

Thorn

UNITED STATES GOVERNMENT

Memorandum

TO : PA/Manager, Apollo Spacecraft Program

DATE: OCT 23 1969

FROM : CA/Director of Flight Crew Operations

SUBJECT: Requirements for photography of future landing sites (PD12/M863-69)

The Flight Crew Operations Directorate has reviewed the photographic coverage assessment for future landing sites enclosed with your memorandum of September 30, 1969. Our reservations concerning the alternatives to additional photography are only related to our confidence in performing an accurate landing by visual recognition of the planned landing point. The photographic requirements given by us as mandatory at the Manned Spacecraft Center review on September 4, 1969, refer only to the question of accurate landings (Enclosure). If the targeting for a given mission is capable of hitting an area with a sufficient number of adequate landing points and if there is sufficient ΔV available for a safe landing, then the alternatives listed are acceptable insofar as crew safety is concerned. However, the definitions of "sufficient number" and "sufficient ΔV " are still open questions that are in part dependent on the pre-mission photographic assessment of the landing sites. We will present our view on these questions in a separate memorandum.

D. T. Slayton
for Donald K. Slayton

Enclosure

cc:

PE/O. Morris

CF32/T. Lindsey

TJ/J. Sasser

CB/All Astronauts

CB:HHSchmitt:mc 10-03-69

Retyped: CB:HHSchmitt:mc 10-15-69



ENCLOSURE

Photographic Requirements
for
Future Lunar Landing Missions

F C O D

Presentation to
MSC Management

September 4, 1969

TYPES OF MISSIONS AS THEY AFFECT CREW OPERATIONS

- AREA LANDING MISSION
 - REDESIGNATE FOR SAFETY ONLY
- ACCURATE LANDING MISSION
 - LAND WITHIN OPS RANGE OF A SPECIFIC SURFACE FEATURE
- ROVER MISSION
 - REDESIGNATE FOR SAFETY ONLY
 - ACCURATE KNOWLEDGE OF LANDED POINT MANDATORY FOR MISSION SUCCESS

MISSION TRAINING

LANDMARK RECOGNITION FOR ORBITAL NAV (CMP)	10-15 HRS
LANDING SITE RECOGNITION FOR LM LOCATION (CMP)	5 HRS
LM DESCENT TRACK MONITORING (CDR/LMP)	10 HRS
ALTITUDE CHECK OR PRE-PDI LDMK RECOGNITION (CDR/LMP)	5-10 HRS
LANDING SITE RECOGNITION (CDR/LMP)	15-25 HRS
SITE SPECIFIC SCIENCE TRAINING (CDR/LMP)	5-20 HRS
	<hr/>
	50-85 HRS*

*NUMBER OF HOURS DEPENDS ON COMPLEXITY OF MISSION AND POINT
LANDING REQUIREMENTS.

ONBOARD DATA DERIVED FROM PHOTOGRAPHY

	REQUIRED FOR		
	AREA LANDING	ACCURATE LANDING	ROVER MISSION
ORBITAL PHOTO CHART GENERAL NAVIGATION, 1:2.5 MILLION SCALE, $\pm 12.5^\circ$ OF GROUND TRACK, 360° LUNAR SURFACE	M	M	M
TARGET OF OPPORTUNITY CHART GENERAL LOCATION OF PHOTOGRAPHY TARGETS 1:7.5 MISSION SCALE, $\pm 20^\circ$ OF GROUND TRACK, 360° LUNAR SURFACE	H.D.	H.D.	H.D.
LANDMARK MAPS PHOTOGRAPHS OF SELECTED LANDMARKS AND SURROUNDING TERRAIN AT 1:2.5 MILLION, 1:630,000 AND OBLIQUES. PHOTOGRAPHS OF THE LANDING SITE AT 1:200,000, 1:630,000 AND OBLIQUES	M	M	M
DESCENT MONITOR CHART STRIP MAP AT 1:630,000 SCALE $\pm 2.5^\circ$ FROM LM GROUND TRACK AND MINIMUM 50° OF LONGITUDE LEADING TO LANDING SITE	H.D.	M	M

ONBOARD DATA DERIVED FROM PHOTOGRAPHY (CONT)

	REQUIRED FOR		
	AREA LANDING	ACCURATE LANDING	ROVER MISSION
LM LANDING SITE MONITOR CHARTS:			
OBLIQUES: THE LANDING AREA FROM AN ANGLE AS NEAR AS POSSIBLE TO THE 7,000 FT AND 3,000 FT DESCENT VIEW	H.D.	M	M
NADIR: VARIOUS SCALE VERTICAL VIEWS OF THE LANDING AREA	M	M	M
EXPLORATION PACKAGE 1:100,000, 1:25,000 AND 1:5,000 SCALES ENABLE PRECISE LOCATION OF LANDED LM AND RELATIVE LOCATION OF FEATURES OF SCIENTIFIC INTEREST	H.D.	M	M
ASCENT MONITOR 1:630,000 SCALE, SIMILAR TO DESCENT CHART BUT COVERS AREA FROM LIFT-OFF TO INSERTION	H.D.	H.D.	H.D.

