CHANGE SHEET

FOR

MSC INTERNAL NOTE NO. 70-FM-19, DATED JANUARY 30, 1970

RTEC REQUIREMENTS FOR APOLLO 14 (H-3) MISSION:

MOON-CENTERED RETURN-TO-EARTH CONIC SUBPROCESSOR

By Frances M. Northcutt

TRW Systems Group

October 1, 1971

Ronald L. Berry, Chief
Planetary Mission Analysis Branch

John P. Mayer, Chief
Mission Planning and Analysis Division

NOTE: A black or dashed line indicates the area of change.

(See Change History)

After the attached pages, which are replacements, have been inserted, insert this change sheet between the cover and the title page and write on the cover "CHANGE 1 inserted".

**Title or Subject:** RTGS Requirements for Apollo 14 (S-3)

**Mission:** Moon-Centered Return-to-Mars Comic Subprocessor

**Date of Paper:** October 1, 1971

**Author(s):** Frances M. Northcut, TN Systems Group

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**Date:** 10-5-71

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MEMORANDUM

TO: Distribution

FROM: M/ Mission Planning and Analysis Division

SUBJECT: RTCC REQUIREMENTS: Modification to Moon-Centered Portion of Return-to-Earth Abort Processor for Apollo 16

References:


Introduction

As a result of a program discrepancy report on the moon-referenced portion of the Return-to-Earth Abort Processor (RTE), a change to the moon-centered fuel-critical unspecified area (FCUA) logic is requested. This change to the moon-centered conic logic is defined by the enclosure. The new logic will eliminate the observed non-optimum solution and further enhance the ability of the FCUA logic to produce the desired solution.

In addition the enclosure documents the previous changes to subroutine FCUA. These changes do not represent a change to the current program. With their incorporation, the original defining document (reference 1) will reflect the current program logic.
Discussion

Prior to the Apollo 15 flight a non-optimum moon-referenced FCUA solution was observed. The investigation of this case indicated that for some situations the AV function was not fully minimized. A minimal change to the logic produced the desired solution for this case. Because the change is small and affects only two portions of the logic and because a non-optimum solution is difficult to identify, this change is requested for Apollo 16.

Two classes of changes are reflected in the enclosure. The first class represented by the dotted lines in the right-hand margin documents corrections for typographical and logic errors to reference 1. Corrections defined by reference 2 are included.

The second class of change represented by the solid lines in the right-hand margin is the requested change to subroutine MCUA (POMCUA). Reference 3 presents this new logic.

To provide verification of the new logic, four unit test cases are defined by reference 4.

Summary

As a result of a non-optimum moon-referenced FCUA solution from the Return-to-Earth Abort processor, a change to the MCUA logic is requested for Apollo 16 and defined herein. Also included are the previous changes to subroutine MCUA in order to update the original program specification.

Ronald L. Berry

APPROVED BY:

John P. Mayer
Chief, Mission Planning and Analysis Division

The Flight Support Division concurs with the above and directs IBM to proceed accordingly.

James C. Stokes, Jr.
Chief, Flight Support Division

Enclosure

FM54/RSDavis:jrh:9/20/71
<table>
<thead>
<tr>
<th>Change no.</th>
<th>Date</th>
<th>Description</th>
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<tr>
<td></td>
<td>10/1/71</td>
<td><strong>Page</strong></td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-69</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Initialization for flag IRSCAN added</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Logic deleted to always allow complete AV minimization with respect to $I_R^*$.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-77</td>
</tr>
<tr>
<td></td>
<td></td>
<td>a. (Dashed line) Same as page A-76.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>b. (Solid line) New logic added to define the initial $I_R^*$ values for the generation of the solution with a landing time 1 hour less than the landing time bound.</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-78</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Same as A-76</td>
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<tr>
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<td></td>
<td>A-79</td>
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<td></td>
<td></td>
<td>Same as A-76</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-81</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Supplies tolerances around the solution constraints</td>
</tr>
<tr>
<td></td>
<td></td>
<td>A-82</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Eliminates possible loop and allows generation of solution on both $h_{pc}$ and $T_{max}$ constraint</td>
</tr>
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<td></td>
<td></td>
<td>A-84</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Same as A-81</td>
</tr>
</tbody>
</table>
MCUA
Logic Flow
Page 2

REP = 0
INTER = \frac{i_r}{|i_r|}
i_r = |i_r| + 61_r

MCDRV: Enter with KIP, \omega_r, r_z, q_m, \xi, INTER, PNT
Exit with \Delta V, t_m, \gamma_p, q_d, \xi, REP

i_r = (i_r - 6i_r) \text{ INTER}

\begin{array}{c}
\text{REP = 0} \\
\text{YES} \\
\Delta V = 10^{10}
\end{array}
\begin{array}{c}
\text{NO} \\
\Delta V > S\Delta V
\end{array}
\begin{array}{c}
\text{NO} \\
S_i_r = i_r \\
S\Delta V = \Delta V
\end{array}

C = 3
\[ \Delta 1 = 5t_zT1(2) - 4t_zT1(1) \]
\[ \Delta 2 = 5t_zT1(2) - 4t_zT1(3) \]
\[ MM = 1 \]

\[ \Delta 1 < t_zT1(3) \]
- YES: \[ t_z = \frac{t_zT1(2) + t_zT1(3)}{2} \]

\[ t_z' = \frac{t_zT1(1) + t_zT1(2)}{2} \]
- NO: \[ \Delta 2 < t_zT1(1) \]
- NO: \[ \Delta 2 < t_zT1(1) \]
- YES: \[ 1 \]

A-78
MCUA
Logic Flow
Page 12

A-80
U

REP = 0

ΔV < ΔV
OR
ΔV > ΔV'_{max} + eΔV

NO

ΔV < ΔV
NO

K

NO

NO

NO

STORE: ENTER WITH OPTION = 1;
STORE SOLUTION

L

L

15

15

14

12

V

ΔV > ΔV'_{max} + 0.001

YES

t'_{z} = t'_{z} + 0.5

NO

YES

a_{r} > a''_{r_{max}} + 0.001

NO

STORE: ENTER WITH OPTION = 1;
STORE SOLUTION