylab, Apollo-Soyuz, and all recent Space Shuttle flights.

The support provided by the Apollo Mission Control Center to the first manned landing on the surface of the moon was critical to the success of the mission. It exercised full mission control of the flight of Apollo 11 from the time of liftoff from Launch Complex 39 at the Kennedy Space Center to the time of splashdown in the Pacific. The technical management of all areas of vehicle systems of Apollo 11 including flight dynamics, life systems, flight crew activities, recovery support, and ground operations were handled here.

Through the use of television and the print news media the scene of activity at the Apollo Mission Control during the first manned landing on the moon was made familiar to millions of Americans. When Neil Armstrong reported his "giant leap for mankind" to Mission Control his words went immediately around the world and into history. The Apollo Mission Control Center and Launch Complex 39 at the Kennedy Space Center are the two resources that symbolize for most Americans achievements of the manned space program leading to the successful first moon landing during the flight of Apollo 11 in July 1969.

9. Major Bibliographical References

See continuation sheets

10. Geographical Data

Acreage of nominated property Less than 1 acre

Quadrangle name League City **Quadrangle scale** 1:24,000

UMT References

	Zone	Easting	Northing		Zone	Easting	Northing
A	15	295660	3271460	B			
C				D			
E				F			
G				H			

Verbal boundary description and justification

The boundary of the Apollo Mission Control Center is defined by the outside perimeter of Building 30 at the Lyndon B. Johnson Space Center.

List all states and counties for properties overlapping state or county boundaries

state	code	county	code
state	code	county	code

11. Form Prepared By

name/title Harry A. Butowsky

organization National Park Service **date** May 15, 1984

street & number Division of History **telephone** (202) 343-8168

city or town Washington, D.C. 20240 **state**

12. State Historic Preservation Officer Certification

The evaluated significance of this property within the state is:

___ national ___ state ___ local

As the designated State Historic Preservation Officer for the National Historic Preservation Act of 1966 (Public Law 89–665), I hereby nominate this property for inclusion in the National Register and certify that it has been evaluated according to the criteria and procedures set forth by the National Park Service.

State Historic Preservation Officer signature

title **date**

For NPS use only

I hereby certify that this property is included in the National Register

date

Keeper of the National Register

Attest: 468 **date**

Chief of Registration

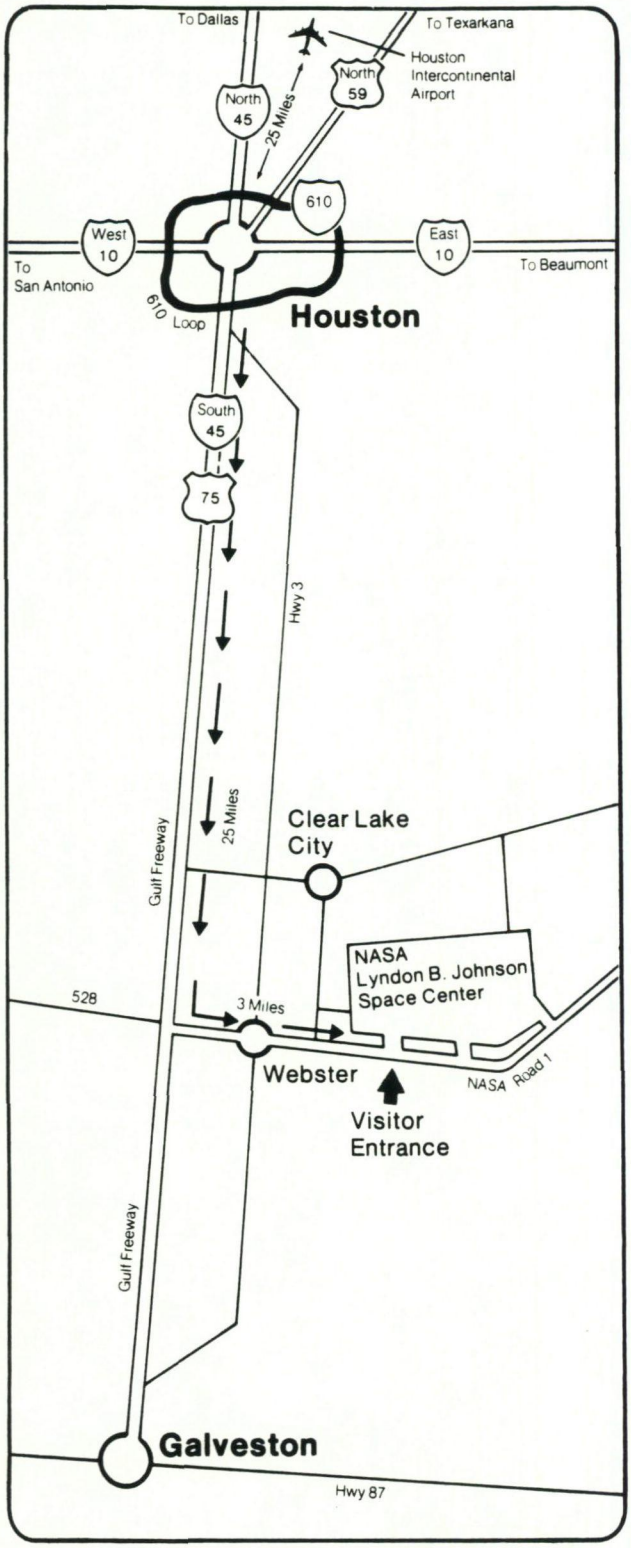
Bibliography

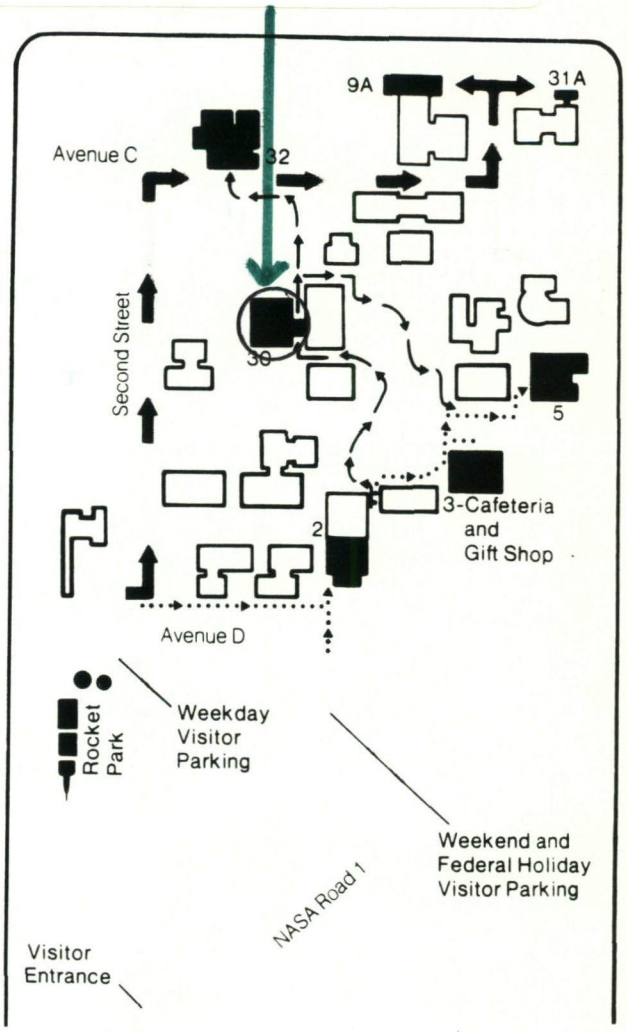
Brooks, Courtney G., Grimwood, James M., Swenson, Loyd S. Chariots for Apollo: A History of Manned Lunar Spacecraft. Washington, D.C.: National Aeronautics and Space Administration, 1979.

Butowsky, Harry, et. al. Man in Reconnaissance Survey. Denver: National Park Service, 1981.

Mission Control Center. Washington, D.C.: National Aeronautics and Space Administration, No Date.

Apollo Mission Control Center
UTM References:
15/297660/3271460

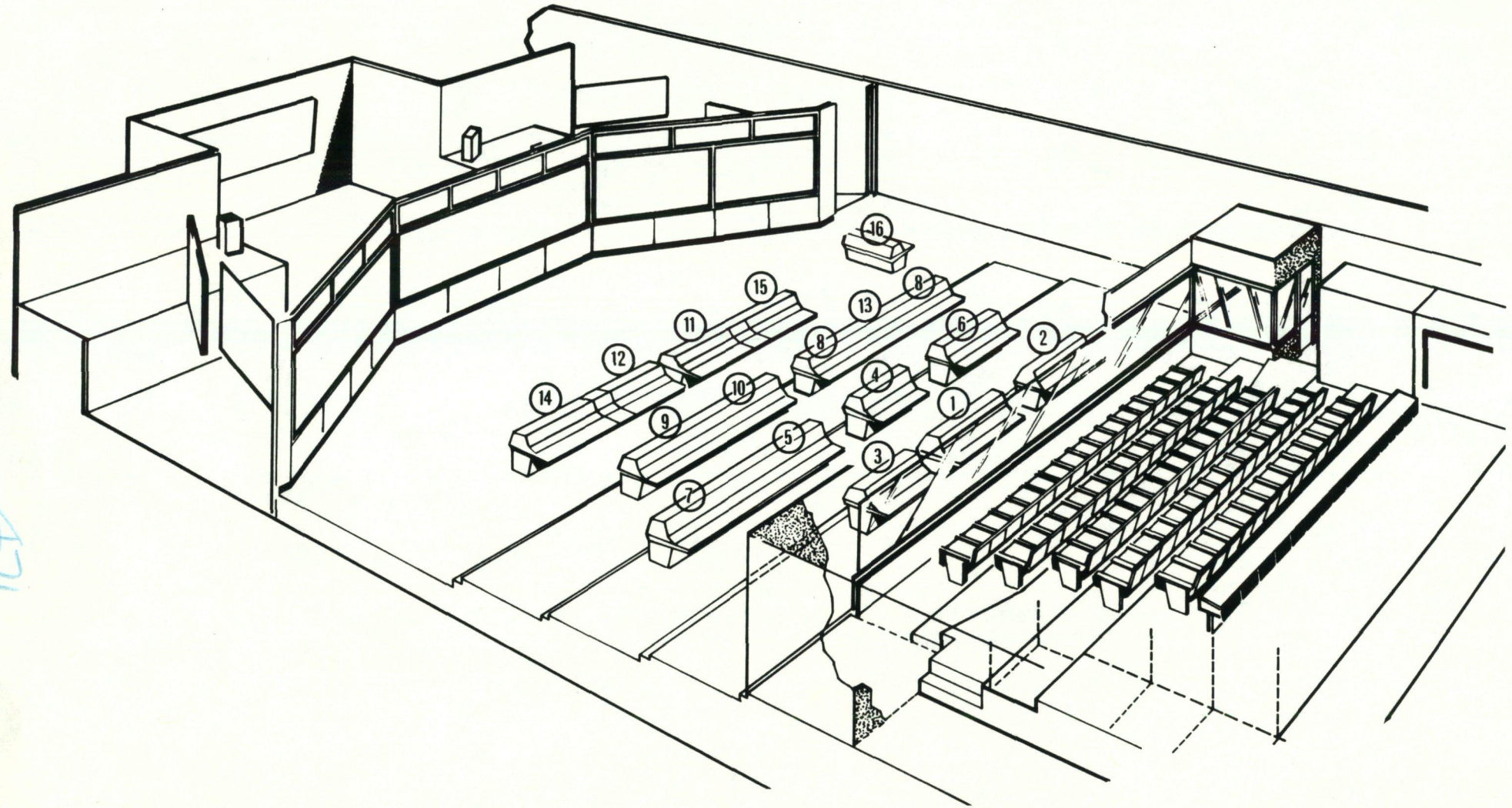




Bldg.

2 - Visitor Center
3 - JSC Cafeteria and Gift Shop
5 - Mission Simulation and Training
9A - Space Shuttle Orbiter Training
30 - Mission Control Center
31A - Lunar Sample Building
32 - Space Environment Simulation Laboratory

Apollo Mission Control Circa 1969



Source: Mission Control Center, No Date, No Page Number.

The 16 positions in the control room and the primary responsibilities are as follows. A graphic illustration shows the location of these consoles.