TRAINING ITEMS DERIVED FROM PHOTOGRAPHY

	REQUIRED FOR		
	AREA LANDING	ACCURATE LANDING	ROVER MISSION
SEQUENCE CAMERA FILM OF APPROACH TO SITE	H.D.	H.D.	H.D.
FACTOR TRANSPARENCES FOR LMS ALTITUDE PROFILE DATA USED IN LMS FOR RADAR INPUTS. PRIMARILY REQUIRED WHERE APPROACH OR SITE IS ROUGH	M*	M*	M*
APPROACH FILM BASICALLY IDENTICAL TO ON-BOARD DESCENT MONITOR. PRESENTS VISUAL DISPLAY OF DESCENT PATH IN LMS	H.D.	M	H.D.
LANDMARK PHOTOGRAPHS ACTUAL PHOTOS OF LANDMARKS USED IN CMS SEXTANT VISUAL DISPLAY	D	D	D
ORBITAL FILM STRIPS PRESENTS CMS AND LMS VISUAL DISPLAY OF LUNAR SURFACE FROM 60 MILE ORBIT	D	D	D
RELIEF MODELS 1:2,000 HIGH FIDELITY RELIEF MODEL OF LANDING SITE AREA FOR LM VISUAL DISPLAY CDR'S WINDOW	M**	M	M
LANDING SITE FILMS LMS VISUAL DISPLAY LMS WINDOW	H.D.	M	M

*MANDANTORY FOR ROUGH APPROACH TERRAIN

**MANDANTORY FOR ROUGH SITES

TRAINING AND ONBOARD DATA DERIVED FROM PHOTOGRAPHY

	REQUIRED FOR		
	AREA LANDING	ACCURATE LANDING	ROVER LANDING
ORBITAL PHOTO CHART	M	M	M
TARGET OF OPPORTUNITY CHART	H.D.	H.D.	H.D.
LANDMARK MAPS	M	M	M
DESCENT MONITOR CHART	H.D.	M	H.D.
LANDING SITE MONITOR CHARTS			
NADIR	M	M	M
OBLIQUE	H.D.	M	M
EXPLORATION PACKAGE	H.D.	M	M
ASCENT MONITOR CHART	H.D.	H.D.	H.D.
SEQUENCE CAMERA FILM OF APPROACH TO SITE	H.D.	H.D.	H.D.
FACTOR TRANSPARENCES FOR LMS	M*	M*	M*
APPROACH FILM FOR LMS	H.D.	M	H.D.
LANDMARK PHOTOGRAPHS FOR CMS	D	D	D
ORBITAL FILM STRIPS FOR CMS	D	D	D
LANDING SITE FILM FOR LMS	H.D.	M	M
RELIEF MODELS	M**	M	M

*MANDANTORY FOR ROUGH APPROACH TERRAIN

**MANDANTORY FOR ROUGH SITES

OCT 01 1969

B A C K G R O U N D

Schmitt



NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
MANNED SPACECRAFT CENTER
HOUSTON, TEXAS 77058

IN REPLY REFER TO: PD12/M863-69

SEP 30 1969

MEMORANDUM TO: CA/Director of Flight Crew Operations
FROM : PA/Manager, Apollo Spacecraft Program
SUBJECT : Requirements for photography of future landing sites

At the next Apollo Site Selection Board, presently scheduled for around October 14, 1969, MSC is to state its position regarding the need for additional photographic coverage of candidate landing sites. This subject was reviewed at MSC on September 4, 1969. The conclusions presented at this meeting are contained in the enclosed charts. You and members of your organization expressed some reservation concerning these conclusions at the meeting. It is requested that FCOD review these conclusions so that MSC will be able to make a positive statement regarding photography at the next ASSB.

