Viking Mission Support

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This article describes the launches of Vikings 1 and 2 and the circumstances surrounding each launch, followed by early cruise coverage of both spacecraft. The article also includes the planetary testing effort being carried out by the DSN to prepare for planetary operations.

I. Introduction

The previous article in this series describes the compatibility testing with the Viking 2 spacecraft. These tests marked the end of formal radio frequency telecommunications compatibility testing between the DSN and the Viking spacecraft. Also described are the prelaunch Operational Verification Tests, Configuration Verification Tests, and Mission Configuration Tests. This article describes additional testing necessitated by launch delays, launch and cruise activities of both Viking spacecraft, and the planetary testing planned for the 64-meter subnet and the conjoint 26-meter subnet.

II. DSN Launch and Cruise Support

The launches and initial acquisitions of Viking 1 on August 20, 1975 and of Viking 2 on September 9, 1975 were flawless and according to plan. The first midcourse maneuvers (trajectory corrections) of both spacecraft occurred as predicted with no problems of any kind and to this writing both spacecraft are being supported by the DSN with no problems or concerns.

A. Viking 1 Initial Acquisition and Cruise Support

As described elsewhere in this issue ("Tracking Operations During the Viking 1 Launch Phase," by A. L. Berman and J. A. Wackley), the initial acquisition of Viking 1 by DSS 42 was according to plan (Ref. 1). This success confirmed the value of the prelaunch initial acquisition testing effort. Following launch and initial acquisition, the DSN provided normal cruise coverage.

A first midcourse maneuver for Viking 1 was supported on August 27, 1975. This maneuver was needed to bring the spacecraft trajectory into closer proximity to the planet Mars following the initial launch "safe" (no impact) trajectory. A change in spacecraft velocity of 16.9 km/h (10.5 mph) was also made, which targeted Viking 1 to arrive at Mars on June 19, 1976. The performance of the DSN throughout the maneuver was without incident.

B. Viking 2 Initial Acquisition and Cruise Support

As a result of the change in the Viking 1 launch date, the Viking 2 launch date had slipped to September 3, 1975. During routine prelaunch checks, a degradation of 3 dB in the spacecraft receiver threshold was detected when switched to the high-gain antenna. In order to investigate this anomaly, the spacecraft was demated from the launch vehicle and the shroud was removed. The problem was cleared after a complete set of new hardware (high-gain antenna, cables, joints, etc.) was installed forward of the diplexer. The spacecraft was then rechecked and mated to the launch vehicle. The revised launch date was now September 9, 1975, and all systems were green. To insure optimum performance additional prelaunch initial acquisition testing was performed with DSSs 42 and 44 (Australia). These stations again entered a configuration freeze condition prior to launch. As was the case with Viking 1, the initial acquisition of Viking 2 was as predicted, and again the testing effort and preparation of the DSN were proved effective.

On September 19, 1975 the DSN provided support for the first midcourse maneuver of Viking 2. All went as planned, and this maneuver has targeted Viking 2 to arrive at Mars on August 7, 1976 .

III. DSN Planetary Test and Training

In order to prepare for Viking lander planetary operations, a DSN program of planetary test and training was begun in October 1975. This test series comprises Mission Configuration Tests (MCTs) and Operational Verification Tests (OVTs) as shown in Fig. 1. Of primary concern is the training of the 64-meter subnet (DSSs 14, 43, and 63) and the conjoint 26-meter subnet (DSSs 11, 61, and 42). Later another series of tests will be conducted in order to check the Network Operations Control Center (NOCC) Block III system, which will be operational in February 1976. These tests will involve the 64-meter and conjoint 26-meter subnets and the Network Operations Control Center. These tests will be conducted primarily for the training of the network operations control team. During April 1976 a short series of OVTs will be conducted with the 64-meter DSSs to check the operation of the new station monitor consoles, validate added enhancement equipment, and maintain DSN operational proficiency in the planetary mode. Upon completion of this final test phase, the DSN will be qualified to support planetary operations. Figure 1 shows the scheduled phases of test activity.

A. Mission Configuration Test and System Performance Test Status

Mission Configuration Tests and System Performance Tests with DSS 14, which were begun in October, required 96 hours of testing to complete on approximately November 1, 1975. The test series at DSSs 43 and 63 was begun in mid-October and requires 233 hours; these are scheduled to be completed by December 1, 1975. The 26-meter subnet (DSSs 11, 42, and 61) requires 16 hours of testing to be concluded by mid-November. All Deep Space Stations will support an additional 20 hours of DSS Monitor and Control MCTs during February 1976.