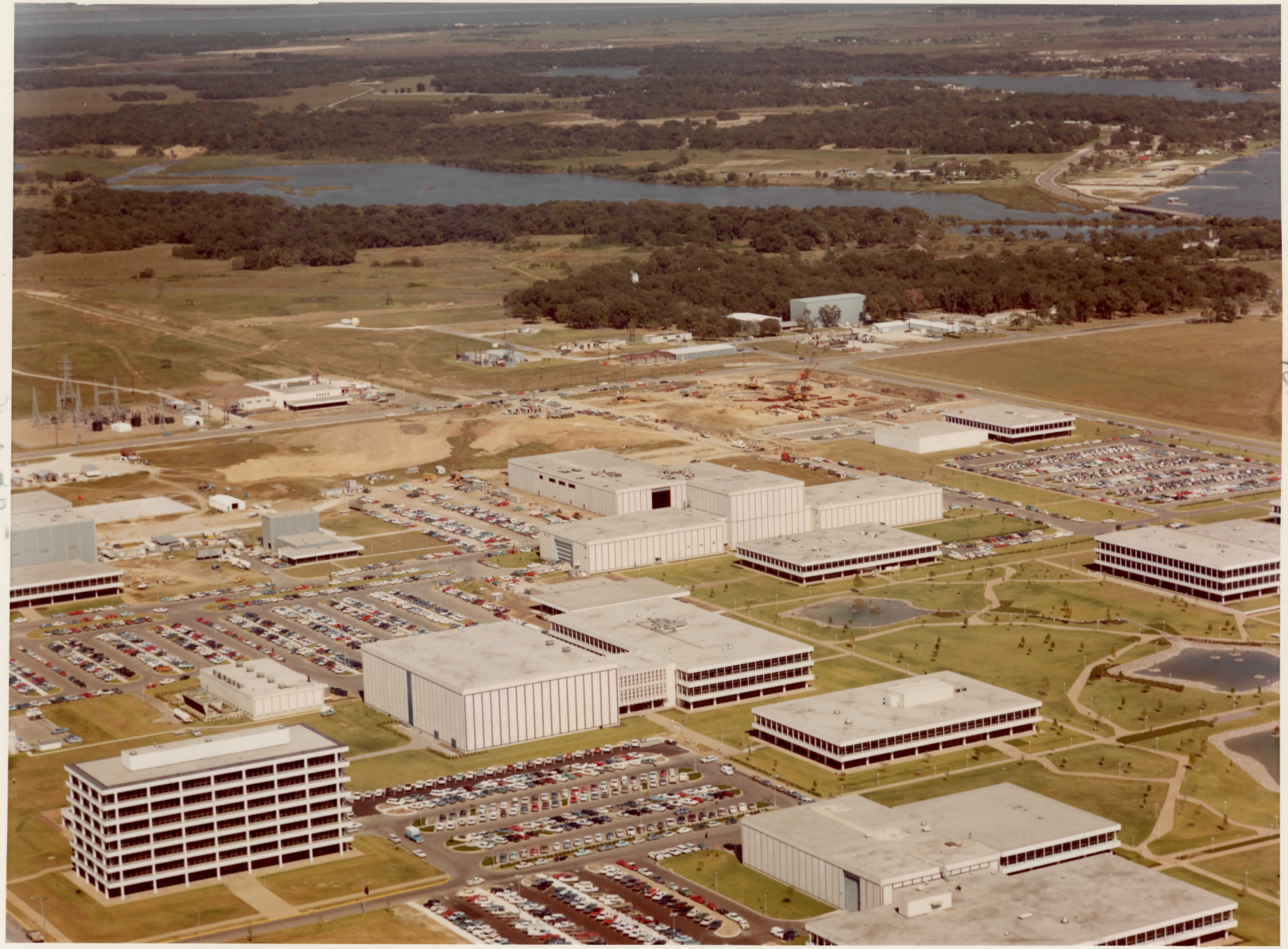
1. Mission Director — overall mission responsibility and control of flight test operations. In Project Mercury there were no alternative mission objectives that could be exercised other than early termination of the mission. The Gemini and Apollo missions, however, offer many possible alternatives which have to be decided in real time.
2. Department of Defense Representative — overall control of Department of Defense forces supporting the mission, including direction of: the deployment of recovery forces, the operation of the recovery communications network, and the search, location and retrieval of the crew and spacecraft.
3. Public Affairs Officer — responsible for providing information on the mission status to the public.
4. Flight Director — responsible to the Operations Director for detailed control of the mission from liftoff until conclusion of the flight; assumes the duties of the Operations Director in his absence.
5. Assistant Flight Director — responsible to the Director for detailed control of the mission from liftoff through conclusion of the flight; assumes the duties of the Flight Director during his absence.
6. Network Controller — has detailed operational control of the Ground Operational Support System network.
7. Operations and Procedures Officer — responsible to the Flight Director for the detailed implementation of the MCC/Ground Operational Support Systems mission control procedures.
8. Vehicle Systems Engineers — monitor and evaluate the performance of all electrical, mechanical and life support equipment aboard the spacecraft (this includes the Agena during rendezvous missions).
9. Flight Surgeon — directs all operational medical activities concerned with the mission, including the status of the flight crew.
10. Spacecraft Communicator — voice communications with the astronauts, exchanging information on the progress of the mission with them.
11. Flight Dynamics Officer — monitors and evaluates the flight parameters required to achieve a successful orbital flight; gives "GO" or "Abort" recommendations to the Flight Director.
12. Retrofire Officer — monitors impact prediction displays and is responsible for determination of retrofire times.
13. Guidance Officer — detects Stage I and Stage II slowrate deviations and other programmed events, verifies proper performance of the Gemini Inertial Guidance System and recommends action to the Flight Director.
14. Booster Systems Engineer — monitors propellant tank pressurization systems and advises the flight crew and/or Flight Director of systems abnormalities.
15. Assistant Flight Dynamics Officer — monitors and evaluates Gemini launch vehicle systems and reports any abnormalties to the Flight Director.
16. Maintenance and Operations Supervisor — responsible for the performance of MCC-H equipment and its ability to support the mission in progress.

Information is displayed on television monitors, indicator lights and digital readout devices on the consoles. Information is also displayed on the large group display projection screens at the front of the control room.

A visitor viewing room, providing seating space for 74 persons, is located at the rear of each MOCR. This is a separate room with a glass front which permits authorized visitors to observe the functioning of the control room during a mission.

P. 473 BLANK

SLH
ASA
S-56317



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
HOUSTON, TEXAS 77058

FOR RELEASE:

PHOTO NO. S-66-56317

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COLOR

OCTOBER 1966 S-66-56317

MANNED SPACECRAFT CENTER, HOUSTON, TEXAS

MSC AERIAL---An aerial view of a portion of the Manned Spacecraft Center, looking northeastward. The Mission Control Center in in Building 30 located in the lower center of the picture.

1. Apollo Mission Control Center
2. Houston, Texas
3. NASA
4. 1966
5. NASA, Houston Public Affairs Office
6. Aerial View of Apollo Mission Control, Building 30
7. 75

NASA National Aeronautics and Space Administration

S- 79- 25702

Lyndon B. Johnson Space Center
Houston, Texas 77058

National Aeronautics and
Space Administration

Houston, Texas 77058

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COLOR

8 JANUARY 1979 S-79-25702

JOHNSON SPACE CENTER, HOUSTON, TEXAS

ASTRONAUT CANDIDATES IN MCC---Overall view of second floor mission operations control room (MOCR) in JSC's Mission Control Center (MCC) facility during an orientation session for 35 astronaut candidates.

NOTE: SINCE THIS PICTURE WAS MADE, ON AUG. 31, 1979, the 35 traineess were named astronauts by the National Aeronautics and Space Administration.

1. Apollo Mission Control Center
2. Houston, Texas
3. NASA
4. 1979
5. NASA, Houston Public Affairs Office
6. Interior View of Mission Operations Control Room
7. 76

PHOTO CREDIT: NASA or National Aeronautics and Space Administration

National Aeronautics and
Space Administration

S84-26332

Lyndon B. Johnson Space Center
Houston Texas 77058

Photo #87

479

National Aeronautics and Space Administration

Houston, Texas 77058

For Release:

Photo No.

COLOR

3 FEBRUARY 1984

S-84-26332

JOHNSON SPACE CENTER, HOUSTON, TEXAS

41-B MISSION CONTROL CENTER ACTIVITY---Robert E. Castle, integrated communications officer (INCO), plays an important role in the first television transmission from the Earth-orbiting Space Shuttle Challenger. Castle, at a console in the Johnson Space Center's mission operations control room (MOCR) in the mission control center, is responsible for ground controlled television from the orbiter on his shift. Here, the Westar VI satellite is seen in the cargo bay just after opening of the payload bay doors.

1. Apollo Mission Control Center
2. Houston, Texas
3. NASA
4. 1982
5. NASA, Houston Public Affairs Office
6. Interior View of Mission Operations Control Room during flight of Space Shuttle Challenger
7. 77

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National Aeronautics and
Space Administration

S-73-16182

Lyndon B. Johnson Space Center
Houston, Texas 77058

National Aeronautics and Space Administration

Houston, Texas 77058

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COLOR

FEBRUARY 1973 S-73-16182

JOHNSON SPACE CENTER, HOUSTON, TEXAS

SNOW BLANKETS JSC — A rare blanket of snow covers the grounds of the Johnson Space Center and whitens the tops of its buildings. This photograph was taken from the project management building, which is JSC's tallest facility. Buildings seen include the photo technology laboratory, crew systems facility, mission control center, cafeteria, technical services shop, central data office and the space environment simulation laboratory.

PHOTO CREDIT: NASA or National Aeronautics and Space Administration

NASA National Aeronautics and Space Administration

S82-41180

Lyndon B. Johnson Space Center
Houston, Texas 77058

National Aeronautics and
Space Administration

Houston, Texas 77503

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COLOR

8 DECEMBER 1982 S-82-41180

JOHNSON SPACE CENTER, HOUSTON, TEXAS

JSC AERIAL SCENE---This north-looking view shows some of the Johnson Space Center's central buildings and facilities neighboring its project management facility (Building 1) from which this scene was photographed. The Houston-based mission control center of the frame. Visible buildings surrounding the mall area include the flight operations facility, crew systems laboratory, photographic technology laboratory, technical services shop, branch cafeteria, mission control center office wing and the central data office.

PHOTO CREDIT: NASA or National Aeronautics and Space Administration

NASA National Aeronautics and Space Administration

S78-36470

Lyndon B. Johnson Space Center
Houston, Texas 77058

National Aeronautics and Space Administration

Houston, Texas 77508

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COLOR

S-78-36470

OCTOBER 1978

JOHNSON SPACE CENTER, HOUSTON, TEXAS

JSC AERIAL VIEW--An aircraft view of the Johnson Space Center (JSC), near Houston, Texas, which supports NASA's manned spacecraft program. Facilities seen include a rocket exhibit featuring Little Joe, Mercury-Redstone and Saturn V; instrumentation and electronics systems laboratory; structures and mechanics laboratory; auditorium and public affairs facility; project management building; central and branch cafeterias; earth resources applications development lab; photographic technology lab, technical service shop; central data office, spacecraft systems laboratory; anechoic chamber test facility; project engineering office building/technical library facility; mission control center; mission simulation and training facility; flight crew training facility; life science laboratory; planetary and earth sciences laboratory; fire station; control heating and cooling plant; space environment simulation laboratory; test article preparation facility; life systems laboratory; and several others. A number of buildings on the north and west sides of the JSC site cannot be seen in this frame. Clear Lake, Mud Lake and NASA Rd. 1 can also be seen in part. 187

PHOTO CREDIT: NASA or National Aeronautics and Space Administration

NASA National Aeronautics and Space Administration

S - 79 - 33305

Lyndon B. Johnson Space Center
Houston, Texas 77058

National Aeronautics and
Space Administration

Houston, Texas 77508

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COLOR

13 JUNE 1979 S-79-33305

JOHNSON SPACE CENTER, HOUSTON, TEXAS

AERIAL VIEW OF JOHNSON SPACE CENTER.--A low-altitude aerial view of the Johnson Space Center (JSC). JSC's newest addition, rocket park, with a Mercury Redstone exhibit, a Little Joe rocket and a huge Saturn V, Apollo payload configuration, are clearly visible in the foreground. Other buildings seen include the project management building, auditorium and public affairs facility, structures and mechanics laboratory, instrumentation and electronic systems laboratory, earth resources applications development laboratory, spacecraft systems laboratory, project engineering offices facility, mission control center, flight operations facility, life systems laboratory, technical services shop, planetary and earth sciences laboratory, training and test facility, flight crew training facility, technical services facility. Among buildings obscured by other facility, are two cafeterias, a technical library, the mission simulation and training facility. The view is looking to the northeast from a point north and west of the main entrance to the center.

PHOTO CREDIT: NASA or National Aeronautics and Space Administration

NASA National Aeronautics and Space Administration

S82-28819

Lyndon B. Johnson Space Center
Houston, Texas 77058

National Aeronautics and Space Administration

Houston, Texas 77058

For Release:

Photo No. S-82-28819

COLOR

27 MARCH 1982 S-82-28819

JOHNSON SPACE CENTER, HOUSTON, TEXAS

STS-3 MISSION CONTROL CENTER ACTIVITY ---- This photograph shows an overall view of activity in the Johnson Space Center mission control center's mission operations control room during the sixth day of NASA's third space transportation system (STS-3) flight. The Columbia was sending back television from its location in space, above the Pacific Ocean's Hawaiian tracking station. Astronauts Jack R. Lousma, commander, and C. Gordon Fullerton were participating in their next to last full day in Earth orbit

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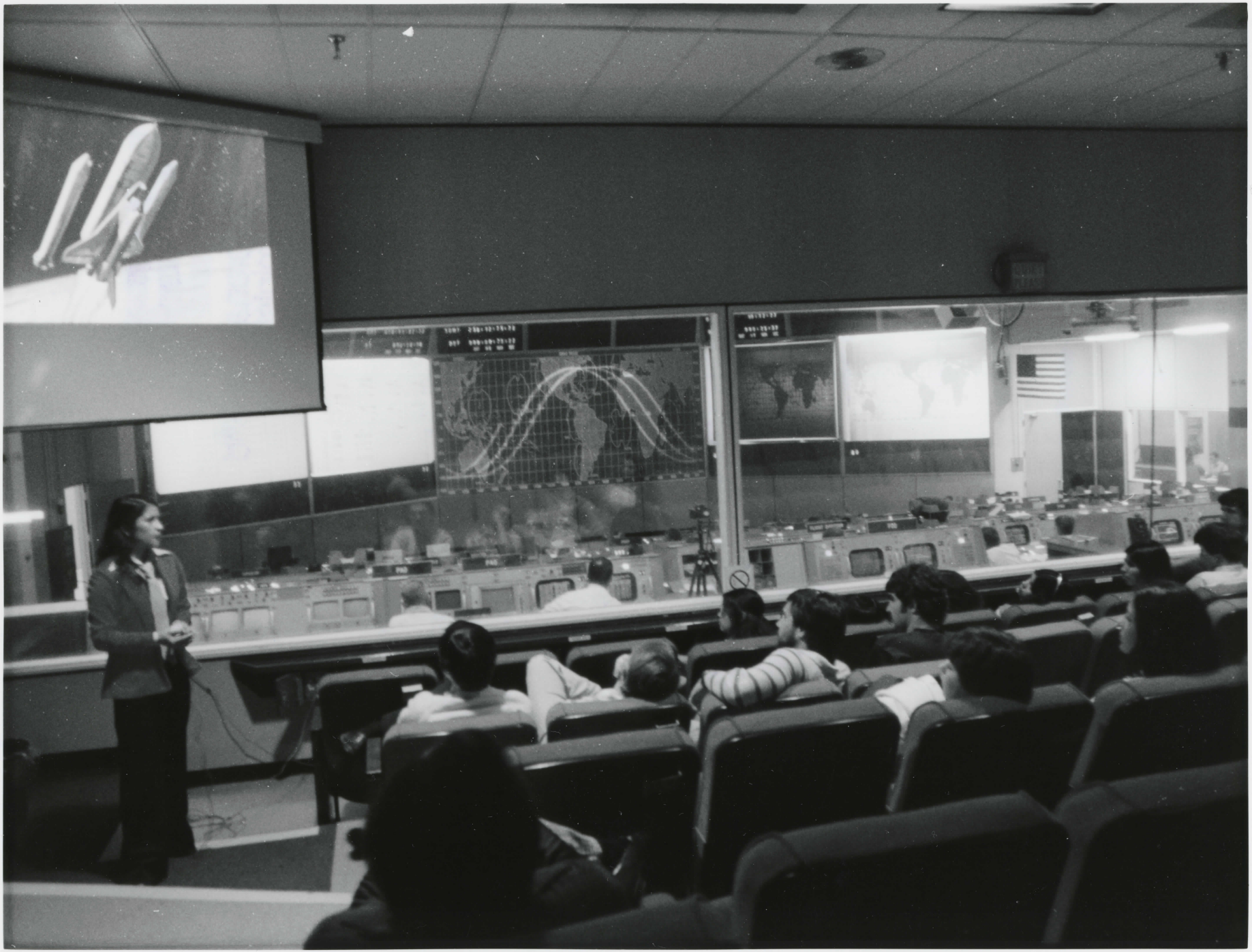
NASA National Aeronautics and Space Administration

S- 79- 39516

Lyndon B. Johnson Space Center
Houston, Texas 77058



National Aeronautics and Space Administration

Houston, Texas 77058

For Release

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COLOR

AUGUST 1979

JOHNSON SPACE CENTER, HOUSTON, TEXAS

MISSION CONTROL CENTER---Sixty-five tourists on the JSC visitors program listen to a briefing by Lisa Vazquez of Visitor's Services in the Public Affairs Office. The group is in the VIP viewing room overlooking second floor mission operations control room (MOCR) in the Mission Control Center (MCC) facility. Briefings are conducted daily in the historic room. The room is planned for usage during the Space Shuttle era as well.