Orig. signed by
O. G. Morris

James A. McDavitt
Colonel, USAF

Enclosures

cc:

- PA/O. Morris
- PE/O. Morris
- CB/T. Stafford
- CE/E. Cernan
- ~~CE/S. Schmitt~~
- CE34/T. Lindsey
- TJ/J. Sasser

PD12:CHPerrine:gn 9-26-69

PHOTOGRAPHIC COVERAGE ASSESSMENT (CONT)

○ FRA MAURO (1) (2)

○ MARIUS HILLS

○ LITTROW

○ COPERNICUS (2)

END PRODUCTS DERIVED FROM PHOTOGRAPHY	TYPE OF PHOTOGRAPHIC DEFICIENCY	TYPE OF PHOTO COVERAGE REQUIRED	ALTERNATIVES TO MORE PHOTOGRAPHY
TOUCHDOWN HAZARD AND REDESIGNATION EVALUATION	CONSTANT ALBEDO ASSUMPTION IS SUSPECT	H/S OF LANDING ELLIPSE	ACCEPT SLOPE INACCURACIES OF PHOTOMETRIC TECHNIQUE USING H/M
APPROACH TERRAIN DEFINITION	LIMITED DOWN RANGE COVERAGE	M/S OF APPROACH FAN TO \approx 100 KM UP-RANGE OF SITE	DELAY USE OF L/R INFORMATION IN COMPUTER AND/OR MODIFY LM SOFTWARE
RELIEF MODELS	NONE	--	
APPROACH FILMS FOR LMS	POOR RESOLUTION AND CONTROL	M/M OF APPROACH FAN TO $>$ 260 KM UP-RANGE	ACCEPT ORBITER IV QUALITY OR FLY WINDOWS UP
LANDING SITE FILMS FOR LMS	NONE	--	
FACTOR TRANSPARENCIES FOR LMS L/R SIMULATION (MANDATORY FOR ROUGH APPROACHES AND/OR LANDING AREAS ONLY)	CONSTANT ALBEDO ASSUMPTION IS SUSPECT	H/S OF LANDING ELLIPSE	PROVIDE LMS L/R SIGNAL AS A FUNCTION OF RANGE ONLY (DELETE CROSS RANGE AND ATTITUDE EFFECTS) OR ACCEPT INACCURACIES OF PRESENT INFORMATION
	LIMITED DOWN RANGE COVERAGE	M/S OF APPROACH FAN TO \approx 100 KM UP-RANGE OF SITE	

(1) H/M ORBITER PHOTOGRAPHY IS NOT CONTIGUOUS

(2) CAN BE PHOTOGRAPHED ON PREVIOUS LANDING MISSION

PHOTOGRAPHIC COVERAGE ASSESSMENT (CONT)

☐ FRA MAURO (1) (2)

☐ MARIUS HILLS

☐ LITTROW

☐ COPERNICUS (2)

ON BOARD CHARTS	END PRODUCTS DERIVED FROM PHOTOGRAPHY	TYPE OF PHOTOGRAPHIC DEFICIENCY	TYPE OF PHOTO COVERAGE REQUIRED	ALTERNATIVES TO MORE PHOTOGRAPHY
	DESCENT MONITOR CHARTS	POOR RESOLUTION AND CONTROL	M/M OF APPROACH FAN TO \geq 260 NM UP-RANGE OF SITE	ACCEPT ORBITER IV QUALITY OR FLY WINDOWS UP
	OBLIQUE LANDING SITE MONITOR CHARTS	OBLIQUE VIEWS NOT AVAILABLE	H/O OF LANDING SITE	USE PHOTOS OF RELIEF MODELS
	LANDMARK MAPS FOR CSM	OBLIQUE VIEWS NOT AVAILABLE	M/O OF LANDING AREA	USE PHOTOS OF RELIEF MODELS
	EXPLORATION PACKAGE	NONE	--	
	NADIR LANDING SITE MONITOR CHARTS	NONE	--	
(M)	ORBITAL PHOTO CHARTS	NONE	--	

(1) H/M ORBITER PHOTOGRAPHY IS NOT CONTIGUOUS

(2) CAN BE PHOTOGRAPHED ON PREVIOUS MISSION

CONCLUSIONS OF PHOTO COVERAGE ASSESSMENT

- ADDITIONAL PHOTOGRAPHY REQUIRED FOR DESCARTE, HADLEY-APPENNINE, AND HIGHLAND IMPACT SITE
- NO ADDITIONAL PHOTOGRAPHY CAN BE PROVIDED FOR TYCHO
- FRA MAURO, LITTROW, MARIUS HILLS, COPERNICUS
 - OBTAIN ADDITIONAL PHOTOGRAPHY IF AVAILABLE WITHOUT CHANGING PRIMARY LANDING SITES
 - MAKE DO WITH PRESENT PHOTOGRAPHY BY
 - ACCEPTING SLOPE INACCURACIES OF PHOTOMETRIC TECHNIQUE USING H/M
 - DELAY USE OF RADAR SIGNAL IN COMPUTER AND/OR DEVELOP SOFTWARE MOD
 - ACCEPT ORBITER IV PHOTOGRAPHY FOR APPROACH TRAINING AND DESCENT MONITORING
 - REDUCE FIDELITY OF LMS L/R SIMULATION
 - BUILD RELIEF MODELS FOR THESE SITES AND ALL OTHER POINT LANDING SITES