UNITED STATES GOVERNMENT

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Memorandum

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TO : AD/Deputy Administrator

DATE: JUL 5 1967

FROM : M/Associate Administrator for Manned Space Flight

SUBJECT: Lunar Mapping and Survey System (IM&SS)

REF : Draft memo, AD to M&S, with attached memo, P to AD, re. LM&SS

I have carefully reviewed the reference material relating to the LM&SS and Lunar Orbiter and would like to ask your further consideration of the following related factors:

a. Of the possibilities considered, only the LM&SS or an improved Lunar Orbiter can provide reasonable confidence site certification capability for AAP missions to scientifically most interesting areas on the lunar surface. This statement is made in the context that present Lunar Orbiter capability is calculated to be marginally adequate for Apollo smooth landing site certification, and that more interesting sites, with associated rough terrain in the approach and terminal areas will require improved local obstacle identification and slope determination. The LM&SS affords a several fold improvement over the present Lunar Orbiter in evaluating these factors.

b. An LM&SS lunar orbit mission could provide 15 times more landing site area coverage, with reasonable confidence certification capability, than could the Lunar Orbiter with its lesser certification capability.

c. An LM&SS lunar orbit mission, flown at higher altitude so as to have the same landing site certification capability as the Lunar Orbiter, could provide 250 times more landing site area coverage than could the Lunar Orbiter.

d. In addition to its site certification capability, the LM&SS can easily map the entire lunar surface area, with greater mapping accuracy than the present Lunar Orbiter. In this instance, the more precise geometric capability of the LM&SS mapping system is of overriding importance as compared with its lesser resolution capability.

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e. Following 2 or 3 Apollo landings in smooth equatorial areas, there may well be little incentive for further lunar surface missions, until more scientifically interesting sites have been certified.

f. Although our analyses of the requirements for surface data for manned landings and of the LM systems for successfully accomplishing that landing have been extensive, we cannot be certain of the compatibility of the two until a landing has been accomplished. In the event of marginal landing performance, we may find it desirable or mandatory to increase our knowledge of the surface prior to additional landings. Utilization of the LM&SS would provide a significant margin of improved surface knowledge.

g. In the event of a catastrophe on the lunar surface during an early Apollo landing, there could be the need for very high resolution observation of the landing area prior to any further landing attempts.

h. The LM&SS payload module can carry a large payload of multi-spectral imagers and other science experiment equipment concurrent with the LM&SS. By this means such experiments, presently in varying states of concept and definition, can be flown at essentially no added mission cost.

i. Additional costs over those already invested for procuring five LM&SS's are $18M in FY 68 and $13M in FY 69. With immediate termination of the LM&SS procurement, expenditure of a significant fraction of the $18M planned for FY 68 ($10M estimated) would still be required for termination and close-out costs.

The preceding listed factors, and others I will discuss, lead me to the conclusion that it would be a mistake to terminate the LM&SS development at this time. For the relatively small additional FY 68 investment of $8M over estimated close-out costs, we can assure availability of the LM&SS for Apollo contingency in 1969 and AAP site certification and mapping in 1970. In terms of dollars per landing area surveyed and surface area precision mapped, the LM&SS is greater than 10 times more cost effective than present Orbiters. This statement is based on including all recurring costs attributable to each mission at the planned rate of manned Saturn V missions per year, and based on the OSSA stated cost of additional lunar orbital missions. In terms of costs beyond those essential to and included in the Apollo Program (see attachment), the manned lunar orbit mission on AS 512 would entail only LM&SS procurement, so that the cost effectiveness in terms of certified area per incremental dollar expended would even more lop-sidedly favor the LM&SS.

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The problem we face is determining the most effective use, for lunar exploration, of capability and hardware we will have in hand, coupled with new resources we will have available in the FY 68-70 period. An effective lunar landing program requires gathering as much landing site data over as wide an area as we can by early 1970 so that lunar landing missions following the first 2 or 3 can be selected to yield the most productive scientific information. To be feasible, this must be done at minimum added cost to the program. If the experience which we have had with Orbiter can be extrapolated, it appears reasonable to assume that it would take a minimum of 5 or 6 additional Orbiter missions to perform site certification for an AAP lunar program of several years. This assumption is based on the realization that 3 Orbiter missions were required to provide data for Apollo landings within the Apollo zone and our anticipation that during Apollo Applications the area of potential landings will be greatly expanded up to and potentially including the poles. Maximum effectiveness of the Apollo Applications landings will require that this site survey begin prior to or early in the AAP lunar program. Support of this criteria with minimum commitment of FY 68 funds clearly favors the LM&SS.

An added factor which is less tangible than the preceding, but possibly of even greater importance, is our inability to look ahead three or four years and predict the importance of measurements and observations from lunar orbit in overall exploration of the moon. I attribute the present reluctance of the scientific community to vigorously express their desires for remote sensors in the lunar exploration program to their lack of knowledge of the composition of lunar surface materials. I firmly believe that as this knowledge increases during Apollo in situ investigations and the analysis of returned samples, the potential utility of remote sensing will rapidly expand. This has certainly been the case in terrestrial exploration. To the extent that this occurs, the requirement for significant orbital payload capability will develop. The LM&SS and its associated PM would afford existing capability for a variety of such measurements concurrent with site certification. It is not reasonable to me to assume that we can make the best of our follow-on landings without extensive and detailed observations from lunar orbit, over much of the lunar surface and over a range of spectral conditions.

Again, the LM&SS offers this capability at minimum added cost to the program, and concurrent with AAP site certification.

For all of the above reasons, I urge that we continue the development of the LM&SS.

George E. Mueller

Attachment:

Photographic Costs/Sq. N.M. ~~(SECRET)~~

cc: S/H. E. Newell

~~SECRET~~

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ATTACHMENT

PHOTOGRAPHIC COSTS/SQ. N.M.

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- Assumptions
  - Estimated cost to run-out is $11.0M/LM&SS
  - Saturn V @ $280,000,000M
  - Orbiter VI
    - 5.0M for spacecraft/photo system
    - 8.0M for booster
    - 13.M
  - Orbiter VII
    - 16.0M for spacecraft/photo system
    - 8.0M for booster
    - 24.0M

- LM&SS survey camera has better ground resolution by a factor of ~ 4 so it can fly at 130 n.m. altitude and be competitive to Lunar Orbiter at 30 n.m:

	Area Coverage	Ground Resolution
Survey camera	1,380,000 n.m.^{2}	~1 meter
Orbiter high res.	5,450	~1 meter
LM&SS mapper	35,600,000* n.m.^{2}	~70M
Orbiter med. res.	59,000	~10M

*This area coverage is ~3.5 times the entire lunar area and could not be effectively exposed except on long duration orbital missions

- Cost/sq. n.m. - LM&SS and Lunar Orbiter VI

Survey camera	$ 211.00
Orbiter high res.	$2,380.00
LM&SS mapper	$ 8.00
Orbiter med. res.	$ 220.00

~~SECRET~~

- Even including Saturn V booster costs, a LM&SS mission is more than an order of magnitude more cost effective on basis of area coverage. The advantages of the LM&SS in better geometry, better photometry, ability to carry color, astronaut supplementary coverage, and for easier data reduction, etc., make the comparison even more lop-sided.

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