PHOTO CREDIT: NASA or National Aeronautics and Space Administration

UNITED STATES
DEPARTMENT OF THE INTERIOR
GEOLOGICAL SURVEY

LEAGUE CITY QUADRANGLE
TEXAS
7.5 MINUTE SERIES (TOPOGRAPHIC)

6942 II NW (PASADENA)
6943 II NW (MORGANS POINT)
6943 II SW (FRIENDSWOOD)
7042 III SW (BACLIFF)
7042 IV NW (TEXAS CITY)
6942 I NW (ALGOA)
6942 I NE (LA PORTE)
6943 II NE (LA PORTE)

95°07′30″ — 95°00′ — 29°37′30″ — 29°30′ — 32′30″ — 35′

3 270 000 FEET — 670 000 FEET — 630 000 FEET

8 MI. TO TEX. 225 — LA PORTE 3 MI. — 3.1 MI. TO TEX. 2351 — HOUSTON (P.O.) 23 MI. 16 MI. TO INTERSTATE 610 — FRIENDSWOOD 6 MI. — LA MARQUE 11 MI. GALVESTON 26 MI. — DICKINSON 3.5 MI. — DICKINSON 2.6 MI. — TEXAS CITY (VIA TEX. 1764) 12 MI.

Apollo Mission Control Center
Building 30
15/297660/3271460

Mapped, edited, and published by the Geological Survey

Control by USGS and NOS/NOAA

Topography by photogrammetric methods from aerial photographs taken 1975. Field checked 1976. Map edited 1982
Selected hydrographic data compiled from NOS/NOAA chart 11326 (1981)
This information is not intended for navigational purposes

Projection and 10,000-foot grid ticks: Texas coordinate system, south central zone (Lambert conformal conic)
1000-meter Universal Transverse Mercator grid, zone 15
1927 North American datum
To place on the predicted North American Datum 1983 move the projection lines 21 meters south and 21 meters east as shown by dashed corner ticks

Fine red dashed lines indicate selected fence lines
Red tint indicates areas in which only landmark buildings are shown
A portion of this map lies within a subsidence area
Contouring based on 1973 adjustment of verical control

Water stages in this area vary with meteorological conditions
Approximate limits of occasional inundation shown by dashed blue lines where mean high water is undetermined for lack of visual evidence
Dotted blue lines indicate the approximate limits of low water

There may be private inholdings within the boundaries of the National or State reservations shown on this map

UTM GRID AND 1982 MAGNETIC NORTH DECLINATION AT CENTER OF SHEET
MN — GN — 6° — 1°01′ — 18 MILS — 107 MILS

SCALE 1:24 000
1 — 0 — 1 MILE
1000 — 0 — 1000 — 2000 — 3000 — 4000 — 5000 — 6000 — 7000 FEET
1 — .5 — 0 — 1 KILOMETER

CONTOUR INTERVAL 5 FEET
NATIONAL GEODETIC VERTICAL DATUM OF 1929
DEPTH CURVES AND SOUNDINGS IN FEET-GULF COAST LOW WATER DATUM
SHORELINE SHOWN REPRESENTS THE APPROXIMATE LINE OF MEAN HIGH WATER
THE MEAN RANGE OF TIDE IS NEGLIGIBLE

THIS MAP COMPLIES WITH NATIONAL MAP ACCURACY STANDARDS
FOR SALE BY U. S. GEOLOGICAL SURVEY, DENVER, COLORADO 80225, OR RESTON, VIRGINIA 22092
A FOLDER DESCRIBING TOPOGRAPHIC MAPS AND SYMBOLS IS AVAILABLE ON REQUEST

TEXAS
QUADRANGLE LOCATION

2995–411

ROAD CLASSIFICATION
Primary highway, hard surface
Secondary highway, hard surface
Light-duty road, hard or improved surface
Unimproved road
Interstate Route — U. S. Route — State Route

LEAGUE CITY, TEX.
N2930—W9500/7.5

1982

DMA 6943 II SE—SERIES V882

INTERIOR—GEOLOGICAL SURVEY, RESTON, VIRGINIA—1982

United States Department of the Interior

OFFICE OF THE SECRETARY
WASHINGTON, D.C. 20240

Log #15173

Memorandum

TO: The Secretary

FROM: ACTING DEPUTY Assistant Secretary for Fish and Wildlife and Parks

9/10/85

SUBJECT SUMMARY: Request to Designate as National Historic Landmarks 22 properties in the Man in Space National Historic Landmarks Program Theme Study

DISCUSSION: The National Park System Advisory Board, meeting on May 3, 1985, recommended that the twenty-two properties in the Man in Space theme study named on the attached list be designated as National Historic Landmarks. In accordance with regulations, the Board examined the studies supporting nomination and found that the subject properties meet the criteria of the National Historic Landmarks Program. Except as noted in the attached report on the Advisory Board meeting, the Board voted unanimously to recommend designation of these properties.

Brief descriptions of these properties and comments of interested parties are contained in Appendixes A and C respectively of the attachments. A summary report of the Advisory Board meeting is being prepared and will be transmitted to you when completed. In its absence, actions of the Board relevant to the following recommendations are described here and in the attached "Recommendations of National Historic Landmark Designations by the National Park System Advisory Board ...."

OPTIONS:

1. To designate the 22 properties on the attached list as National Historic Landmarks.

Your Advisory Board found that these properties meet the prescribed criteria and recommended that they be designated National Historic Landmarks. The criteria are the sole legal basis for designation.

2. To designate only those properties whose owners have not objected to designation.

Air Force objections to designation of the two Man in Space properties under its jurisdiction, Space Launch Complex 2W at Vandenberg Air Force Base and Rogers Dry Lake at Edwards Air Force Base have been resolved. Representatives

Prepared by: Laura Feller ext: 343-8167

of the National Park Service and the Air Force have reached mutually acceptable agreements on these two nominations. As a result, we are not requesting designation of SLC 2W at this time, and the Air Force has agreed to support designation of Rogers Dry Lake with a revised boundary.

In a letter of July 22, 1985, the National Aeronautics and Space Administration objected to designation of all properties under its jurisdiction. Those are the remaining Man in Space properties other than Launch Complex 33, which is administered by the Army. (This letter is in Appendix B.) While contending that some of its properties do not meet the Landmarks Program criteria, NASA appears primarily concerned about adverse effects on its operations. I believe that such concerns are unwarranted. In any case they should not influence your decision, which should be guided solely by your determination that the properties either do or do not meet the criteria.

3. To designate none of the 22 properties.

This option, like the partial non-designation option above, would require your finding that the properties do not meet the Landmarks Program criteria.

RECOMMENDATION: In light of the discussion above and the recommendation of your Advisory Board, I recommend that you approve Option 1.

Option 1: Approve Ann McLaughlin Date 10-3-85

Option 2: Approve _____ Date _____

Option 3: Approve _____ Date _____

Attachments

Properties in the Man in Space Theme Study
Recommended for Designation as National Historic Landmarks

1. Variable Density Tunnel (Langley Research Center, Hampton, VA)
2. Full Scale Tunnel (Langley)
3. Eight-Foot High Speed Tunnel (Langley)
4. Unitary Plan Wind Tunnel (Ames Research Center, Moffett Field, CA)
5. Rocket Engine Test Facility (Lewis Research Center, Cleveland, OH)
6. Zero-Gravity Research Facility (Lewis)
7. Spacecraft Propulsion Research Facility (Lewis Plum Brook Operations Division)
8. Redstone Test Stand (George C. Marshall Space Flight Center, AL)
9. Propulsion and Structural Test Facility (Marshall)
10. Rocket Propulsion Test Complex (National Space Technology Laboratories, MS)
11. Saturn V Dynamic Test Stand (Marshall)
12. Launch Complex 33 (US Army White Sands Test Facility, NM)
13. Lunar Landing Research Facility (Langley)
14. Rendezvous Docking Simulator (Langley)
15. Neutral Buoyancy Space Simulator (Marshall)
16. Space Environment Simulation Laboratory (Lyndon B. Johnson Space Center, Houston, TX)
17. Spacecraft Magnetic Test Facility (Goddard Space Flight Center, Greenbelt, MD)
18. Twenty-Five-Foot Space Simulator (Jet Propulsion Laboratory, Pasadena, CA)
19. Pioneer Deep Space Station (Goldstone Deep Space Communications Complex, CA)
20. Space Flight Operations Facility (Jet Propulsion Laboratory)
21. Apollo Mission Control Center (Johnson)
22. Rogers Dry Lake (Edwards Air Force Base, CA)

DEPARTMENT of the INTERIOR
news release

NATIONAL PARK SERVICE

For Release January 8, 1986 Anita Clevenger 202/343-7394

INTERIOR DESIGNATES 22 "MAN IN SPACE" NATIONAL HISTORIC LANDMARKS

Secretary of the Interior Don Hodel today announced that he has designated 22 properties in Alabama, California, Maryland, Mississippi, New Mexico, Ohio, Texas and Virginia, as national historic landmarks representing the early years of the American space program.

"These designations represent the best, most intact and most important examples of the technology which will interpret for future generations the early years of the American space program," Hodel said.

The Interior Department's National Park Service, as directed by Congress (P.L. 96-344), studied approximately 350 sites associated with the early space explorations for preservation and interpretation. "A Man in Space Theme Study" was initiated to consider resources relating to the following general subthemes: technical foundations before 1958; the effort to land a man on the moon; the exploration of the planets and solar system; and the role of scientific and communications satellites.

The Historic Sites Act of 1935 authorizes the Secretary to designate as national historic landmarks properties identified as having significance to the Nation. National historic landmarks are entered in the National Register of Historic Places upon designation.

DOI

(Attached is a list of the 22 national historic landmarks by category.)

For further information contact Dr. Harry Butowsky, Historian, telephone: 202/343-8155.

DESIGNATED NATIONAL HISTORIC LANDMARKS

National Advisory Committee for Aeronautics Wind Tunnels

1. Variable Density Tunnel, Langley Research Center, Hampton, Va.
2. Full Scale Tunnel (Langley)
3. Eight-Foot High Speed Tunnel (Langley)
4. Unitary Plan Wind Tunnel, Ames Research Center, Moffett Field, Calif.

These sites represent the technological base of aeronautical research created by the National Advisory Committee for Aeronautics facilities.

Rocket Engine Development Facilities

5. Rocket Engine Test Facility, Lewis Research Center, Cleveland, Ohio
6. Zero-Gravity Research Facility (Lewis)
7. Spacecraft Propulsion Research Facility (Lewis Plum Brook Operations Division)

These represent the important role of the Lewis Research Center in developing hydrogen as a fuel for the Centaur and Saturn V rockets.

Rocket Engine Test Stands

8. Redstone Test Stand, George C. Marshall Space Flight Center, Huntsville, Ala.
9. Propulsion and Structural Test Facility (Marshall)
10. Rocket Propulsion Test Complex, National Space Technology Laboratories, Bay St. Louis, Miss.

These facilities represent the role of the Marshall Space Flight Center in the building and testing of actual space flight rockets.

Rocket Test Facility

11. Saturn V Dynamic Test Stand, George G. Marshall Space Flight Center, Huntsville, Ala.

This facility illustrates another facet of the building and testing and man-rating of the Saturn V Rocket.

Launch Pads

12. Launch Complex 33, White Sands Test Facility, New Mexico

Launch Complex 33 was designated because of its close association with the testing of the V-2 rocket and the origins of the American Rocket Program.

Apollo Training Facilities

13. Lunar Landing Research Facility, Langley Research Center, Hampton, Va
14. ~~Rendezvous Docking Simulator (Langley)~~
15. Neutral Buoyancy Space Simulator, George C. Marshall Space Flight Center, Huntsville, Ala.

These facilities were designated because of their association with training programs necessary to prepare American astronauts to land on the moon.

Apollo Hardware Test Facility

16. Space Environment Simulation Laboratory, Lyndon B. Johnson Space Center, Houston, Texas

This Laboratory is important because it was used to man-rate and test the integrity of the Apollo Command and Service Module, Lunar Module, and spacesuits under simulated space conditions here on Earth.

Unmanned Spacecraft Test Facilities

17. Spacecraft Magnetic Test Facility, Goddard Space Flight Center, Greenbelt, Md.
18. Twenty-Five-Foot Space Simulator, Jet Propulsion Laboratory, Pasadena, Calif.

These facilities illustrate the extensive ground support testing facilities needed to accomplish the American unmanned space program--the exploration of the near and deep space environment.

Tracking Stations

19. Pioneer Deep Space Tracking Station, Goldstone Tracking Station, Calif.

The station was the first antenna to support NASA's unmanned exploration of deep space.

Mission Control Centers

20. Space Flight Operations Facility, Jet Propulsion Laboratory, Pasadena, Calif.
21. Apollo Mission Control, Lyndon B. Johnson Space Center, Houston, Texas

These sites are the very heart and soul of both the American Manned and Unmanned Space Programs.

Other Support Facilities

22. Rogers Dry Lake, Edwards Air Force Base, Edwards, Calif.

Although a natural resource, Rogers Dry Lake was designated because of its association with flight testing of advanced aircraft that opened the way to space.

