Viking Extended Mission Support

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This report covers the period from 1 July through 31 August 1977 and includes the remainder of post DSN Mark III Data Subsystem Implementation Project Viking-related testing at DSS 14. It also includes reports on the Viking DSN Discrepancy Reporting System, Viking command support, tracking support, and periodic tests conducted with the Viking spacecraft.

I. Viking Operations

A. Status

As of 21 August 1977, all four Viking spacecraft continued to perform as planned. The Orbiters' X-band transmitter and relay subsystems were on continuously, with relays being performed routinely. All Orbiter subsystems continued to perform well, and no performance trends could be established during this reporting period.

Lander 1's sampler scoop successfully rolled a Mars rock, and a subrock soil sample was taken. The scoop was also used to scratch a rock in an attempt to obtain rock chips for chemical analysis. The temperatures at the Lander 2 location started an upward trend, accompanied by lower pressures. Lander 2 continues in a dormant state, with no direct links taking place.

The first dual-subcarrier high-rate data for 26-meter stations were processed by DSS 11 on August 16. Due to some confusion regarding the 2 kb/s receive capability and the lack of one Symbol Synchronizer Assembly at the station, three and a half hours of data were lost. Following the turnaround from VO-2 to VO-1, commands were sent to replay the recorded data. One third of the original data were recovered.

B. Maneuvers

(1) There were no scheduled Mars Orbit Trim (MOT) maneuvers during this reporting period. The last Viking Orbiter 1 maneuver (MOT-16) took place on 1 July 1977 and changed the orbit period to 24 hours, so that earth occultations occurred during the DSS 14/DSS 43 overlap period. The last Viking Orbiter 2 trim maneuver (MOT-10) took place on 18 April 1977.

(2) Nonpropulsive maneuvers continued at a rate of two or three per week per Orbiter during the reporting period. The maneuvers make it possible to take orbital science data. At the present time the 26-meter subnets are unable to obtain telemetry during these maneuvers since the received signal level is about −170 dBm on the low-gain antenna (LGA). By the end of November 1977, the LGA link should improve by 5 dB and make it possible for the 26-meter stations to receive roll-only telemetry.

C. Radio Science

Radio science experimentation continued during July and August. Earth occultations by Viking Orbiter 1 were supported by DSS 14 and 43. Some difficulties in obtaining post-occultation downlink lock were experienced due to the close proximity of occultation and periapsis.

D. Spacecraft Tests

(1) VO-1 High-Gain Antenna Calibration. This test was conducted on 15 July 1977 during the DSS 43 view period, using X-band CONSCAN for more accurate DSS antenna pointing. During the test it was noted that the signal level had changed by 1.5 dB even though the start and end pointing angles were supposedly equal. This same phenomenon occurred during a previous Orbiter 2 high-gain antenna (HGA) calibration over DSS 43.

(2) CDU "SNORE" Tests. Routine Command Detector Unit (CDU) signal-to-noise ratio estimator (SNORE) tests were accomplished using DSS 61 on 4 and 25 August (VO-1) and 5 and 23 August (VO-2).

(3) Viking Orbiter 1 Threshold Test. This test was conducted on 3 August 1977 to check on VO-1 uplink signal level residuals and CDU "SNORE" degradations observed previously. It was supported by DSSs 12 and 14, with DSS 12 providing the uplink and DSS 14 providing the downlink.

During the first test, the Planetary Ranging Assembly (PRA) was used to suppress the uplink carrier in 1-dB steps. The spacecraft Command Detector Unit was observed to go out of lock at an uplink signal level of −150.8 dBm, which was the same out-of-lock level seen during the previous test.

The Radio Frequency Subsystem dropped lock at −152.8 dBm, which was within 1 dB of the previous test.

The second test again used the PRA range modulation to suppress the uplink carrier, but a step attenuator was placed in the line between the output of the PRA and the input to the exciter. This step attenuator was then used to change the modulation in 1-dB steps. Due to the fact that the step attenuator had not been calibrated, the results of this run are questionable.

These tests indicated that there has been little, if any, shift in the threshold of the CDU or RFS during the flight of VO-1.

II. Network Support

Table 1 lists the Viking Extended Mission (VEM) tracking support for 1977 through this reporting period. It should be noted that in spite of the fact that stations have been removed from tracking support for the DSN Mark III Data Subsystem (MDS) Implementation Project reconfiguration, the total number of tracking passes and hours has remained constant during 1977.

Table 2 identifies the total number of commands transmitted by the DSN for the Viking Project during 1977. August was a record month for command activity during 1977, with DSS 61 sending more than half the total.

Table 3 gives the DSN VEM Discrepancy Report status for 1977.

III. Mark III Data Subsystem Testing and Status

As indicated in the last report of this series, the MDS implementation had been completed at DSSs 12, 14, 44, and 62. DSSs 12, 44, and 62 were fully trained and tested, while the testing at DSS 14 was just getting underway.

