R.S.Y. → J.L.

JPL/HR-2

#277
pg. 1

PROJECT RANGER: A CHRONOLOGY

R. Cargill Hall

Jet Propulsion Laboratory
California Institute of Technology

National Aeronautics and Space Administration

April 1971

Jan. 26 Ranger 3 (Atlas 121D, Agena B 6003), the first lunar flight in the Block II series, was launched from AMR Pad 12 at 3:30 EST in the first countdown. The planned mission was achievement of a lunar impact trajectory, with lunar impact at a preselected site. Principal objectives for this flight involved testing of all ground and space borne operational system elements for unmanned lunar missions, including midcourse trajectory correction and terminal maneuvers performed by the spacecraft, and the conduct of scientific experiments in transit and upon the lunar surface. (Ranger Block II flights carried a single axis seismometer capsule to be rough-landed on the moon, as well as approach television, radar, and gamma-ray experiments.) (Figures 45 and 46.)

The planned lunar mission was not accomplished due to a combination of booster and spacecraft malfunctions; however, several important test objectives were achieved during the flight. The first variance in mission plans occurred less than a minute after liftoff, when the pulse beacon failed in the Atlas guidance system. The Atlas booster continued independently through engine shutdowns operating only on autopilot and internal programmed information, although the dispersion error introduced in the trajectory exceeded

Jan. 26 cont. the correction capability of the RA-3 midcourse propulsion system and precluded any lunar impact. The Agena B performed its programmed dual engine burns, accelerating RA-3 out of an earth parking orbit; however, an additional trajectory dispersion--later traced to a mis-set Agena guidance constant--was also introduced.

Following injection into an unplanned deep space trajectory, RA-3 properly deployed its solar arrays, acquired the sun and earth, and stabilized in attitude. Communication with the DSIF through the high-gain antenna was successfully initiated by ground command. In the Spaceflight Operations Center at JPL, members of the Ranger Project Office decided to proceed with midcourse and terminal maneuvers in order to demonstrate spacescraft propulsion system capability and to position the spacescraft for an experiment with the approach television camera. The midcourse maneuver command was transmitted from Goldstone at 5:00 p.m. EST on January 27. The spacecraft received, processed, and executed the command; upon reacquisition (following spacecraft attitude return to sun and earth-lock) by ground stations, it was soon apparent that the maneuver velocity change had been a mirror image of that desired. Within a period of about 40 hours, between the midcourse and terminal maneuvers, the fault was analyzed: a sign inversion had existed undetected between the preprogrammed digital maneuver code of the ground computer and the spacecraft computer. Preflight tests had checked only the magnitude and polarity, but not the meaning of the commands.

A terminal maneuver command with the signs reversed was sent from Goldstone to Ranger 3 at 12:21 p.m. EST on January 28, as the spacecraft neared the moon (about 20,000 miles distance at closest approach). The spacecraft commenced the terminal maneuver correctly, thus confirming the sign inversion diagnosis, but lost attitude control when the CC&S failed for an unknown cause, and the maneuver was not completed. Execution of this command would have oriented the spacecraft so that the vidicon field of view covered a well-lighted area of the far side of the moon not previously photographed, and would have allowed a viewing period of approximately 41 minutes before the second Goldstone pass ended. The terminal sequence had included programmed exposure of the vidicon and the taking of pictures. Although the vidicon apparently operated, since the fiducial marks on the face plates appeared in initial pictures, the CC&S-attitude control failure caused the high gain antenna to lose its earth orientation, and the signal strength dropped below Goldstone receiver capabilities causing the vidicon signal to be obscured by noise. Ranger 3 swept past the moon at closest approach six hours later on January 28. The DSIF continued to track the battery-powered

Jan. 26 cont. beacon in the lunar capsule to a range of 1,010,000 miles when tracking efforts were discontinued. (Figure 47.)

Performance of the passenger science experiment was acceptable under the nonstandard flight conditions. The gamma-ray boom extended properly and useful spectrometer data on radiation background were received on January 27 and 28. (This gamma ray spectrometer data provided the first identification of a diffuse flux of primary gamma rays coming from outside the solar system.)

The spacecraft temperature control system performed adequately, although the temperature rose slowly toward the upper limit as the vehicle passed the moon. As a result, plans were made to alter the thermal paint pattern on Ranger 4. While the milestone midcourse maneuver had been accomplished--albeit in reverse fashion--the various discrete flight failures, including loss of AMR-DSIF downrange telemetry data when ground equipment failed, demonstrated the importance of system-wide simulation analysis and testing. (JPL Space Programs Summary No. 37-14, Vol. I, for the period January 1, 1962 to March 1, 1962, 7-9; Ranger III Technical Bulletins 1 through 4, January 29 through February 9, 1962; and, Ranger History--working draft, op. cit., 15-16.)

ADF submitted a firm cost proposal for development of SURMEC for Ranger follow-on flights. (ADF, letter from E.L. Montgomery to L.C. Pehl of JPL, January 26, 1962, JPLHF 2-1228.) (See January 8, 1962.)