National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center
Houston, Texas
77058

NASA

Reply to Attn of: JA

JUN 16 1989

Mr. Robert D. Bush, Executive Director
Advisory Council on Historic Preservation
The Old Post Office Building
1100 Pennsylvania Avenue, N.W. #809
Washington, DC 20004

Dear Mr. Bush:

The purpose of this letter is to formally request the comments of the Council under 36 CFR Section 800.6(b) concerning the planned "Equipment Upgrade to Mission Control Center (MCC)," Lyndon B. Johnson Space Center (JSC), Houston, TX. By copy of the May 10, 1989, JSC letter to the Texas SHPO, we notified the Council of the JSC finding of "Adverse Effect" concerning the "Equipment Upgrade to MCC" and provided documentation under Section 800.8(d). Another copy of the documentation on the equipment upgrade is enclosed for your ready reference.

By letter dated June 6, 1989, the Texas SHPO notified JSC that it concurred with the finding of "Adverse Effect," but that it did not agree with the NASA mitigative efforts. Accordingly, it is determined that further consultation with the Texas SHPO will not be productive since we are unable to reach agreement with the SHPO on that issue.

Please provide NASA with the Council's comments as expeditiously as possible, but not later than the 60-day period established in your regulations. Within the 60-day period, and if you so request, NASA will be pleased to assist the Council in arranging an onsite meeting by the Council; all to be completed within the 60-day timeframe.

We look forward to your prompt response.

Sincerely,

K. B. Gilbreath

K. B. Gilbreath
Director, Center Operations

Enclosure

cc:
Mr. Curtis Tunnell, Executive Director
State Historical Preservation Officer
Texas Historical Commission
P. O. Box 12276
Austin, TX 78711

1400
3093

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

AUG 4 1989

Mr. James E. Ridenour
Director
National Park Service
Department of the Interior
Washington, DC 20240

Dear Mr. Ridenour:

We have received a request for Council comments from the National Aeronautics and Space Administration on their proposal to upgrade equipment within the Mission Control Center, Lyndon B. Johnson Space Center, Houston, Texas. Mission Control is a National Historic Landmark, designated by the Secretary of the Interior on December 24, 1985, because of its place in the manned space program and its pivotal role in the 1969-72 lunar landings.

We have been discussing various problems concerning NASA's programs, their effects on a number of NASA-controlled NHL's, and NASA's proposals for Mission Control for some time with Associate Director Rogers and staff of the Service's History Division. Since the effect of the proposed upgrade will be adverse, and since Mission Control is a National Historic Landmark, we are requesting a report from you, on behalf of the Secretary of the Interior, in accordance with our regulations (36 CFR Part 800) implementing Section 110(f) of the National Historic Preservation Act. The report may address the Department's views on the significance of the property, effects of the undertaking, and any recommendations you may have to avoid, minimize, or mitigate adverse effects.

Copies of NASA's proposal and a June 21, 1989 letter to Texas Governor William P. Clements, Jr. on Mission Control that was signed by Acting Director Herbert S. Cables are enclosed.

We appreciate your cooperation, and look forward to receiving your reply as soon as possible. If you or your staff have questions on the time frame for Council comment on this case, or wish to discuss other substantive or procedural issues, please contact Ronald D. Anzalone at 786-0505.

Sincerely,

John Fowler

John Fowler
Deputy Executive Director

Enclosures

AUG 9 1989

United States Department of the Interior

NATIONAL PARK SERVICE
P.O. BOX 37127
WASHINGTON, D.C. 20013-7127

IN REPLY REFER TO:
H30(418)

JUN 2 1 1989

The Honorable William P. Clements, Jr.
Governor of the State of Texas
Austin, Texas 78711

Dear Governor Clements:

This is in reply to your letter of April 28, 1989, to President George Bush regarding the preservation of Apollo Mission Control, a National Historic Landmark, in Houston, Texas.

As you know, on September 8, 1980, the Congress passed Public Law 96-344, requiring the Secretary of the Interior to prepare a study of the sites, locations and events associated with the historical theme of Man in Space. Public Law 96-344 also asked the National Aeronautics and Space Administration and other responsible government agencies controlling such sites to preserve them from destruction or change during the study and congressional review period insofar as is possible.

The Man in Space Alternatives Study, required by P. L. 96-344, still has not been officially released to the Congress. Since it is a planning document we need to obtain the approval of the Office of Management and Budget before it can be transmitted. The study has been under review by OMB since October 1987.

The 25 National Historic Landmarks identified by the Man in Space study represent only a fraction of the technological resources that supported the early American Space Program. They are the best remaining examples of the large technological base that enabled Americans to go to the moon and explore deep space. The physical and documentary record of this technological base needs to be preserved. These resources relate to and illustrate the entire history of the American Space Program.

In the interim, we believe the preservation of Apollo Mission Control and the other National Historic Landmarks identified by the National Park Service as a result of the Man in Space study are critical to the successful completion of the study effort required by the Congress in P.L. 96-344.

It is my hope that the Man in Space study effort will eventually lead to the preservation of the Man in Space sites and their interpretation to the public so that this important part of our history will not be lost to future generations of humankind. The National Park Service stands ready to work with the State of Texas and the National Aeronautics and Space Administration in the successful completion of the requirements of P. L. 96-344.

Sincerely,

/s/ Herbert S. Cables

Director

NOTICE OF FINDING OF ADVERSE EFFECT
"Equipment Upgrade to Mission Control Center"

The National Aeronautics and Space Administration (NASA) has determined that the proposed equipment upgrade will have an adverse effect on the Mission Control Center, since the modifications will involve a changeout of equipment, as described on the attachment. Accordingly, please provide your written comments. The following documentation is provided in response to each item listed in 36 CFR 800.8(d):

(1) A description of the proposed equipment upgrade is provided in the attachment. Please note that the activity does not involve any structural changes to the room or building.

(2) The MCC was designated as a National Historic Landmark by the Secretary of Interior, December 24, 1985.

(3) The MCC is significant because Apollo 11, man's first landing on the Moon, July 20, 1969, was controlled from the Mission Operations Control Room.

(4) The equipment changeout is essential for the flight control systems technology upgrade that will meet future space flight mission requirements.

(5) The Agency proposed to document the original state of the MCC and retain the original equipment for future determination of appropriate disposition.

(6) The State Historic Preservation Officer (SHPO) has suggested that the equipment be retained in place; however, the Agency has determined that the modifications are absolutely essential to satisfy the operational flight control requirements for Space Shuttle flights manifested through the 1990's.

(7) In keeping with 36 CFR 800.3(b), the Agency has been in contact with the SHPO on an informal basis since June 11, 1987. Documentation of these informal contacts exists, but does not address the equipment changeout in specific detail.

(8) The MCC is an operational space flight facility, and there has been no demonstrated need for additional consultation.

(9) See the attachment for a schedule of the equipment upgrade.

(10) See item 7 above.

We would appreciate your written comments.

Enclosure

MISSION CONTROL CENTER UPGRADE (MCCU)
Lyndon B. Johnson Space Center
Houston, Texas

SUMMARY OF PREVIOUS UPGRADES

Technical upgrade modifications to the Mission Control Center (MCC) flight systems are mandatory in order to meet the dynamically changing requirements of evolving technology characteristic of the Nation's space program. The components and the configuration of the MCC must change as we pursue our goal of striving to maintain technical preeminence in the international space community.

The following is a description of the modifications, deletions, and additions which have been made to the two flight control rooms (FCR's) since the Apollo Program. This listing includes equipment cabinets and consoles in the FCR's and the MCC support rooms, as well as facility wall changes in various areas of the MCC:

1. All MCC display-control system equipment has been converted to the Console Input System (CONIS). This was a major MCC project that affected every console in the MCC (approximately 150) and all display-control subsystems that supported the consoles. This project was implemented in phases from 1979 to 1984. Every console in the MCC was removed and stripped of all components. The old technology components were sent to surplus and replaced with the new CONIS technology. While the consoles were away in the manufacturing area, facility modifications including deletions and relocations of walls in the support room areas were accomplished. In all cases, once the consoles were returned to the MCC, they were placed into an assembly schedule and remounted according to use, not according to originality.

2. The electronic support equipment cabinets located in the support rooms (supporting the 150 consoles mentioned in item 1) were all redesigned and replaced with the CONIS equipment, which remains in operation today. This allowed the removal of 85 electronic equipment racks and provided space for the new transition flight control room supporting the MCC equipment upgrade.

3. In early 1984, the second floor FCR control consoles were dismantled and sent to the manufacturing facility for repainting from the green to brown color scheme. As a result of flight control requirements, the consoles were placed in different locations when returned. The wallpaper, furniture, and carpet were changed to brown tone complements, but glass projection screens, window and wall locations were not changed.

4. All vacuum tube type console-mounted television monitors have been removed and replaced with solid state units.

5. The rear screen Eidophor projectors were replaced with new GE light-valve type projectors.

Attachment

6. The flight control teams normally identify changes required from one flight to the next and, as a result, the total estimated change of consoles since the 1984 refurbishment is approximately 20 percent.

7. The MCC computer system has been changed twice since the Apollo Program. In 1975, the 360/75 computer and all peripherals were replaced with the larger 370/168. In 1986, all these host computers in the MCC were again changed out and upgraded to the 308X series.

PROPOSED UPGRADE

The MCCU is a program to replace aging equipment of older technology located on all three floors of the MCC. The equipment in place is outdated and deteriorating. It is showing signs of increased maintenance problems, decreased mission support reliability, and the loss of vendor support due to discontinued manufacturing. Expansions and enhancements to the older equipment are difficult, since the high-skill labor requirements are intensive, costly, and time consuming. Current old technology equipment requires excessive mission-to-mission reconfiguration time and makes the projected-mission flight manifest difficult to meet. The existing equipment reduces the capability to respond to late or unexpected mission requirements.

SUMMARY

The MCC is used continuously for flight preparation and support functions, requiring an implementation of upgrades without disrupting ongoing mission operations. MCCU capabilities will be accomplished by a phased approach that will allow the flight control team to become familiar and grow with the systems as they are implemented. This new MCCU capability will be accomplished by utilizing a transition flight control area located in the MCC. This approach proposes to minimize implementation risks and allows a course of correction to the system design prior to operational use. Concepts and capabilities will be proven prior to essential mission support and, at the same time, training can be provided to the flight control team members.

The attached MCCU Implementation Schedule identifies proposed upgrades to be accomplished in the 1989-1994 timeframe:

1. The delivery of System 2.3, which is scheduled for May 1989, involves new host computer program software in addition to 33 new flight control workstations, some of which will receive real-time data from a local area network (LAN). The MCCU program will include complete installation of a new fiber optic backbone system for distributing data throughout the building. This new fiber optic technology will eliminate the massive numbers of copper cables previously used for this function. The MCCU fiber optic backbone system will be utilized for all LAN functions in the future. Copper cables will not be removed until all old technology console systems are removed, approximately October 1993. The

System 2.3 is one increment of the MCCU program which extends to the delivery of System 2.13, which is scheduled for late 1994.

2. The MCCU delivery of Systems 2.5 through 2.13 involves incremental software enhancements for host computers and workstations. Enhancements in the LAN will also be incorporated. The installation of the Digital Voice Intercom System (DVIS) key sets will begin in late 1989 and will be completed in late 1990. The old voice key sets will be removed as the DVIS key sets are installed. After removal of all voice key sets, the old mainframe and support equipment will no longer be required and will be removed by the support contractor. After testing, verification, and acceptance by the flight control community of System 2.5, the old technology consoles will be removed and replaced with new workstations. This action will continue incrementally through delivery of System 2.13 in late 1993 (see attached photo for artist's conception).

3. The last groups of consoles to be upgraded to workstations are the two flight control rooms (FCR's) which are scheduled for console changeout beginning mid-1993. After the last old technology consoles are removed, all support equipment for the old CONIS console system will be removed, approximately late 1993.

4. The FCR projection area (behind the screen) will receive new projectors in the mid-to-late 1990 timeframe. The old glass screens may be replaced with new screens at that time. The old projectors and the old mirrors will be retained until the new projector system has been proven and verified. Present schedule shows facility-type wall and screen modifications occurring in the early 1993 timeframe.

5. MCCU Step 4 identifies communication front end system equipment removal and upgrade in mid-1993.

JSC is implementing the following historic preservation actions to document the Apollo FCR configuration and to retain the original equipment for any future replication.

a. Representative equipment not already archived will be cataloged for retrieval.

b. A complete photographic documentation of the Apollo FCR's will be available from the JSC archival files.

c. Technical documentation including drawings and specifications of the basic room, structure, utilities, configuration, flight control systems, control consoles, and visual displays will be compiled and available on request.

d. Flight plans, checklists, procedures, and some planning documents will be made available.

e. Vertical visual mission status display panels will be retained and made available for possible future relocation.

f. Locations will be provided both inside and outside the MCC for the installation of suitable State Historical Preservation Office (SHPO) plaques presenting historical information.

g. Locations will be made available for artistic renderings inside the FCR as appropriate.

h. NASA will explore the potential for replication of the Apollo Flight Control Room to be included in Phase II of the planned Space Center Houston (public visitor center).

