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955 L'ENFANT PLAZA NORTH, S.W. WASHINGTON, D.C. 20024

B70 08013

SUBJECT: LRV Performance Status Reporting Methods - Case 320

DATE: August 6, 1970

FROM: R. D. Raymond

ABSTRACT

Visibility of the LRV operational capability in specific mission roles is needed during the transition of LRV development from the design phase to the operational phase. This report suggests, by performance report examples, the types of data that should be provided by NASA Centers to support the monthly APO Performance Review.

Two of the performance reporting examples emphasize the LRV weight status and control. The third example stresses energy margins and potential energy uses, which appear to be critical performance parameters. Periodic performance reports should be based on an actual mission plan and current vehicle capabilities, rather than a hypothetical reference mission. Selection of the optimum reporting method requires a review of the Centers' capabilities to respond to the Program Office reporting needs.

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MEMORANDUM FOR FILE

INTRODUCTION

The transition of LRV development from the design phase to the operational deployment phase necessitates a new means of providing program visibility of the operational capability of the LRV in specific mission roles. One element of this process is the development of meaningful performance reporting methods that can be implemented by the cognizant NASA Centers and readily understood by the Apollo Program Office. Typical, but not necessarily valid, values are used to describe three examples of performance related reports that indicate the types of data need for adequate program visibility.

It is suggested that data be provided periodically by NASA Centers sufficient to provide the suggested or similar reports to Apollo Program Office as one element of the monthly APO Performance Review. As LRV mission plans develop, it is expected that the importance of specific data will become more apparent and that the reporting techniques can be continually oriented toward the most critical items.

RANGE AND GROSS WEIGHT PERFORMANCE

The vehicle performance in terms of total range capability as a function of total LRV weight is illustrated in example 1. In order to generate this curve, the vehicle range is calculated for a variety of gross weights on actual traverses expected for a specific mission. The mission illustrated is a Marius Hills "J-1" mission*, which is comprised of three sorties totalling 42 km in 12 hours. Several parameters of interest can be shown on this figure as demonstrated by the total range requirement (42 km) for the specific mission, the gross weight references for one or two astronauts plus cargo, and a potential maximum gross weight limit, e.g., 1450 lbs. Although the data shown on this figure are useful, periodic variations in results may be masked because the LRV range is not very sensitive to gross weight.

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*Minutes of the seventh Lunar Surface Reference Mission Plan meeting enclosures 7 and 11 (Marius Hills Northwestern Site Candidate Traverses), July 21, 1970.

LRV CONTROL WEIGHT AND PAYLOAD CONTROL WEIGHT PERFORMANCE

A second means of expressing the vehicle performance in terms of weight and range is given in example 2. The unloaded LRV weight on the lunar surface is plotted against the payload weight. This allows a weight control point to be shown representing a gross weight that consists of a specified LRV weight and a specified payload weight. A weight status point is also shown for current vehicle and payload reported weights.

Again, the range can be calculated for given gross weights on specific J-missions, as shown for a Marius Hills "J-1" mission. The range capability is plotted along equal gross weight lines, providing a scale against which to measure the range capability at the status point. The required range of 42 km for the mission shown is a "limit" line that constrains the status point to the left to achieve adequate LRV performance.

The additional payload or range available can be interpreted from the figure. However, additional notes, e.g., electrical energy budget, are needed to better understand the performance status, because weight is probably not the most critical LRV performance parameter.

ENERGY BUDGET PERFORMANCE

A report on the LRV energy budget and potential use of any margins would apparently cover the most critical performance parameters. Example 3 illustrates one means of displaying energy performance status. The energy used to operate the LRV on a specific "J-1" mission is plotted against the remaining or "reserve" energy, and the total energy limit (8712 wh) is shown.

The reserve energy control point can be established by specifying the minimum reserves, e.g., 10% of the total source for maximum depth of discharge and 1600 wh for other use. The remainder of the total 8712 wh can be used as an operating energy control limit.

The status point is established by calculating the operating energy needed for the specific mission using current weights and mission environment data. The reserve energy above the control point is the usable energy margin.

The usable energy margin can be converted to additional mission range, standing time, or gross weight. A conversion scale for each of these parameters, as shown, can be computed based on the average conditions, or sensitivities, for the specific mission. This will enable a quick assessment of additional capability to be made by extrapolating the existing mission conditions.

