If a restart occurs during a radar read, the following radar read may be incorrect. If this happens in R12, the state vector may be incorrectly updated.

Apollo 11 flight. There were two incorrect altitude readings in powered descent after software restarts.

**MIT ANALYSIS**

2.1 CAUSE:

2.7 RECOMMENDATION:
Monitor radar data on downlink.

2.4 AVOIDANCE PROCEDURE:
None

2.5 RECOVERY PROCEDURE:
Subsequent radar updates will correct the state vector.

2.6 PROGRAM CORRECTION:
Inhibit incorporation of landing radar data on the first radar read after a restart.

2.7 RECOMMENDED DISPOSITION (Fix, Work-around, etc.):
Fix in LUMINARY 1C.

2.8 RECOMMENDED RE-TESTING:
Digital simulation with restarts to verify that the radar data is not incorporated after a restart.

**NASA DIRECTION:**

2.9 NASA SIGNATURE:

2.10 DATE:

4.1 CLOSING ACTION TAKEN:

**NASA MSC SIGNATURE:**

**NASA ORGANIZATION:**

**NASA DATE:**

MSC Form 1-I3 (Rev May 68)
2.3 Mission Effect, cont'd.

the radar might indicate zero altitude. The altitude update, $\Delta R$, is then given by:

$$\Delta R_{\text{max}} = W_h \Delta h = W_h (O - H) = -W_h H$$

The present weighting function is

$$W_h = 0.35 (1 - H/50000)$$

so that

$$\Delta R_{\text{max}} = -0.35 H (1 - H/50000)$$

The following table gives the value of the update as a function of altitude in the case where the radar gives a zero reading:

<table>
<thead>
<tr>
<th>$H$</th>
<th>$\Delta R_{\text{max}}$</th>
</tr>
</thead>
<tbody>
<tr>
<td>50000 ft.</td>
<td>0 ft.</td>
</tr>
<tr>
<td>40000</td>
<td>-2800</td>
</tr>
<tr>
<td>30000</td>
<td>-4200</td>
</tr>
<tr>
<td>25000</td>
<td>-1375</td>
</tr>
<tr>
<td>15000</td>
<td>-3675</td>
</tr>
<tr>
<td>10000</td>
<td>-2800</td>
</tr>
<tr>
<td>5000</td>
<td>-1675 (would fail reab. test)</td>
</tr>
<tr>
<td>1000</td>
<td>333</td>
</tr>
</tbody>
</table>

In Apollo 11, the two bad readings gave altitude errors of -1000 ft. and -272 ft., which was much less than the maximum possible error.