MCCU IMPLEMENTATION SCHEDULE

AS OF: 9/3/89

LEGEND: △ MSC, ⧋ OTHER

	FY89				FY90				FY91				FY92				FY93				FY94				95
	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q	2Q	3Q	4Q	1Q

MSC — STEP 4 & SSSC / STEP 2

MSC AWARD 10/89 1/90 ← STEP 4 & SSSC TRANSITION COMPLETE & INCUMBENTS NO LONGER INVOLVED

INITIAL MSC INVOLVEMENT WITH STEP 2 10/89 ← TRANSITION → 12/90 ← STEP 2 TRANSITION TO MSC COMPLETE & INCUMBENT CONTRACT TERMINATED

OVIS

CDR 12/88; PHI EQUIP RETURN 4/89; BLACK AT 12/89; RED AT 8/90; QT 9/90; STEP 2 COMPL

FCR/MPSR

MOD TRAINING

BEGIN MOD TRAINING 12/88; QCR HW O/D 10/89; INTG TEST 3/90; QCR ONLINE 10/90; GRP 1 COMPL 2/91; GRP 2 COMPL 6/91; GRP 3 COMPL 10/91; GRP 4 COMPL 2/92; GRP 5 COMPL 6/92; GRP 6 COMPL 10/92; GRP 7 COMPL 2/93; FCR1 COMPL 8/93; FCR2 COMPL 10/93

GCR FLT FOLLOWING; STS/DOD SUPPORT ROOM INSTALLATION; STS/DOD FCR INSTALLATION

HOST UPGRADE

HOST UPGRADE FAR 9/89

HOST/WS SW

DEL 2.3 3/89; (DEL 2.4 N/A); DEL 2.5 8/90; (DEL 2.6 N/A); DEL 2.7 10/91; DEL 2.9 10/92; DEL 2.11 10/93; DEL 2.13 10/94

FIBER SYSTEM

PHC BEG DEL 2.3 INST TPS 11/88 2/89; 2.9 TPS 10/90; INCREMENTAL DELIVERY WITH WORKSTATIONS & DV13 SPARING 10/93

WS HOUSING

HSGS O/D 10/90; HSGS O/D 8/91; INCREMENTAL DELIVERY OF HOUSINGS 10/93

WS

LAN DATA DR & MITSU WS O/D 10/88; 2.3 WS QT 3/89; 10 DUAL OPS WS O/D LAN OD O/D 10/89; 42 O/D 10/90; 38 O/D 10/91; 35 O/D 10/92; 22 O/D 10/93

GP LAN/CHANNEL SWITCH

2.3 TEST 2/89; PDR 3/89; BEGIN BLACK 6/89; BEGIN RED 11/89; DEL 2.5 QT 2/90; (DEL 2.5) DEL 3/90; INCREMENTAL DELIVERY WITH WORKSTATIONS; GP LAN COMPL 10/93

RT LAN

INST COMPL 11/88; (DEL 2.2) QT 2/89; DEL 3/89; QT 8/89; (DEL 2.5) DEL 3/90; INCREMENTAL DELIVERY WITH WORKSTATIONS; RT LAN COMPL 10/93

TVSS

BEGIN 10/89; PDR 4/90; CDR 10/90; INCREMENTAL DELIVERY WITH WORKSTATIONS; TVSS QT 10/93

LARGE SCREEN DISPLAYS

STS/DOD HW CDR & POC DEMO 10/88; PPD DISP GRAPHICS DEV; GCR/FCR1 FLT FOL'G (RITS) 10/88; INST 2 PROJ O/D 8/90; INST FCR1 PROJ 8/90; INST FCR2 PROJ 9/90; 11/90; FCR1 WALL/SCREEN EFFORTS; FCR1/2 FLT FOL (GP) 10/91; FCR2 WALL/SCREEN EFFORTS; 1/93 3/93 8/93 9/93; QT

TIMING (MB & BLDG)

PDR 4/91; CDR 10/91; HW O/D 8/92; QT 10/93

TPC REPLACEMENT (PHASE 2)
(PHASE 1- DATA DRIVER 2.3 & 2.5)

DEL 2.9 DD 3/88; CONCEPTUAL DESIGN COMPL 10/88; DEL 2.5 SW SDR 4/89; DEL 2.5 SW DDT 5/90; SW PDR 8/90; HW PDR 10/90; HW CDR 12/90; HW O/D 8/91; SW CDR* 9/91; 1ST TPC INST'D 8/92; HW QT 7/92; STS TPC'S COULD BE REMOVED 4/93; INST DOD TPC'S 6/93; QT 8/93; DOD TPC'S COULD BE REMOVED 10/93; STEP 4 COMPL

MCCU STEP 4

PSDR 9/89; SDR 4/90; MIN CDR 1/92; MOF CDR 12/92; MIN QT 2/94; MOF QT 8/94; 10/94

MPCC

TSS PSDR 2/89; TSS PDR/CDR 6/89; MPCC SDR 1/90; TSS FAR 5/90; MPCC FULL CAPABILITIES 3/93; AFE FAR 8/94

FADS

SDR 10/89; DESCENT PROTOTYPE DEMO 10/90; ORBIT DYNAMICS PROTOTYPE DEMO 10/91; FADS FAR 10/93

GRP 1:	1 STS MAC 9 DOD SOAC 1 DOD P/L EXP 1 DOD OIR 1 DOD A/F MGMT
GRP 2:	7 STS C3P 1 STS LIFE SCIENCES TBD STS JSC POCC 2 STS SPAN 2 DOD SPAN
GRP 3:	3 STS FAO 3 DOD FAO
GRP 4:	3 STS TRJ 1 DOD NAV 3 STS TRAJ 1 DOD NAV
GRP 5:	6 STS EECOM 5 DOD GNC 4 STS EECOM 6 DOD GNC
GRP 6:	1 STS MEDICAL/SAAC 1 DOD MEDICAL/SAAC
GRP 7:	9 STS P/L 2 DOD P/L 5 STS INCO 2 DOD INCO
GRP 8:	19 STS FCR1
GRP 9:	19 DOD FCR2

NOTE: OST & SCR WILL BE DONE CONSOLE BY CONSOLE FROM 10/90 - 10/93.

H30(418)

AUG 1 0 1989

Mr. John Fowler
Deputy Executive Director
Advisory Council on Historic Preservation
The Old Post Office Building
1100 Pennsylvania Avenue, NW., Suite 809
Washington, DC 20004

Dear Mr. Fowler:

In response to your request of August 4, 1989, to the National Park Service and in accordance with the National Historic Preservation Act of 1966, as amended, we are submitting a report on the changes proposed by the National Aeronautics and Space Administration (NASA) for Apollo Mission Control in Houston, Texas. Should you have any further questions about this matter please feel free to contact Mr. Jerry Rogers at 343-7625 for additional information.

Sincerely,

/Sgd/Jerry L. Rogers

(for) James M. Ridenour
Director

Enclosure

cc: Mr. Curtis Tunnell
Executive Director
Texas State Historical Commission
P. O. Box 12276, Capitol Station
Austin, Texas 78711

bcc: 7000 (SWRO) Regional Office
001 Ridenour
001 RF
190 CL
400 Rogers
400 RF
413 RF
424 RF
418 Butowsky
763 Brown
418 Apollo Mission Control (NHL)

HButowsky:gmg:8/10/89
Alternatives Disk #28

DEPARTMENT OF THE INTERIOR

REPORT ON APOLLO MISSION CONTROL NATIONAL HISTORIC LANDMARK IN HOUSTON, TEXAS

Legal Status of the Property

Apollo Mission Control is owned and operated by the National Aeronautics and Space Administration at the Lyndon B. Johnson Space Center in Houston, Texas. The site was designated a National Historic Landmark on October 3, 1985, by the Secretary of the Interior as part of a thematic group on nominations in the Man in Space National Historic Landmark Theme Study.

Significance of Apollo Mission Control

The Apollo Mission Control Center is significant because of its close association with the manned spacecraft program of the United States. This facility was used to monitor nine Gemini and all Apollo flights, including the flight of Apollo 11 that first landed men on the moon. After the end of the Apollo Program this facility was used to monitor manned spaceflights for Skylab, Apollo-Soyuz, and all recent Space Shuttle flights.

The support provided by the Apollo Mission Control Center to the first manned landing on the surface of the moon was critical to the success of the mission. It exercised full mission control of the flight of Apollo 11 from the time of liftoff from Launch Complex 39 at the Kennedy Space Center to the time of splashdown in the Pacific. The technical management of all areas of vehicle systems of Apollo 11, including flight dynamics, life systems, flight crew activities, recovery support, and ground operations was handled here.

Through television and the print news media the scene of activity at the Apollo Mission Control during the first manned landing on the moon became familiar to millions around the world. When Neil Armstrong reported "Houston, the Eagle has landed" to Mission Control, his words went immediately around the world and into history. The Apollo Mission Control Center and Launch Complex 39 at the Kennedy Space Center are the two resources that symbolize for most Americans achievements of the manned space program leading to the successful first moon landing during the flight of Apollo 11 in July 1969.

Description of Apollo Mission Control

The Apollo Mission Control Center (MCC) is in Building 30 at the Lyndon B. Johnson Manned Space Flight Center in Houston, Texas. The three-story structure consists of a mission operations wing (MOW), operations support wing (OSW), and an interconnecting lobby wing. The MOW contains systems and equipment required to support the mission control function. The OSW contains offices, laboratory, and technical support areas for the flight operations directorate. The lobby wing provides additional office space and dormitory facilities utilized by flight controllers during space flights of extended duration. The mission

control center is supported by an emergency power building that houses standby electrical power and air-conditioning systems in the event that primary sources fail.

Principal systems on the first floor are the real time computer complex and the communications systems. These systems support the dual mission facilities and systems on the second and third floors. The communications system provides the interface between the mission control center in Houston and the manned space flight network and the launch site.

Principal areas on the second floor are the mission operations control room (MOCR), the staff support rooms (SSR), the simulation facilities, and the master digital command system. The MOCR is the principal command and control center, staffed with key mission operations teams responsible for overall management of the flight.

Principal areas on the third floor are a second MOCR, staff support rooms, recovery control room, meteorological area, and display and timing area. The MOCR and SSR are exact duplications of the areas on the second floor.

The recovery control room, the meteorological area, and the display and timing areas support the dual mission facilities and systems on the second and third floors.

The MOCR on the second floor is the principal command and decision area in the Mission Control Center. Critical information related to spacecraft, launch vehicle, and ground systems, as well as aeromedical parameters from the world-wide stations, ships, and aircraft, is processed and displayed within the MOCR. Based on an analysis of this continuous flow of information, personnel in this room must assess the spacecraft flight status and progress, and then, in time-critical periods, determine the continuation, alteration, or termination of the space flight.

Summary of Previous Upgrades

This is an on-going NASA facility and has been modified to accommodate flights of the shuttle. The third floor of the facility has been turned over to the Air Force and has been converted into a secure area from which Air Force shuttle flights are monitored. According to documentation provided by NASA, technical modifications to the Mission Control Center (MCC) have continued since the end of the last Apollo Flight in 1975. These modifications included upgrades of the MCC display-control system to the Console Input System (CONIS); redesign of the electronic support equipment cabinets located in the support rooms; repainting of the control consoles to another color (green) and the placement of the consoles in different locations; removal and replacement of all vacuum console-mounted television monitors; the replacement of rear screen Ediophor projectors with newer equipment; and the upgrading of the MCC computer system.

Proposed Upgrade

NASA proposes an extensive revision of the existing Apollo Mission Control to include the delivery of enhanced computer software and flight control work stations, installation of new fiber optic technology to replace copper wiring, and installation of a new projector system.

Effect of Proposed Changes

The National Park Service believes that the proposed changes will have an "Adverse Effect" on the integrity of Apollo Mission Control and we welcome the efforts of the Johnson Space Center to record the technology and preserve representative equipment from Apollo Mission Control. However, in assessing the full impact of the proposed changes to this National Historic Landmark, we must keep in mind that Apollo Mission Control and the other National Historic Landmarks identified by National Park Service in the Man in Space National Historic Landmark Theme Study resulted from the passage of Public Law 96-344, in September 1980, requiring the Secretary of the Interior to prepare a study of the sites, locations and events associated with the historical theme of Man in Space.

Public Law 96-344 also asked the National Aeronautics and Space Administration and other responsible government agencies controlling such sites to preserve them from destruction or change during the study and congressional review period insofar as is possible.

The Man in Space Alternatives Study, required by P. L. 96-344, still has not been officially released to the Congress. The study has been under review by the Administration since October 1987.

In the interim, we believe the preservation of Apollo Mission Control and the other National Historic Landmarks identified by the National Park Service as a result of the Man in Space study are critical to the successful completion of the study effort required by the Congress in P.L. 96-344.

The passage of P.L. 96-344, and its implementation, has enjoyed the wide support of members of Congress, including former Representative and now Secretary of the Interior Manuel Lujan, Jr., who signed two letters on March 18, 1983, and August 15, 1986, requesting the completion and transmittal of the Alternatives Study. In addition, on July 20, 1989, Representative Joel Hefley introduced a bill (HR 2944) to establish the America in Space National Historic Park. We understand that this bill includes Apollo Mission Control as one of the significant properties that supported the American effort to land a man on the moon.

Because the Man in Space Alternatives Study has never been cleared by the Office of Management and Budget for distribution to the Congress of the United States and to the public, the American people have never been allowed the

opportunity to participate in decisions concerning the future disposition of these significant resources, including Apollo Mission Control.

We believe the implementation of these changes for Apollo Mission Control, as proposed by NASA, would negate the intent of Congress, as noted in P.L. 96-344, and would also negate 8 years of effort on the part of the National Park Service, the Advisory Council on Historic Preservation, various State Historic Preservation Officers and other Federal agencies to comply with the requirements of the 1980 act. We believe the continued use of Apollo Mission Control in support of the missions of the American Space Program and its preservation as a National Historic Landmark, indelibly etched in the American psyche, as the place where Neil Armstrong first reported his successful landing on the surface of the moon on July 20, 1969--are fully compatible. To this end we urge that NASA re-open discussions with the Texas SHPO office to resolve this issue. We note that the Mission Control Center (MCC) occupies only a small fraction of the building space in Apollo Mission Control and believe that there are options that will satisfied both the operational requirements of NASA and the concerns of the Texas SHPO.

It is our hope that the Man in Space study effort will eventually lead to the preservation of Apollo Mission Control and other Man in Space sites and their interpretation to the public so that this important part of our history will not be lost to future generations of humankind. The National Park Service continues to stand ready to work with the State of Texas and the National Aeronautics and Space Administration in the successful completion of the requirements of P. L. 96-344.

HButowsky:gmg:8/10/89
Alternatives Disk #27

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

AUG 28 1989

MEMORANDUM TO THE MEMBERS

FROM: JOHN F.W. ROGERS
CHAIRMAN
by RLB

SUBJECT: Failure to Agree, Lyndon B. Johnson Space Center, Equipment Upgrade to Mission Control Center

The National Aeronautics and Space Administration has notified the Council of a failure to agree on the subject project. We have determined that it would be most appropriate to provide comments on the case by a Chairman's letter. Briefing materials on the case and a draft of the proposed letter are enclosed for your review. If you have any comments, please provide them by 12 noon Eastern time on Friday, September 1, 1989. Comments can be provided in writing, by telefax transmittal (202-786-1172), or by telephoning Ron Anzalone at 202-786-0505.

Enclosures

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OFF OF THE
EXECUTIVE SECRETARIAT

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

EXECUTIVE DIRECTOR'S BRIEFING STATEMENT

Date: August 15, 1989

To: Chairman

From: Executive Director Bob Bush

Subject: TX/Mission Control/NASA/Equipment Upgrade

Summary and Recommendation

On June 20, 1989, the National Aeronautics and Space Administration (NASA) formally determined that consultation with the Texas State Historic Preservation Officer (SHPO) that had been ongoing since June, 1987 had reached an impasse, and therefore requested the Council's comments pursuant to Sections 106 and 110(f) of the National Historic Preservation Act and the Council's regulations for the proposed upgrading of equipment in the Mission Control Center, Building 30, Lyndon B. Johnson Space Center, Houston, Texas.