SUMMARY

A method of quick look reporting is needed to enable periodic assessments of LRV mission performance. The first two examples given emphasize the weight status and control, which may not be the most critical parameters for LRV performance monitoring. The third example stresses energy margins and potential energy uses, which appear to be critical performance parameters.

It is appropriate, as stressed in all three examples, to present performance in terms of an actual mission plan and current vehicle capabilities, rather than basing performance on a hypothetical reference mission.

A thorough review of the Centers' capabilities to respond to the Program Office reporting needs is necessary before the optimum reporting method can be determined.

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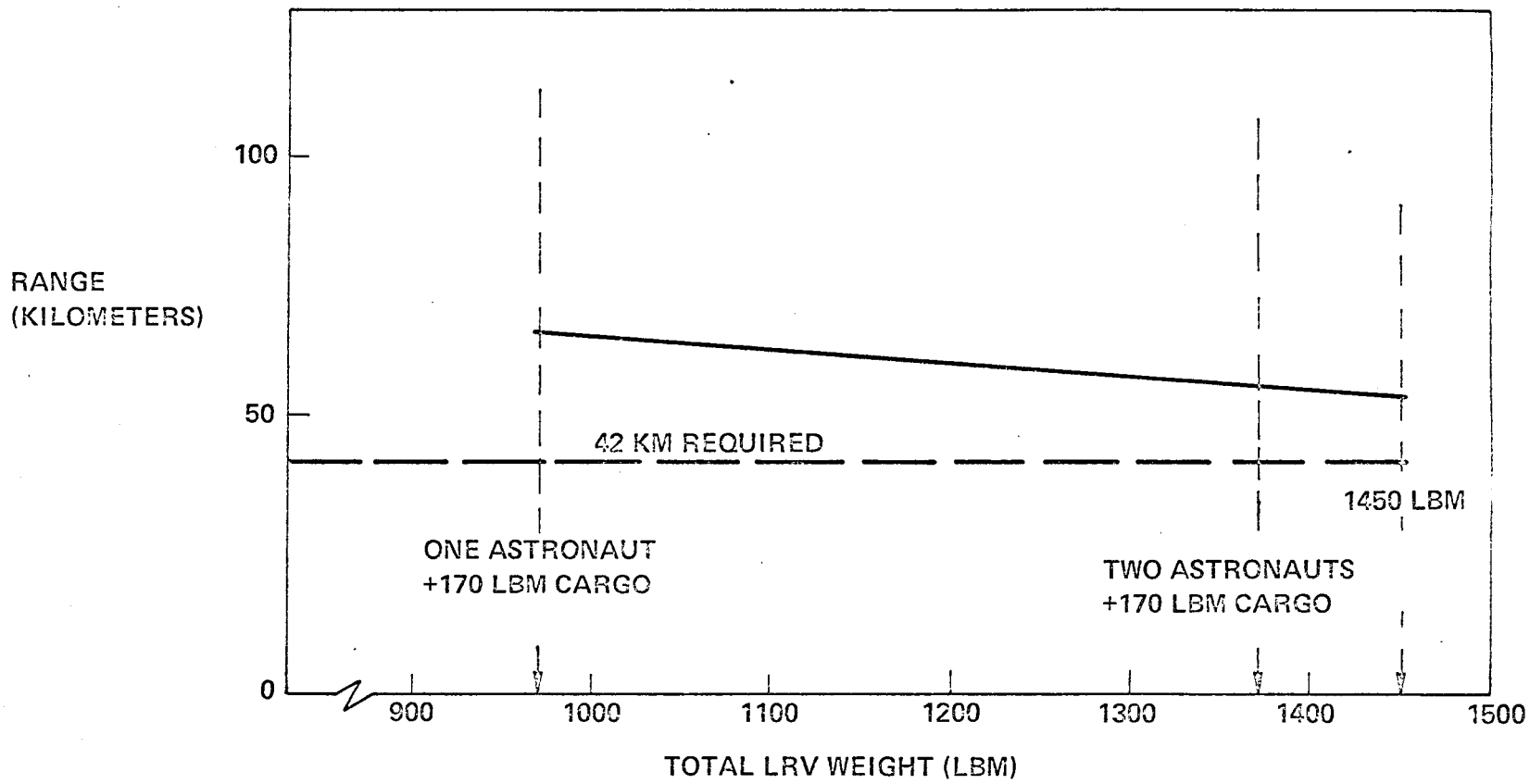
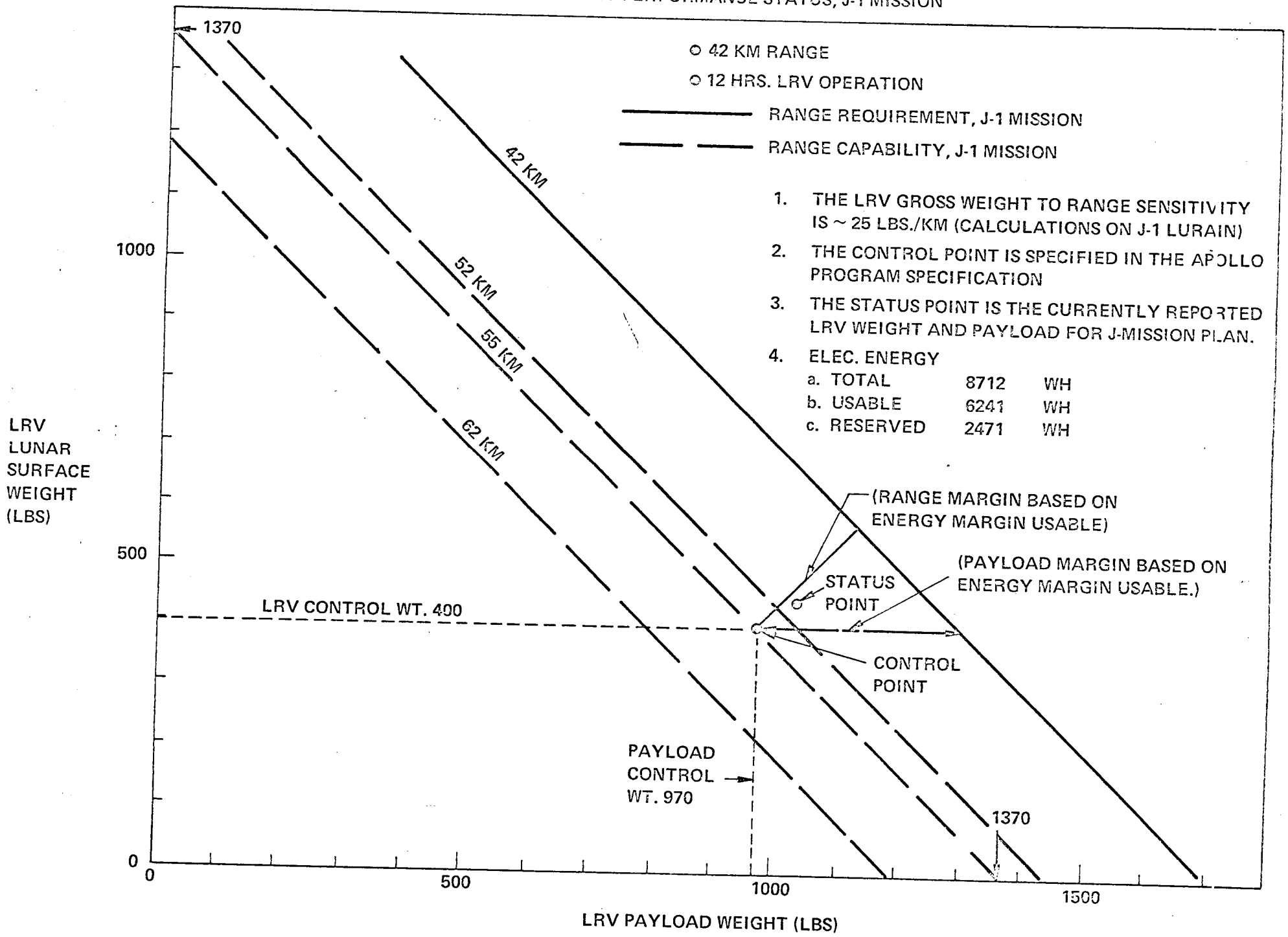
R. D. Raymond

