

BELLCOMM. INC.

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B70 07059

SUBJECT: Apollo 13 LM Battery Anomaly and  
Lunar Roving Vehicle Battery  
Inference - Case 320

DATE: July 16, 1970

FROM: W. O. Campbell

ABSTRACT

One of the areas being investigated relative to the Apollo 13 battery anomaly is the 12-hour battery-on-end test. The test shows the amount of free electrolyte in the activated battery. Apparently a freshly-activated old battery will not hold as much electrolyte in absorption as will a freshly-activated young battery. Too much electrolyte presents a safety hazard; too little affects the battery total energy.

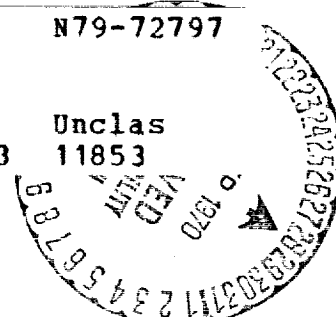
Under the presently-estimated manufacturing schedule and flight schedule the Lunar Roving Vehicle (LRV) batteries for the Apollo 16 and 18 missions will be about one year old at launch. For this reason it is suggested that the LRV battery program be examined now to determine the aging effect while program options are still open. The outcome of the Apollo 13 investigation may offer some guidance.

(NASA-CR-113360) APOLLO 13 LM BATTERY  
ANOMALY AND LUNAR ROVING VEHICLE BATTERY  
INFERENCE (Bellcomm, Inc.) 5 p

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FF No. 602

CX-113360

(NASA CR OR TMX OR AD NUMBER)

(CATEGORY)

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MEMORANDUM FOR FILE

INTRODUCTION

Item 10 of the Apollo Spacecraft Configuration Control Board meeting on June 17, 1970 concerned the Apollo 13 LM descent battery anomaly. In order to provide a better understanding of the concern, the following background and status of item 10 are presented. The data also offer insight into the general subject of battery activation and some of the factors which must be considered to arrive at a correct procedure.

For these reasons the data are also presented as background for the Lunar Roving Vehicle (LRV) program battery. The aging process and the *excess*\* electrolyte (KOH) situation in item 10a could also apply to the Apollo 16 and 18 missions because the LRV batteries for these missions will be about one year old at launch.

ITEM 10 BACKGROUND AND STATUS

LM Item 10a.

Action Requested: GAC determine subsequent action to be taken when the 12-hour battery-on-end test shows *too much* free KOH.

Background: This on-end test originated some time ago during a LM 3 test in which old\*\* batteries were used.

According to MSC<sup>(1)</sup> the old batteries had probably undergone a slow decrease in capability to hold KOH in absorption. This condition permitted more than *normal* free KOH to show in the top of the cell.

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\*Italics are used to denote an empirical quality of the data, with quantitative values determined by the battery vendor during development tests under a specified set of conditions. When field conditions vary (battery age, etc.), the *correct* value may no longer appear to be correct. Changing the *correct* value calls for battery requalification and change of the controlling documentation.

\*\*Unused, but with little time left under the shelf life specification.

There are alternate courses of action. They minimize the battery age situation more directly by (1) using younger batteries and by (2) refrigerating young batteries to slow down the inevitable aging process. Withdrawing the *excess* KOH from a freshly-activated old battery is prohibited unless the battery is requalified with the *new* amount of KOH, where *new* could conceivably vary with battery age. *Too little* KOH affects battery total energy. *Too much* is a potential safety hazard.

Status: The request is under consideration.

LM Item 10b.

Action Requested: GAC determine measures to make the battery case and terminals impervious to KOH leakage-- and present a proposal.

Background: The MSC position is that the battery design is not a bad design. The exact details of the design came up for final approval some years ago during a prolonged LM weight-saving campaign during which a gram per cell was an important item, incrementally \$10,000 per battery pound.

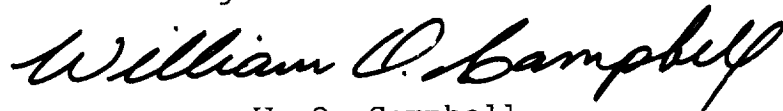
Status: Several changes to the battery are being considered. One causes a gross increase in battery weight. Others cause a slight increase or even a decrease. They are being studied and tested. GAC, MSC and the battery vendor are participating in the investigations. The proposal submittal date is about <sup>(1)</sup> July 31.

#### RELEVANCE TO LRV

Previous conversations <sup>(2)</sup> with MSFC LRV personnel indicate that the LRV batteries will be manufactured in two phases: phase 1 for the Apollo 15 and 16 missions; phase 2 for the Apollo 17 and 18 missions. Under these circumstances and the present flight schedule the batteries for Apollo 16 and 18 will be about one year old at the time of the mission. They may therefore exhibit the same decreased capability to absorb KOH as the LM 3 battery described in item 10a. Improving the age situation by manufacturing the batteries in four phases would increase the manufacturing start-up, personnel attrition and retraining problems with possibly a resultant decrease in battery confidence. Requalification of aged batteries to prove the adequacy of the revised amount of KOH has drawbacks. There may be other alternates.

SUGGESTION - LRV

It is suggested that the LRV battery program be examined to determine the effect of aging. The suggestion is made now while program options are still open. The outcome of item 10 for Apollo 13 may offer some guidance.

A handwritten signature in cursive script that reads "William O. Campbell". The signature is written in black ink and is positioned to the right of the typed name.

2032-WOC-t1a

W. O. Campbell

BELLCOMM. INC.

REFERENCES

1. Trout, J. B./MSC/EP5, conversation July 10, 1970.
2. Alter, J. D./MSFC/PM-SAT-LRV, conversation during Lunar Roving Vehicle Pre-Critical Design Review, June 9, 1970.

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