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A PROPOSED TERMINOLOGY FOR THE LEM
POWERED DESCENT AND LANDING MANEUVER

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INTRODUCTION

To develop a Lunar Excursion Module that will successfully carry out a landing mission on the Lunar Surface, there is a requirement for both Engineering and Operational personnel to have a common understanding of the details of the mission. It is rather fundamental that the spacecraft should be designed to be operated as close as possible to the way that it will be operated. This is simply another way of stating that both the mission and the spacecraft are strongly influenced by both engineering and operating considerations.

At least one element important to the understanding desired is the terminology that is adapted for description of the mission. Unfortunately, the LEM is currently suffering from the use of terminology that imparts an incorrect impression of the mission. An outstanding example is the employment of the term "Hover Phase" to describe the terminal approach portion of the LEM mission in which a hover, as understood by most operational personnel, is only one probable element in the sequence of events that will take place. The wide spread use of this term has misled some personnel into assuming that an actual hover condition must be reached prior to final landing site selection. Other less confusing, but nevertheless still misleading terms, are "fuel-optimum phase" and "visibility phase". The former is commonly applied to the first portion of the powered descent and is misleading because the guidance logic is based upon meeting specified end conditions at a predetermined time rather than fuel optimization (although the fuel utilization is not significantly greater). Furthermore, it is also possible that an off-nominal descent could result in less fuel expenditure than the nominal "fuel-optimum" descent. The term "visibility phase", while being descriptive on one attribute of the second phase of the descent, does not recognize other trade-off factors such as approach velocity and abort capability.

The purpose of this paper is to present a proposed set of terminology that can be applied to the LEM powered descent to provide a basis of understanding shared by all elements contributing to the mission design. It is the intent to draw heavily upon current aircraft flight terminology where it provides a meaningful analogy between aircraft and LEM landing operation.

PROPOSED TERMINOLOGY

Design considerations of the LEM powered descent have led to a three-phase design as described in reference 1. In addition to the three phases, the points at the beginning or end of each phase require descriptive terminology. Figure 1 presents an outline of the descent trajectory and the proposed terminology for each major phase and point. The terms are tabulated along with previously accepted terms as follows:

Event	Old Terminology	Proposed Terminology
Start of powered descent	None	"Initial"
Phase I	Fuel-optimum	"Braking"
End of Phase I	None	Gate
Phase II	Visibility	Landing approach
End of Phase II	None	Low Key
Phase III	Hover	Final approach
Landing point	Touchdown point	Touch point

The terminology proposed is thought to be descriptive of the characteristics of the descent trajectory and/or familiar to astronauts because of their extensive aircraft operations experience. With the exception of "Gate" and "Low Key", the terms are not thought to require explanation. "Gate" is a commonly accepted term applied to a particular point in an aircraft instrument approach using Tacan or Omni Equipment. It usually designates a point that is about 6 miles from the intended point of landing. The aircraft arriving at the "Gate" is further required to have specified altitude and velocity conditions - thus the term "Gate" appears applicable to the end of Phase I. The term "Low Key" has been commonly used in jet aircraft flame-out approaches and signifies a point fairly close to the desired landing site where again a desired set of altitude and velocity conditions should exist.

CONCLUDING REMARKS

A generally acceptable set of terminology is seldom accomplished on the first attempt. The design of the LEM lunar landing mission is, however, progressing rapidly and perhaps enough is known to confidently decide upon the terms which describe important parts of the mission. It is proposed that the terminology presented be reviewed by appropriate MSC organizational elements and, after necessary revisions, formal acceptance be made to facilitate program progress.

REFERENCES

1. NASA Technical Note D-2426, "Study of Powered-Descent Trajectories for Manned Lunar Landings, Floyd V. Bennett and Thomas G. Price, August, 1964.

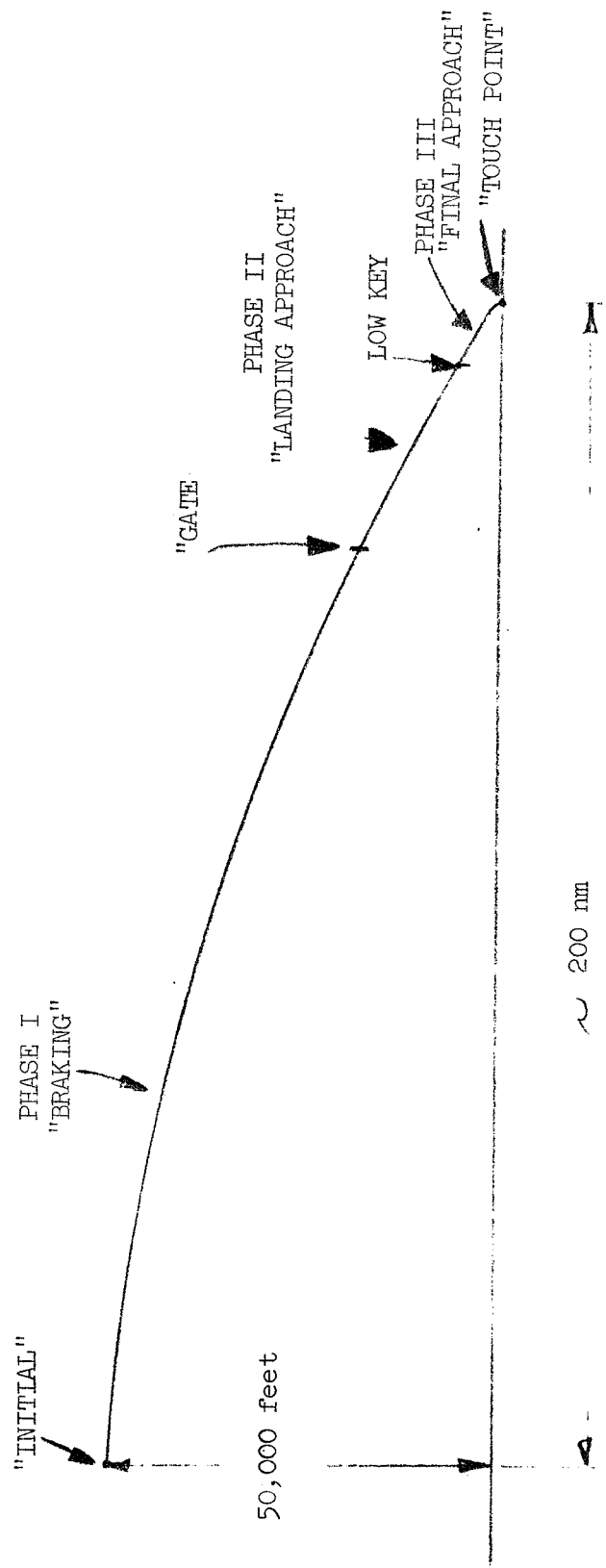


FIGURE 1. Sketch of LEM Powered Descent with proposed terminology