EXAMPLE 1: LRV PERFORMANCE STATUS, J-1 MISSION

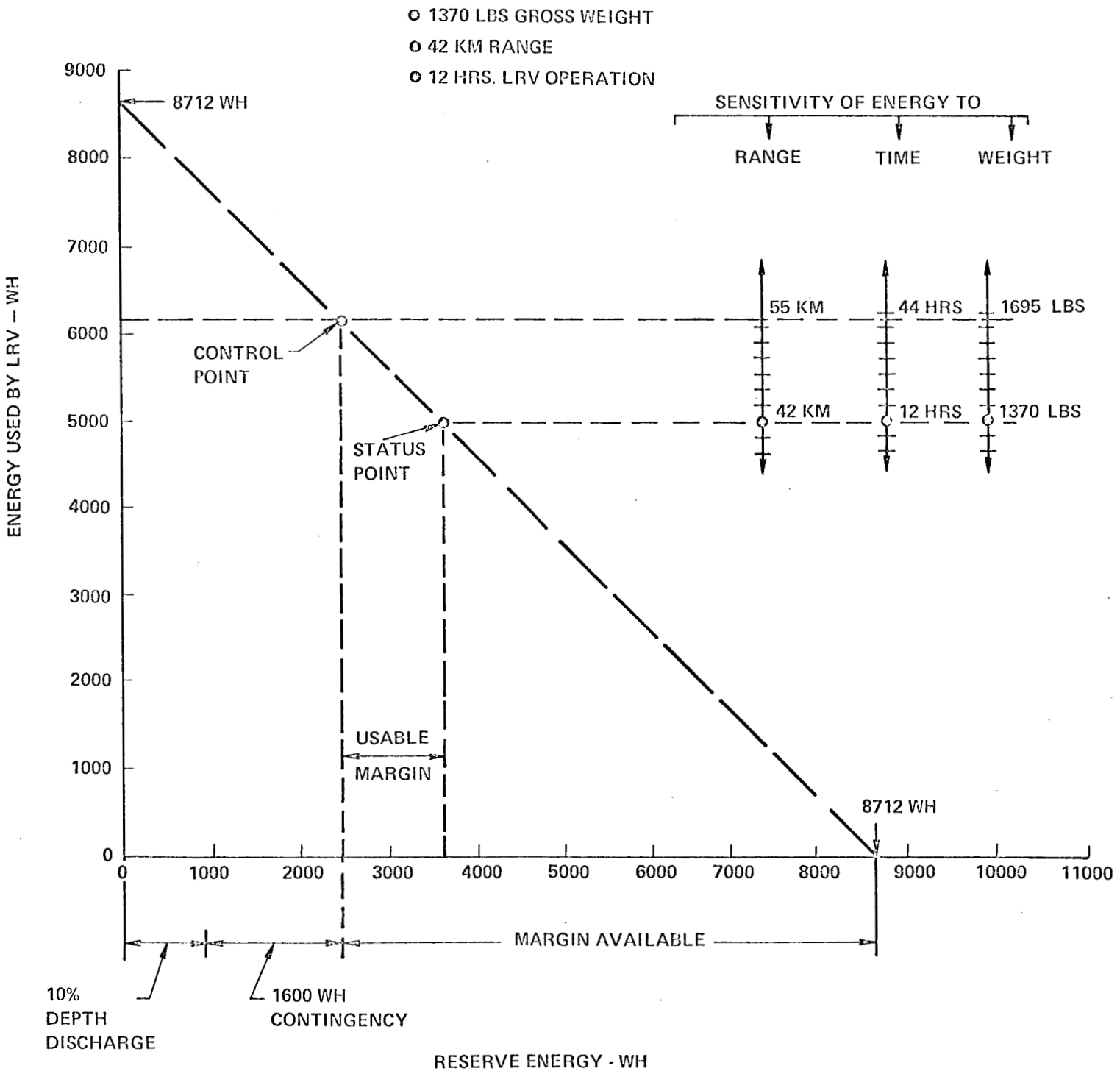
- 42 KM RANGE
- 12 HRS. LRV OPERATION



EXAMPLE 2: LRV PERFORMANCE STATUS, J-1 MISSION



EXAMPLE 3: LRV PERFORMANCE STATUS, J-1 MISSION



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From: R. D. Raymond

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