On July 27, 1989, Ron Anzalone of the Council staff visited the Johnson Space Center, toured Mission Control, and discussed the project with NASA representatives and the Texas Deputy State Historic Preservation Officer. Based on the extensive information we have received from NASA and the Texas SHPO, as well as discussions with the National Park Service, we recommend that a Chairman's letter be sent to NASA with the Council's comments. A draft of the proposed letter is attached.

Significance of Mission Control

The Mission Control Center (Building 30), also known as Apollo Mission Control because of its association with the lunar landing

conception of a post-equipment upgrade FCR in 1993, are provided (Attachment 2). As noted in a letter from the NASA Administrator to Texas Governor William P. Clements, Jr. (June 21, 1989), "The contemplated changes will inevitably lead to a facility with internal features that are different in function and appearance from the original Apollo design. Although changes occur, the facility will retain its identity and will be readily recognizable, inside and out, as having evolved from the original Apollo design."

Consideration of Alternatives That Would Avoid Adverse Effects

The only alternatives that would avoid adverse effects are "no project," unacceptable to NASA given its space mission operational requirements, or preservation in place of one of the two FCRs and construction of a new one elsewhere in the complex.

At the request of the Texas State Historic Preservation Officer, NASA considered preservation in place of one of the Flight Control Rooms in its Apollo configuration. The Texas SHPO took the position that "the 2400 square foot room that the THC would like to preserve could be replaced by space in a new 107,000 square foot addition being built adjacent to Mission Control or in other space that is becoming available in the existing facility due to changing functional requirements (i.e., the elimination of a planed and partially constructed third mission control room). NASA has concluded that this is not feasible, given the integrated nature of the Mission Control Center, including the FCRs and support facilities, the different operations and training requirements for the Mission Control Center and the proposed new Space Station Control Center, the need for space for a Transitional Flight Control Room on a temporary basis during the construction and modification period, and the prohibitive costs to NASA (and therefore, the public) of constructing additional new facilities. Based on the documentation submitted and our discussions onsite in Houston, we must unfortunately agree with NASA.

Measures to Minimize Harm

NASA has proposed the following measures to mitigate the adverse effects, and address the requirement of Section 110(f) to "take such planning and actions as may be necessary to minimize harm" to the NHL:

o Representative equipment not already archived will be catalogued.

o A complete photographic documentation of the Apollo FCR's will be available from the JSC archival files.

o Technical documentation including drawings and specifications of the basic room, structure, utilities, configuration, flight control systems, control consoles, and visual displays will be compiled and available on request.

o Flight plans, checklists, procedures, and some planning documents will be made available.

o Vertical visual mission status display panels will be retained and made available for possible future relocation.

o Locations will be made available for artistic renderings inside the FCR as appropriate.

o NASA will explore the potential for replication of Apollo Flight Control Room to be included in Phase II of the planned Space Center Houston (public visitor center). (Space Center Houston is being developed on NASA land by a private foundation using non-Federal funds; a rendering of the facility, scheduled for ground-breaking in the fall of 1989, are contained in Attachment 3).

Policy Considerations

At the time of the termination of consultation, NASA and the Texas SHPO had made considerable progress in their discussions, and had exchanged draft MOAs. Johnson Space Center was then directed to break off discussions by its Washington office, pending resolution of its request for a legislative waiver from historic preservation requirements or conclusion of a Programmatic Agreement with the Council. As you are aware, NASA ended further discussions on the Programmatic Agreement in May, 1989, and we recently learned that language providing for a legislative waiver along the lines NASA had sought appeared in NASA's reauthorization language and passed its House committee. Through our regular staff contact at OMB, we understand that both OMB and NASA disclaim participation in the introduction of the waiver language, and OMB is looking into the matter.

We need to regularize the way we do business with NASA. The designated Federal Preservation Officer for NASA recently retired, and we have not been informed of a replacement. Individual facilities seem interested in managing their historic properties in a responsible manner, but they seem to get little support for these efforts from the Washington office, which can override many of their decisions on budgetary or other program grounds. NASA headquarters seems to be using the aborted Programmatic Agreement discussions and the legislative waiver to sidestep NASA's historic preservation responsibilities. We should continue to express understanding for their operational and mission needs, while at the same time urging further

examination of effective ways to integrate preservation and Section 106 review in NASA actions.

Two final notes involve pending legislation and other Congressional oversight of NASA activities. The National Park Service has advised us that a study of alternatives for the preservation of Man in Space sites required of the Secretary of the Interior under P.L. 96-344, although completed by Interior in October, 1987, has never been cleared by the Office of Management and Budget for transmission to the Congress. P.L. 96-344 called on NASA and other responsible government agencies controlling such sites **"to preserve them from destruction or change during the study and congressional review period insofar as is possible"** (Ridenour to Fowler, August 10, 1989). Meanwhile, Congressman Joel Hefley (R-CO) introduced legislation on July 20, 1989, the 20th anniversary of the Apollo 11 lunar landing, to create an "America in Space National Historical Park" at Cape Canaveral, Florida (H.R. 2944). Also contained in the bill are provisions for Interior Department documentation of NHLs through HABS/HAER recordation, as well as interagency cooperation in onsite interpretation, long-term curation of hardware, and other preservation activities. NASA cooperation with the Smithsonian Institution for the disposition historic hardware and artifacts is underscored in the bill; NASA currently has an agreement with the Smithsonian for this purpose, NASA Management Instruction 4310.4.

Findings and Recommendations

NASA's proposed actions are generally consistent with H.R. 2944, and fine as far as they go. However, the Council should take the opportunity in its comments to NASA to address several points outlined in more detail in the draft MOAs exchanged by NASA and the Texas SHPO, particularly the documentation, salvage, and possible future replication or reconstruction of an Apollo Flight Control Room. In addition, in accordance with P.L. 96-344, the Council should call upon NASA to refrain from implementing the most significant changes to the Mission Control Center involving the console "changeout" in the Flight Control Rooms, currently scheduled for 1993, until Congress has received and had time to review the Man in Space Alternatives Study.

The attached draft letter from the Chairman to the Administrator of NASA includes both findings and recommendations that address the aforementioned issues (Attachment 4). Once the Council members have been given an opportunity to review and comment on the letter, we recommend that it be signed and forwarded to NASA.

Advisory Council On Historic Preservation

The Old Post Office Building
1100 Pennsylvania Avenue, NW, #809
Washington, DC 20004

DRAFT

Admiral Richard H. Truly
Administrator
National Aeronautics and Space Administration
Washington, DC 20546

Dear Admiral Truly:

The National Aeronautics and Space Administration (NASA) has terminated consultation with the Texas State Historic Preservation Officer (SHPO) on proposed plans to upgrade equipment in the Mission Control Center, Lyndon B. Johnson Space Center, Houston, Texas. Mission Control is a National Historic Landmark, and listed in the National Register of Historic Places. In accordance with Sections 106 and 110(f) of the National Historic Preservation Act and pursuant to Section 800.6(b) of the Council's regulations, "Protection of Historic Properties" (36 CFR Part 800), this letter is to convey to NASA the comments of the Council on the proposed undertaking.

Findings

1. The historical and technological significance of Mission Control is well established, and has been recognized officially since 1985, when it was designated by the Secretary of the Interior as a National Historic Landmark, under the theme of "Man in Space."

2. In accordance with our regulations (36 CFR Sec. 800.10), the Council requested a report from the Secretary of the Interior detailing the significance of the property, describing the effects of the undertaking on the property, and recommending measures to avoid, minimize, or mitigate adverse effects. For your information, we are attaching a copy of this report (enclosure).

3. Due to the proposed equipment upgrade, and as acknowledged by NASA, the interior of the Mission Control Center, and particularly the contents and "look" of the two Flight Control Rooms (known during Apollo as Mission Operations Control Rooms) that were alternately used to control Gemini, Apollo, and subsequent manned space missions, and are so familiar to millions of persons worldwide, will be adversely affected through alteration so as to "diminish the integrity of the property's location, design, setting, materials, workmanship, feeling, or association" (36 CFR Sec. 800.9(b)).

4. NASA argues that the Mission Control Center needs to be substantially updated to meet future Space Shuttle and Space Station mission needs and further take advantage of state of the art data processing, communications, and other technology developments.

5. At the same time, the Mission Control Center is organized and designed in such a way that the various operational areas, including the Flight Control Rooms and all of their support facilities within Building 30, are integral to each other. As such, NASA argues that it would be neither cost- nor operationally effective to set aside one of the Flight Control Rooms as an interpretive facility in order to preserve in place a 1960s-70s vintage Mission Operations Control Room of the type that ran the lunar missions.

5. While acknowledging these constraints to preservation, and also acknowledging NASA's proposed mitigation efforts and the sincere attempts of both the Johnson Space Center and the Texas State Historic Preservation Officer to reach an agreement, we believe that more can be done by NASA in response to Section 110(f) of the National Historic Preservation Act for this National Historic Landmark. Serious consideration needs to be given by NASA to long-term preservation of hardware and furnishings, organization of and public access to Mission Control Center archives, and appropriate public interpretation of the Apollo program.

Recommendations

Based on our review, it is the opinion of the Council that NASA should:

1. Cooperate with the Department of the Interior in its efforts to clear the Man in Space Alternatives Study called for under P.L. 96-344 for transmission to Congress as soon as possible.

2. In accordance with P.L. 96-344, refrain from implementing major modifications (such as console changeout) to the Flight Control Rooms in the Mission Control Center until transmission of

the Man in Space Alternatives Study to Congress. Unless otherwise directed by Congress, proceed with the remaining equipment upgrade of the Mission Control Center and construction of the Space Station Control Center (SSSC) building adjoining the existing Mission Control Center.

3. Prior to further modifications to the Mission Control Center, and particularly changes that may affect the Flight Control Rooms, work with the Texas State Historic Preservation Officer and the National Park Service to prepare a documentary record of the historically significant portions of the Mission Control Center consistent with the Secretary of the Interior's Standards and Guidelines for Archeology and Historic Preservation (48 FR 4416-44740, September 29, 1983).

4. Prepare a Historic Preservation Plan for the Mission Control Center and its removed historic components in consultation with the Texas State Historic Preservation Officer that includes alternative courses of action and an implementation schedule for NASA to identify, catalogue, secure, remove, store, reconstruct, and (to the extent feasible for interpretive purposes) partially reactivate historic hardware associated with Mission Control's role in the Apollo program.

5. As previously agreed upon by NASA, install a National Historic Landmark plaque in a prominent location within or adjacent to the Mission Control Center complex, and install interpretive graphics, photos, and other material within or adjacent to the public visitors' gallery in the operational Flight Control Room.

We were pleased to learn that NASA has appointed a new Federal Preservation Officer, Mr. Norman J. Willis, to succeed Mr. James Bayne. Our office will be contacting Mr. Willis in the near future to discuss cooperation between our agencies on historic preservation matters.

In accordance with Sections 106 and 110(f) of the National Historic Preservation Act and the Council's regulations, NASA should given full consideration to the comments of the Council prior to reaching a final decision and should notify the Council of its decision prior to taking any action. Pursuant to our regulations, copies of these comments are being provided to the President, Congress, and other interested parties.

Sincerely,

John F.W. Rogers
Chairman

H3417 (RMR-PR)

JUN 2 6 1992

K. B. Gilbreath
Director, Center Operations
National Aeronautics and Space Administration
Lyndon B. Johnson Space Center
Building 1, Room 805
2001 NASA Road One
Houston, Texas 77058

Dear Mr. Gilbreath:

I am pleased to notify you that the bronze plaque for the **Apollo Mission Control Center National Historic Landmark** (NHL) has been cast and is being forwarded to you under separate cover.

If you are interested, the National Park Service would be happy to provide a representative to speak and present the award at an NHL recognition or plaque presentation ceremony. Please contact Gregory D. Kendrick at (303) 969-2875 if we may provide assistance with an event or answer questions regarding NHLs.

Thank you for your commitment to our Nation's historic resources.

Sincerely,

(Sgd) Michael D. Snyder

for Robert M. Baker
Regional Director
Rocky Mountain Region

bcc:
SWR-RD
Jim Charleton, WASO-History Division

Old Mission Control Is Set for a Final Sign-Off

HOUSTON, July 15 (AP) — The original Mission Control, which has sent orders and wake-up calls during 30 years of American space flights, passed the baton this week to a sleek new successor and will soon be retired completely.

The National Aeronautics and Space Administration switched command of the space shuttle Discovery to the new $250 million center on Thursday, nine and a half hours into the mission.

It marked the first time since 1965 that an American spacecraft was not being commanded from one of the two flight control rooms in the original Mission Control, which like its successor is at the Johnson Space Center here. Before June 1965, space missions were monitored from Cape Canaveral, Fla.

The control rooms, dominated by men in white shirts and clouds of tobacco smoke, became familiar to millions of Americans during the Apollo moon landings. In recent years, female flight controllers joined the ranks and no smoking became the rule, but technologically Mission Control had remained in need of change.

The most noticeable difference between the old center and the new is the way engineers monitor information transmitted from shuttle computers.

The old center relies on a lumbering and inflexible, but highly reliable, mainframe computer. Controllers stare at monochrome displays, flashing lights and back-lit buttons.

The core of the new center is a network of 200 computer work stations, each able to perform 120 million operations per second. Controllers there have color monitors with advanced graphic displays and custom software that allows quick access to the latest data.