A. DSS 14 Test Status

(1) Ground Data System Tests – July 1977. Ground Data System (GDS) tests are tests designed to test the end-to-end configuration of the Deep Space Network and Mission Control Center systems. This test was unsuccessful. The test began one hour and twenty minutes late due to various problems. The test was delayed again at the one hour and nine minute mark due to a command problem in the Mission Control Center. The remainder of the time was spent in unsuccessful attempts to lock on lander block coded data at 1 kb/s data rate.

A GDS retest was conducted on July 12 and was considered to be a success, although it got off to a slow start because of problems establishing and validating the Mission Control Center to DSN long loop simulation interface. All items of the test sequence of events were completed, with the exception of the temporary ODR demonstration, and the non-real-time data replay of the test.

(2) Operations Verification Tests (OVTs) – July 1977. This was the third and last OVT for DSS 14. OVTs serve the dual purpose of providing operational training

for Network personnel and demonstrating the operational proficiency of Network personnel in the use of operational procedures, interfaces, and equipment. The test was successful even though not all sequence items were completed. Not enough time remained to exercise the conversion of analog recorded data to digital form, or the data replay and recall capabilities.

(3) Demonstration Passes. Demonstration passes are conducted during the first month following completion of the MDS Reconfiguration: Demonstration passes permit the stations to provide support to flight projects without having completed the full test and training plan.

The first demonstration pass for DSS 14 was conducted on July 8 and was successful. A second demonstration pass on July 9 had several problems but was considered successful. Further demonstration passes were conducted on July 15, 27, and August 3 and 5. Following the last demonstration pass, DSS 14 was placed under Viking configuration control.

B. DSS 42/43 MDS Implementation Status

DSSs 42/43 were released from tracking support on 15 July 1977 and began their two and a half months of implementation and system performance testing. The two months of test and training are scheduled to begin on 1 October 1977.

Table 1. VEM tracking support 1977

DSS	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
	Tracks / Hrs											
11	23 135	22 142	10 100	17 118	38 228	40 289	44 322	42 343				
12	4 11	1 6	–	24 176	17 119	1 4	1 1	1 7				
14	52 341	59 392	50 368	20 176	–	–	10 46	16 126				
42	21 247	25 226	58 453	17 138	17 162	14 112	10 69	–				
43	68 721	62 627	–	63 603	60 521	57 486	31 238	–				
44	–	–	7 7	1 4	–	–	16 99	26 166				
61	35 261	29 227	12 72	40 317	54 461	51 475	37 337	35 322				
62	–	2 7	4 22	9 55	3 14	2 7	–	–				
63	38 327	28 202	66 525	15 78	23 186	15 136	40 399	64 590				
Total	241 2043	228 1830	207 1547	206 1665	212 1691	180 1509	189 1511	184 1554				

Note: Number of tracks represent the summation of all Viking spacecraft tracked. Track time, in hours, represents scheduled station support.

Table 2. Number of commands transmitted in Viking Extended Mission during 1977

DSS	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
11	1521	1394	1027	117	811	0	1	795				
12	0	0	0	1314	721	0	0	0				
14	769	1404	1206	274			74	108				
42	2072	953	1778	8	1886	1619						
43	919	2523	0	2094	1447	972	1190					
44	0	0	2	1				5				
61	605	1116	1328	1925	1922	3838	4257	5589				
62	0	0	1	1991		496						
63	795	472	2039	381	675	383	2579	2318				
Total	6681	7862	7381	6180	7465	7308	8101	8815				

Table 3. DSN VEM Discrepancy Reports

DSS	Jan.	Feb.	Mar.	Apr.	May	Jun.	Jul.	Aug.	Sept.	Oct.	Nov.	Dec.
	0[a] / C[b]											
11	4 0	3 4	4 6	1 3	2 3	2 6	2 7	1 7				
12	4 0	0 0	0 0	5 2	7 5	0 7	0 0	0 0				
14	14 2	11 19	4 33	3 9	2 2	0 2	6 2	4 18				
42	0 1	2 3	0 7	0 2	0 0	0 0	0 0	0 0				
43	10 13	11 10	0 12	9 11	8 17	2 14	1 6	0 1				
44	0 0	0 0	0 2	0 1	0 0	0 0	1 0	1 4				
61	1 9	1 6	0 3	0 1	1 2	0 6	1 4	0 7				
62	0 0	0 8	1 2	2 1	0 2	0 1	0 0	0 0				
63	1 4	7 3	1 18	0 6	4 4	3 12	4 4	9 17				
Others[c]	4 3	3 9	2 10	4 7	7 12	10 13	8 16	5 9				
Total	38 32	38 62	12 93	24 43	31 47	17 61	23 39	20 63				

[a] Number remaining open at end of month.

[b] Number closed during month.

[c] DSN, NDPA, NOCA, GCF.