Hornton

UNITED STATES GOVERNMENT

Memorandum

TO : All Astronauts

DATE: 11-3-67

FROM : Michael Collins

SUBJECT: Some curious facts about VHF ranging

1. <u>SCHEDULE:</u> A tight squeeze for CSM 106/LM5: next milestone:
    PDR at RCA Camden, 20-21 November.

2. <u>CSM SWITCHES:</u>

    A. Power SW: Old HF SW on MDC Panel #3
    B. Ranging Reset SW: To Be added to Panel #9.
    C. Range Readout: To Nearest .01 mile, on EMS (Panel #1)
    D. Tracker Light: On both DSKYS.

3. <u>HOW IT OPERATES:</u>

    A. <u>ACQUISITION:</u> Within 200 miles of the LM, system should lock on
        as soon as Power and Range Reset Switches are turned on. This
        lock on sequence is automatic, takes five to ten seconds, but
        requires <u>VHF voice radio silence</u> until lock on is assured, i.e.
        until Range is displayed on EMS (EMS Switch must be in OFF
        position). If lock is broken, or if the EMS is used for some
        other purpose such as monitoring a burn ΔV (i.e. if EMS switch
        is moved away from OFF) the acquisition process must be repeated.
        Note that this requires manipulation of the Ranging Reset Switch
        on Panel 9, so that if reacquisition is necessary during that
        portion of the rendezvous sequence when the crew man is in the
        LEB, he must return to the left couch. The chances of the thing
        breaking lock are reportedly high, i.e. one chance in four some-
        time during a rendezvous. Crew indication of broken lock is
        (a) TRACKER light comes on both DSKYs and (b) Range display on
        EMS goes blank.

    B. <u>AFTER ACQUISITION:</u> Range information is sent to the EMS each
        millisecond, but the CMC samples it only once per minute (plus
        computation time) in Program 20. The VHF system constantly
        checks itself, and if it decides that its data is NO GOOD, it
        sends a discrete to the CMC which lights the TRACKER light on
        both DSKYs. If the VHF data passes its own DATA GOOD check, then
        it goes into the CMC where it is processed, in P20, in a manner
        similar to optical data. It passes through a W matrix and the new

state vector is compared with the old SV. If the SV change is within pre-set limits, the update is incorporated. If excessive, the DSKY displays the $\triangle$ Position and $\triangle$ Velocity. The crew can accept these limits or override them by appropriate DSKY entry. The crew can also call up R31 to get the computer's latest guess on what R, R, and $\emptyset$ might be

4. <u>LIMITATIONS:</u>

A. The CMC can <u>either</u> navigate through burns, as in P47, <u>or</u> update the SV with VHF data, as in P20, but not both. This means that during the braking, when R31 is called up in 47, the R is not an instantaneous value, i.e. is not corrected for any burns made since P20 was exited. To get the latest R, the crew must read R from the EMS and time its change over an appropriate interval. Ed Smith of G&C Division says his simulations show this is entirely satisfactory. He uses one minute and converts directly from miles to ft/sec: If R at T_O=2.45 NM and one minute later = 2.20 NM, then Ṙ = 25 ft/sec.

B. Whenever VHF ranging is turned on, LM PCM data cannot be received by the CM for recording or relay to ground. Mr. Kraft has not yet been heard from on this one.

C. If the LM pilots are using VOX, it is possible that background noise might trigger the mikes and screw up the acquisition cycle described earlier.

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