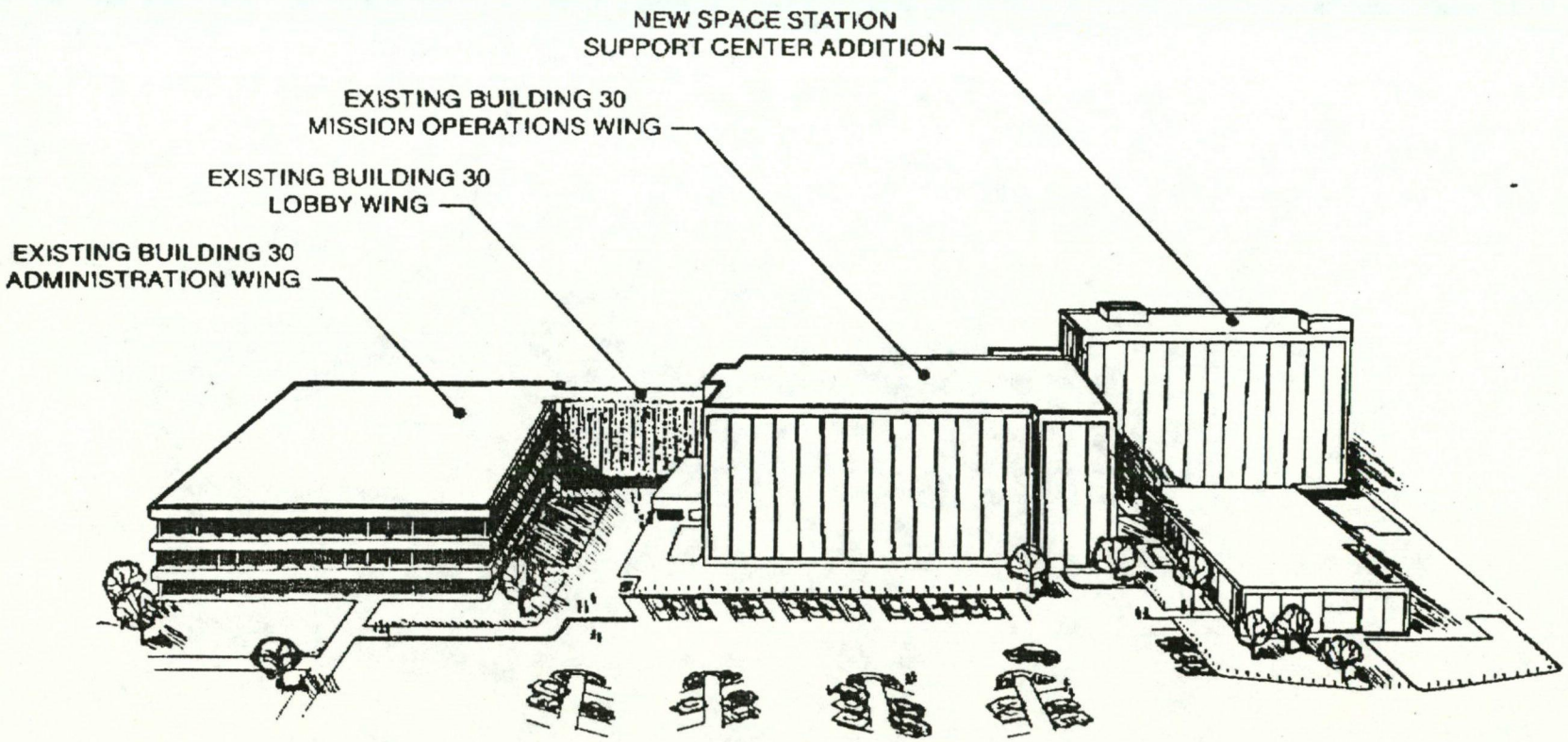
The new center will be responsible for Discovery until the shuttle is ready to come home. The old center will take over for the landing, which is scheduled for Friday. Launchings and landings, the most dangerous parts of space flight, will be monitored from the original Mission Control at least through the end of this year so NASA can be sure there are no glitches with the new center.

Gene Kranz, the flight director who oversaw several Apollo moon flights, said the old control rooms were more than just rooms.

"You feel a sense of history, that things have really happened here," he said. "You walk into that control room and you can almost smell the old stale cigar smoke and you can see the jubilation of the controllers."

LYNDON B. JOHNSON SPACE CENTER
FISCAL YEAR 1990 ESTIMATES

CONSTRUCTION OF ADDITION TO MISSION CONTROL CENTER



FLIGHT CONTROL ROOM POSITIONS

If you visit the FCRs, you'll notice initials or names placed atop each console. These are abbreviations for each console's function. Each console also has a "call sign," the name the controller uses when talking to other controllers over the various telephone communication circuits. In some cases, console names or initials are the same as the call signs. Mission command and control positions, their respective initials, call signs, and responsibilities are:

- **Flight Director** (FD), call sign "Flight," serves as leader of the flight control team, and is responsible for overall Shuttle mission and payload operations and all decisions regarding safe, expedient flight conduct;
- **Spacecraft Communicator** (CAPCOM), call sign "Capcom," serves as primary communicator between flight control and astronauts. The initials are a holdover from earlier manned flight, when Mercury was called a capsule rather than a spacecraft;
- **Flight Dynamics Officer** (FDO), call sign "Fido," plans maneuvers and monitors trajectory in conjunction with Guidance Officer;
- **Guidance Officer** (GDO), call sign "Guidance," monitors onboard navigation and onboard guidance computer software;
- **Data Processing Systems Engineer** (DPS) determines status of data processing system including the five onboard general purpose computers, flight-critical and launch data lines, the malfunction display system, mass memories and systems-level software;
- **Flight Surgeon** (Surgeon) monitors crew activities, coordinates medical operations flight control team, provides crew consultations, and advises flight director of the crew's health status;
- **Booster Systems Engineer** (Booster) monitors and evaluates main engine, solid rocket booster and external tank performance during prelaunch and ascent phases of missions;
- **Propulsion Systems Engineer** (PROP) monitors and evaluates reaction control and orbital maneuvering systems during all phases of flight, and manages propellants and other consumables available for maneuvers;
- **Guidance, Navigation, and Control Systems Engineer** (GNC) monitors all vehicle guidance, navigation and control systems, notifies flight director and crew of impending abort situations, advises crew regarding guidance malfunctions;
- **Electrical, Environmental and Consumables Systems Engineer** (EECOM) monitors cryogenic levels for fuel cells, avionics and cabin cooling systems, electricity distribution systems, cabin pressure control systems and vehicle lighting systems;
- **Instrumentation and Communications Systems Engineer** (INCO) plans and monitors in-flight communications and instrumentation systems configuration;
- **Ground Control** (GC) directs maintenance and operation activities affecting Mission Control hardware, software and support facilities, coordinates spaceflight tracking and data network and tracking and data relay satellite system with Goddard Space Flight Center;
- **Flight Activities Officer** (FAO) plans and supports crew activities, checklists, procedures and schedules;
- **Payload Officer** (Payload) coordinates onboard and ground system interfaces between the flight control team and payload user, and monitors Spacelab and upper stage systems and their interfaces with the payload;
- **Maintenance, Mechanical Arm and Crew Systems Engineer** (MMACS), call sign "Max," monitors operation of the remote manipulator arm and the Orbiter's structural and mechanical system, and follows use of onboard crew hardware and in-flight equipment maintenance;
- **Public Affairs Officer** (PAO), provides mission commentary to supplement and explain air-to-ground transmissions and flight control operations to the news media and the public.

During missions on which a Spacelab module is carried in the Orbiter's payload bay, an additional flight control position is Command and Data Management Systems Officer (CDMS), responsible for data processing systems involving Spacelab's two major computers. In support of the Spacelab missions, additional responsibilities are borne by EECOM in management of systems extended from the Orbiter to the Spacelab. Power distribution, life support, cooling, and cabin fans require more complex monitoring. Management of cryogens for fuel cells, also performed by the EECOM, becomes a more significant duty for Spacelab missions because of the higher power levels used, and because consumption must be monitored and budgeted over a longer period. The DPS controller works closely with the CDMS officer in monitoring additional displays covering nearly 300 items.

One FCR is on the second floor and one on the third.

NASA Facts
National Aeronautics and
Space Administration

Lyndon B. Johnson Space Center

Mission Control Center

Neil Armstrong, Commander Apollo 11 Lunar Lander: *"Houston, Tranquility Base here, The Eagle has landed."*

Those words, the first ever transmitted to Earth by a human being from the surface of the Moon, are testimony to the essential role played by the Mission Control Center at NASA's Johnson Space Center in Houston. The reply, the first ever heard by a man on the Moon, conveys the urgency that permeates the Mission Control during such moments:

Mission Control: *"Roger, Tranquility, we copy you on the ground. You've got a bunch of guys about to turn blue. We're breathing again. Thanks a lot."*

Since 1965, the Mission Control Center (MCC) has been the nerve center for America's manned space program. The men and women who work in Building 30 at Johnson Space Center (JSC) have been vital to the success of every manned space flight since Gemini 4. These teams of experienced engineers and technicians monitor systems and activities aboard spacecraft 24 hours a day during missions, using some of the most sophisticated communication, computer, data reduction and data display equipment available. They watch every movement the crew and spacecraft make, double-check every number to be sure missions are proceeding as expected, and provide the expertise needed to deal with the unexpected.

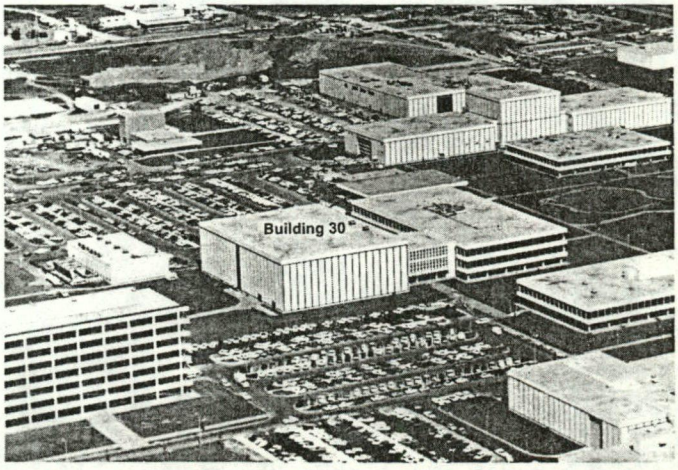
During the Mercury project, when mission control was at Cape Canaveral, capsules were controlled almost entirely from the ground. The capsule's manual control systems served in most cases as backups to the automated systems, and astronauts relied heavily on ground control for solutions to problems that arose. As spacecraft became more complex in the Gemini years, dependence on the new MCC in Houston lessened slightly. During Apollo, when distance and communications breaks made it necessary, some onboard systems became prime while others retained their reliance on MCC direction. The frequent missions of the Space Shuttle program require a new approach to flight control. Since the crew monitors most systems using the Orbiter's onboard computers, the flight control team's main responsibilities are following the flight's activities and staying ready for major maneuvers, schedule changes and unanticipated events.

Still, from the moment the giant solid rocket boosters ignite at liftoff to the moment the landing gear wheels roll to a stop at the end of a mission, the MCC is the hub of communication and support for the Shuttle.

Mission Control's focal points are the two Flight Control Rooms, or FCRs (pronounced "Fickers"), where flight controllers get information from console computer displays or from projected displays that fill the wall at the front of the room. Almost everyone has seen the television pictures of MCC flight controllers working feverishly at their consoles, headsets in place.

The Mission Control Center contains two functionally identical FCRs, one on the second floor and one on the third. Only the third floor FCR is used for missions carrying classified Department of Defense payloads. Either FCR can be used for mission control, or they can be used simultaneously to control separate flights. More often, one team of flight controllers conducts an actual flight while a second team conducts highly realistic training, called a simulation or "sim" for short, for a future mission.

Flight controllers who work in the FCRs represent only the tip of the staffing iceberg in the Mission Control Center. Each of the 20 to 30 flight controllers who sits at a console in the FCR has the help of many other engineers and flight controllers monitoring and analyzing data in nearby staff support rooms.



Mission Control Center is a three-story building at Johnson Space Center (JSC). In it are some of the most sophisticated communication, computer, data reduction, and data display equipment available.

THE SUPPORTING CAST

Multipurpose support room (MPSR) groups represent one support discipline and encompass planning and support functions. The MPSR groups are dedicated to multiple flights in order to provide planning expertise for future flights, perform periodic support and systems checks on current flights, and respond quickly to any in-flight contingency.

Operating in conjunction with the FCRs are Payload Operations Control Centers (POCCs) from which the owners of payloads or experiments carried in the cargo bay of the Orbiter can monitor and control their payloads.

The Spacelab POCC, located at NASA's Marshall Space Flight Center in Huntsville, Alabama, is the site for continual monitoring and control of Spacelab experiments and other attached payloads. It is a command post, communications center and data relay station for principal investigators, mission managers and their support staffs. All decisions about payload operations are made and coordinated with the mission flight director at the Mission Control Center in Houston, then transmitted to the Spacelab or Shuttle crew from the POCC.

Free-flying systems that are deployed, retrieved, or serviced in Earth orbit by the Orbiter are monitored by a POCC at the NASA's Goddard Space Flight Center in Greenbelt, Maryland. Private sector organizations as well as foreign governments maintain individual POCCs at locations of their choice for long-term control of free-flying systems. Payloads with distant destinations, such as those exploring other planets, are controlled from the POCC at NASA's Jet Propulsion Laboratory, Pasadena, California.

COMMUNICATIONS

Communication with and tracking of the Shuttle are accomplished through a combination of the Tracking and Data Relay Satellite System (TDRSS, pronounced "teadruss") which consists of three geosynchronous satellites (the first was put into orbit in 1983; the second will be launched in 1988; a third, spare satellite, will be launched later), one ground station at White Sands, New Mexico, and the Ground Space Flight Tracking and Data Network (GSTDN). When the TDRSS becomes fully operational, the ground-based tracking network will be closed. The NASA communications network (Nascom), which will be augmented with a domestic satellite (Domsat), links tracking stations with ground control centers. The TDRSS provides the principal coverage for all Shuttle flights. TDRSS makes it possible to monitor the flight almost continuously, increasing the probability of experiment success, reducing the need for onboard data storage, and allowing in-flight experiment changes.

Mission Control Center is supported by an emergency power building that houses generators and air-conditioning equipment for use if regular power fails. In the event a catastrophic failure shuts down the Houston control center, an emergency facility at White Sands Test Facility is activated. The emergency control center is a stripped-down version of the MCC in Houston, incorporating just enough equipment to let the controllers support the flight to its conclusion.

Operating in conjunction with the JSC Mission Control Center FCRs are Payload Operations Control Centers (POCCs).

One of the most interesting of the FCR support facilities is the display/control system, a series of projection screens on the front wall of the FCR for displays ranging from plotting charts that show the spacecraft's location, to actual television pictures of activities inside the Shuttle as well as views of Earth, payload deployment/retrieval, and extravehicular (EVA) work by mission specialists. Other displays show such things as elapsed time after launch, or time remaining before a maneuver or other event.

Flight controllers base many of their decisions or recommendations on the information given by the display/control system. The real-time computer complex processes telemetry and tracking data to update controllers on Shuttle systems. Controllers can call up stored reference data based on simulated flights previously conducted as practice for the actual mission.

The consoles at which the flight controllers work in the FCR, the MPSR, and the POCC include one or more TV screens and the necessary switches to let the controller view a data display on a number of different channels. The controller may view the same display being shown on the large projection screens on the front wall, or may "call up" data of special interest just by changing channels. A library of prepared reference data is available to display static information, while digital-to-television display generators provide dynamic, or constantly changing, data.

In the future, these traditional consoles will be augmented with engineering work stations that provide more capability to monitor and analyze data in support of the increasing flight rate. A further update will change the way computer support is provided. Instead of driving all flight control consoles with a central main computer, each console will have its own smaller computer designed to monitor a specific system. These smaller computers then will be linked together in a network so that they can share data.

BEHIND THE SCENES

The Flight Control Room, with its rows of consoles and its large display screens, is a familiar sight to many television viewers around the world.

But other equally busy areas of the Mission Control Center are just as important to the success of a flight. One such area is Network Interface Processor (NIP) on the first floor. The NIP processes incoming digital data and distributes it on a real-time basis to the facilities associated with the FCR and support room displays. The system also handles the digital command signals to the spacecraft — the up-data link that lets Mission Control do such things as keep the spacecraft guidance computer's facts and figures up to date.

The data computation complex (DCC), also on the first floor, processes incoming tracking and telemetry data and compares what is happening with what should be happening. Often, it does not display the information unless something is going wrong. As the system evaluates factors such as spacecraft position and velocity, it also computes what maneuvers should be made to correct any shortcomings.

The DCC computes and evaluates on a real-time basis. Through high-speed electronic data from the worldwide tracking station network, including TDRSS, the complex "sees" what is happening almost at the instant it happens; its computations are fast enough to aid in correcting a situation as it develops. Using this same data, the DCC also predicts where the spacecraft will be at any given time in the flight.

Further, the computers are used to give acquisition information that helps the tracking stations point their antennas at the spacecraft. And the DCC is used to monitor and evaluate telemetry information from the spacecraft to be sure that equipment is performing normally.

There are five primary computers in the DCC, any of which can be used to support one FCR. Another can be used simultaneously to support a live mission from the other FCR, or to support a simulated flight for training additional teams of flight controllers. For critical mission phases, one of the computers is used as a dynamic standby, processing identical data concurrently, in case of a computer failure. The computers are also used in developing and perfecting the computer programs used in each flight.

Another important facility is the voice communications system, which enables flight controllers to talk to one another without having to leave their consoles. The system also connects controllers with specialists in support rooms, with flight crew training facilities where specific procedures can be tried on spacecraft simulators before they are recommended to the mission crew, and with the personnel along the Spaceflight Tracking and Data Network. It also provides the voice link between the MCC and the spacecraft.

The separately located simulation checkout and training system enables flight controllers in the Mission Control Center and flight crews in spacecraft simulators at the Johnson Space Center to rehearse a particular procedure or even a complete mission. The system even simulates voice and data reception from the worldwide stations of the Spaceflight Tracking and Data Network.

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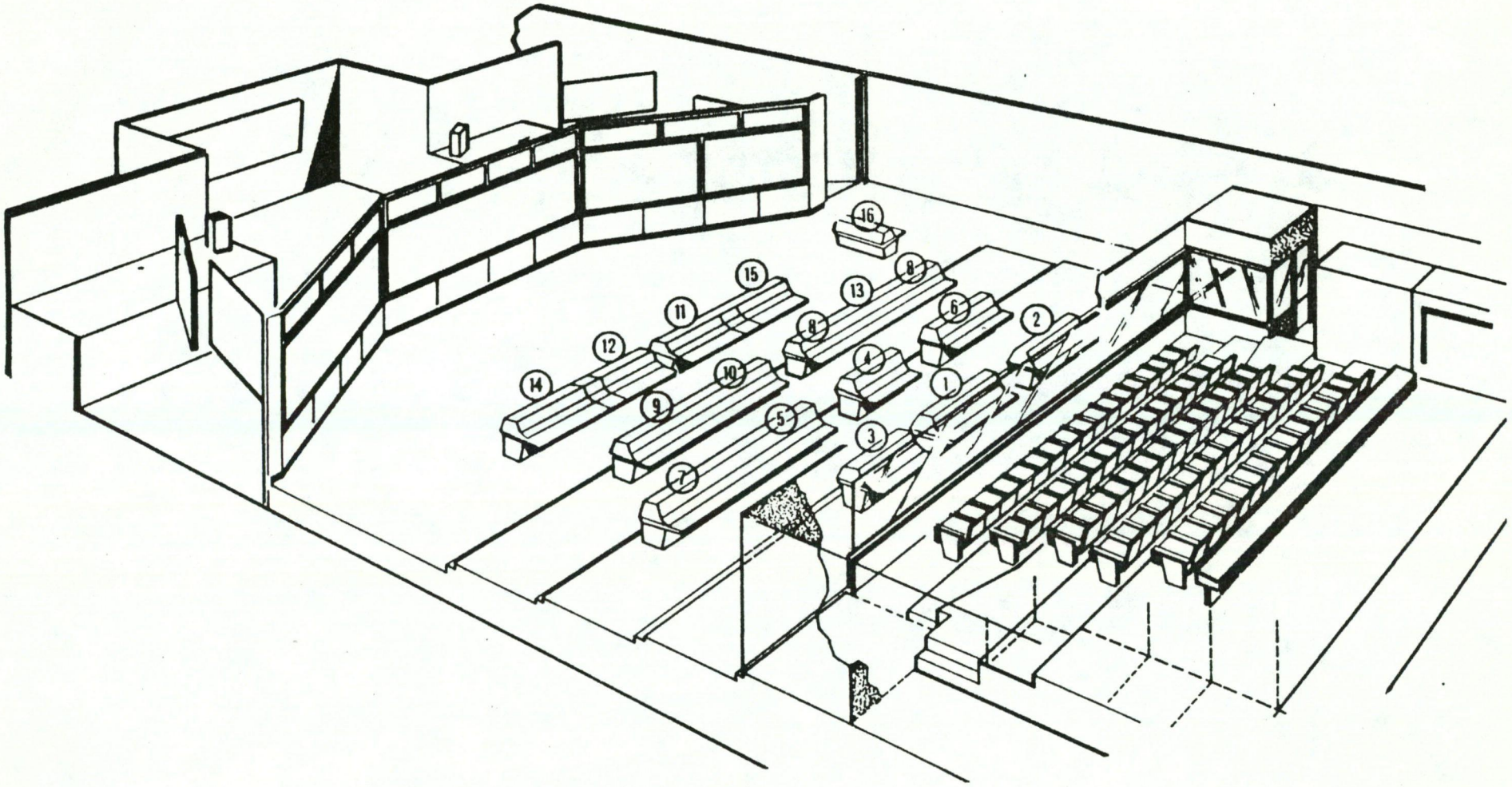
Houston, Texas

Apollo Mission Control Circa 1969



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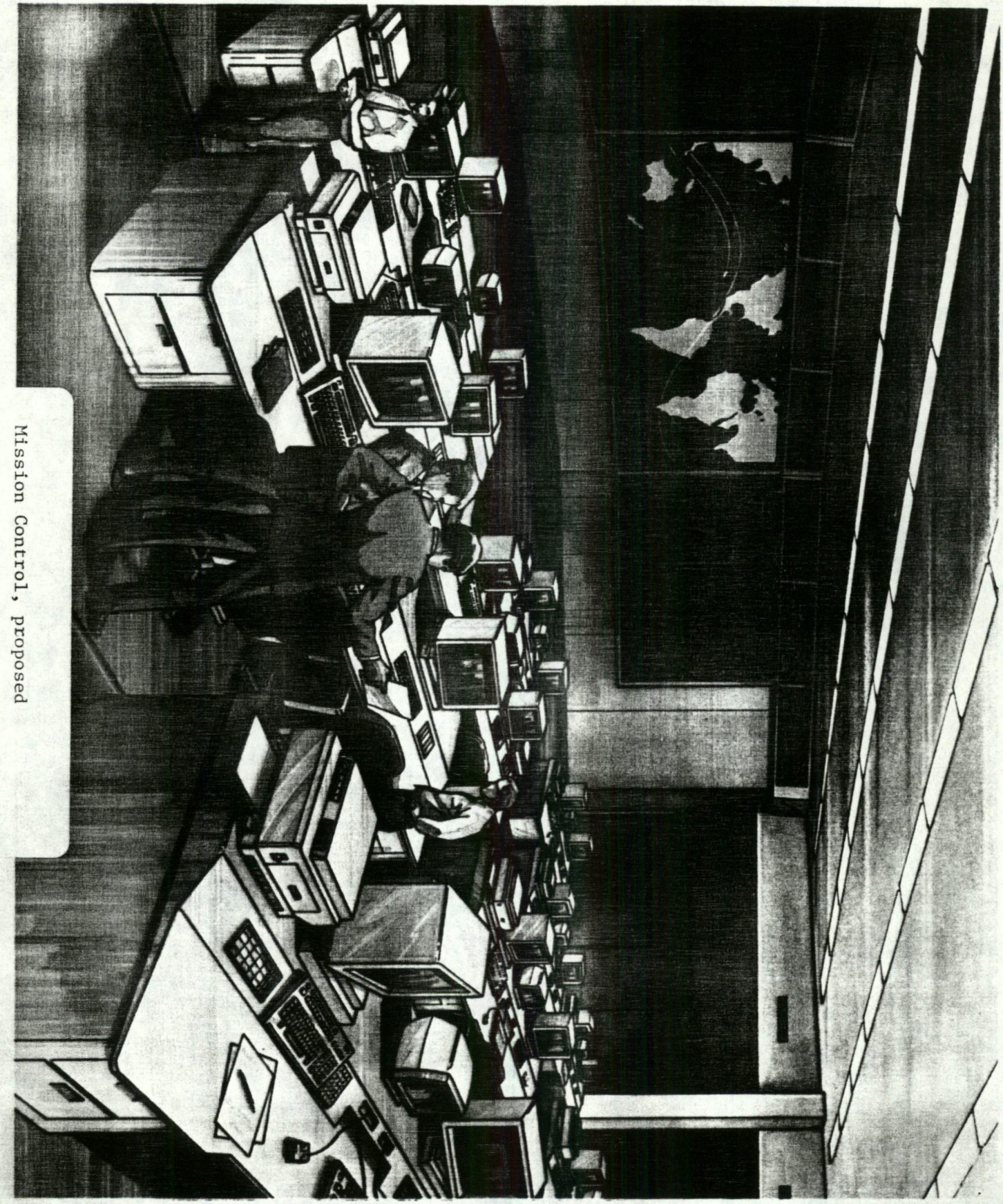

Mission Control, proposed

National Aeronautics and Space Administration

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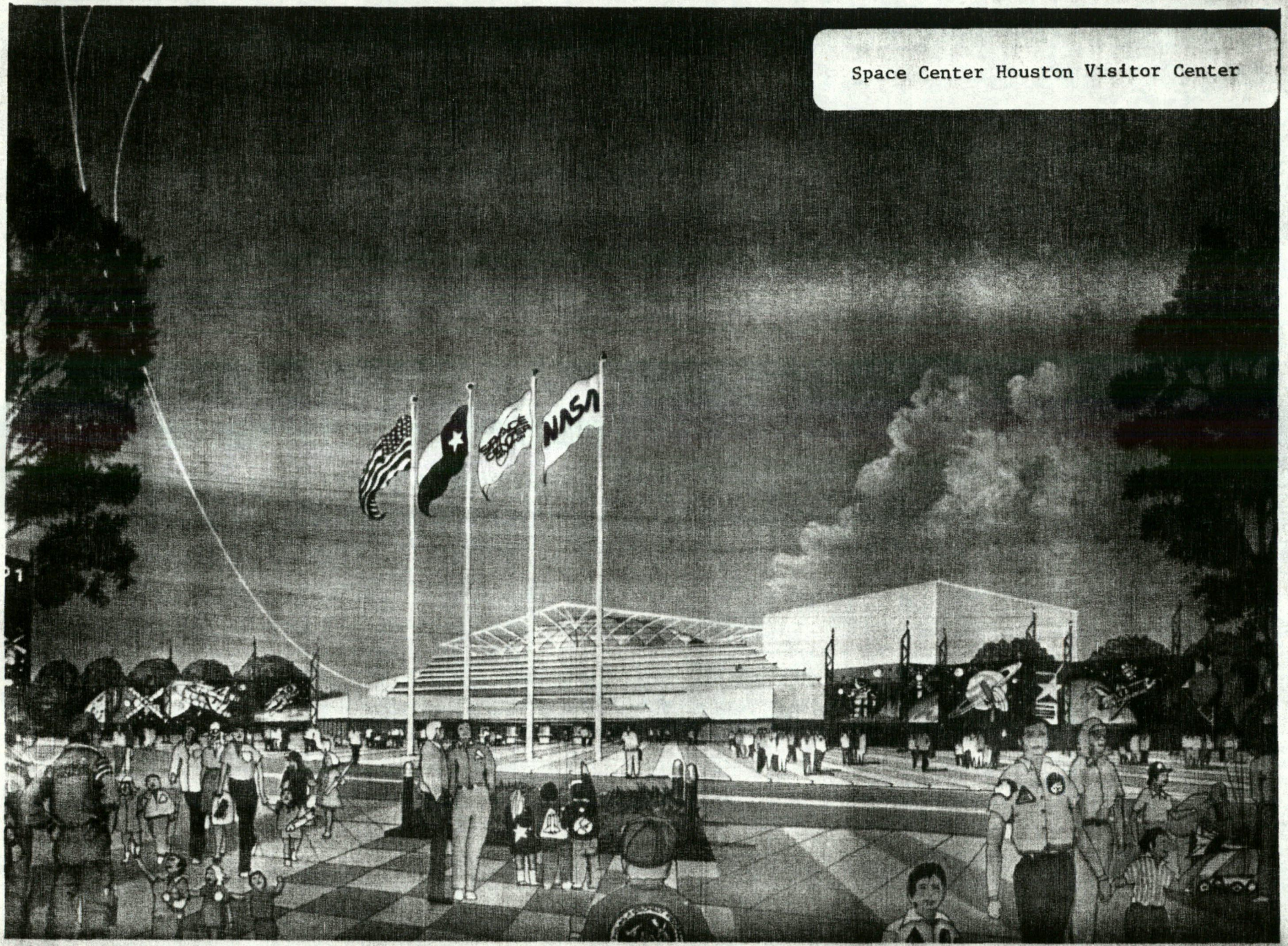

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