B. Operational Verification Test Status

Viking planetary testing was begun October 21, 1975 by an Operational Verification Test (OVT) conducted with DSS 14 located at Goldstone, California. The first phase of the planetary testing will comprise eight OVTs with the Goldstone complex—the first four involving only DSS 14 and the remaining four involving DSS 14 and DSS 11, the conjoint 26-meter station. In November a similar testing program will commence with the overseas stations DSSs 63 and 61 in Spain and DSSs 43 and 42 in Australia. Ten OVTs are scheduled for each of the overseas facilities. These will be divided, as was the series with DSSs 14 and 11, so that the first five will be with the 64-meter stations and the remaining five with both the 64-meter and the respective 26-meter conjoint stations. The first half of the tests have the purpose of training 64-meter-station personnel for planetary operations involving the processing of telemetry data from three spacecraft (two orbiters and one lander, six simultaneous data streams); commanding of orbiters and landers individually (no dual commanding is planned at this time); and tracking of the spacecraft, processing doppler and radio metric data of only one spacecraft at any one time. The second half of the tests involves both the 64-meter and the respective 26-meter conjoint stations, and will be primarily concerned with practicing the Viking planetary failure strategies. This will involve rerouting of telemetry data through the 26-meter conjoint station. The practice of these backup configurations is essential, because during full planetary operations all of a 64-meter station's equipment is fully committed, with no backup equipment existing at the facility. Upon completion of this first phase of testing, the DSN will be prepared to support the scheduled Viking flight-team training tests. The two additional phases of OVTs will be discussed in greater detail in future articles.

IV. DSN Support of Additional Viking Testing

Soon after the internal DSN planetary testing begins, the DSN will be required to extend support to other Viking test programs. These include Viking Mission Control and Computing Center (VMCCC) System Integration Tests (SITs) and the Ground Data System (GDS) testing similar to the cruise tests conducted prior to Launch. The schedule for these tests is depicted in Fig. 1.

A. VMCCC System Integration Test

The first SIT is scheduled for November 12, 1975 with DSS 14. Time has also been scheduled for retests, if required, on November 21 and November 28, 1975. Following the system integration testing with DSS 14, these same tests will be conducted with DSS 43 on January 5, 1976 with a retest scheduled for January 13, 1976, and with DSS 63 on January 8, 1976 with a retest scheduled for January 16, 1976. Upon completion of these tests, the DSN and VMCCC will be prepared to support the Viking Project planetary testing effort.

B. Viking Project Ground Data System Tests

The first Viking Ground Data System (GDS) test scheduled for December 6, 1975, will be GDS 5.1, and will be a combined station test involving the 64-meter station, DSS 14, and the 26-meter conjoint station, DSS 11. The next GDS test 5.31 will be conducted with DSSs 14 and 11 and is scheduled for December 16, 1975 with a possible retest on December 29, 1975.

The overseas stations, DSSs 43 and 42 in Australia and DSSs 63 and 61 in Spain, are scheduled to begin GDS testing in January 1976. Ground Data System 5.32 is scheduled first with the Australian stations scheduled for January 21, 1976 with a possible retest on January 29; GDS 5.32 test is scheduled with the Spanish stations on January 24, 1976 with a possible retest on February 1, 1976. The GDS 6.0 combined station test will be conducted following GDS 5.32. Ground Data System 6.0 will have an 18-hour test involving DSSs 14 and 11 at Goldstone and DSSs 43 and 42 in Australia. Ground Data System 6.0 test will conclude the GDS planetary series.

C. Flight Operations Personnel Test and Training

Following the GDS testing, the flight operations personnel test and training exercises will be conducted. These will involve the DSN and are scheduled for late February and March of 1976. Detailed discussions of these will be reserved for future articles in this series.

V. Summary

Now that the Viking mission is in its long cruise phase the DSN has a dual function to perform. First, it is responsible for real-time flight operations of the two Viking spacecraft, and, secondly, it must embark on an extensive planetary test and training program. The testing program described herein is directed toward providing proper and timely support for all areas of the Viking mission. During planetary operations the Viking mission will utilize virtually all of the resources of the DSN; therefore, it is imperative that all functions be tested to insure success.

VI. Conclusions

It is felt that the planetary testing effort as planned will bring the DSN to the same high level of proficiency as was attained by launch and cruise testing effort. The progress of the DSN's endeavors toward this goal will be reported in future articles.

Reference

1. Mudgway, D. J., Bryan, A. I., and Johnston, D. W., "Viking Mission Support," in *The Deep Space Network Progress Report 42-29*, pp. 10–14, Jet Propulsion Laboratory, Pasadena, Calif., Oct. 15, 1975.

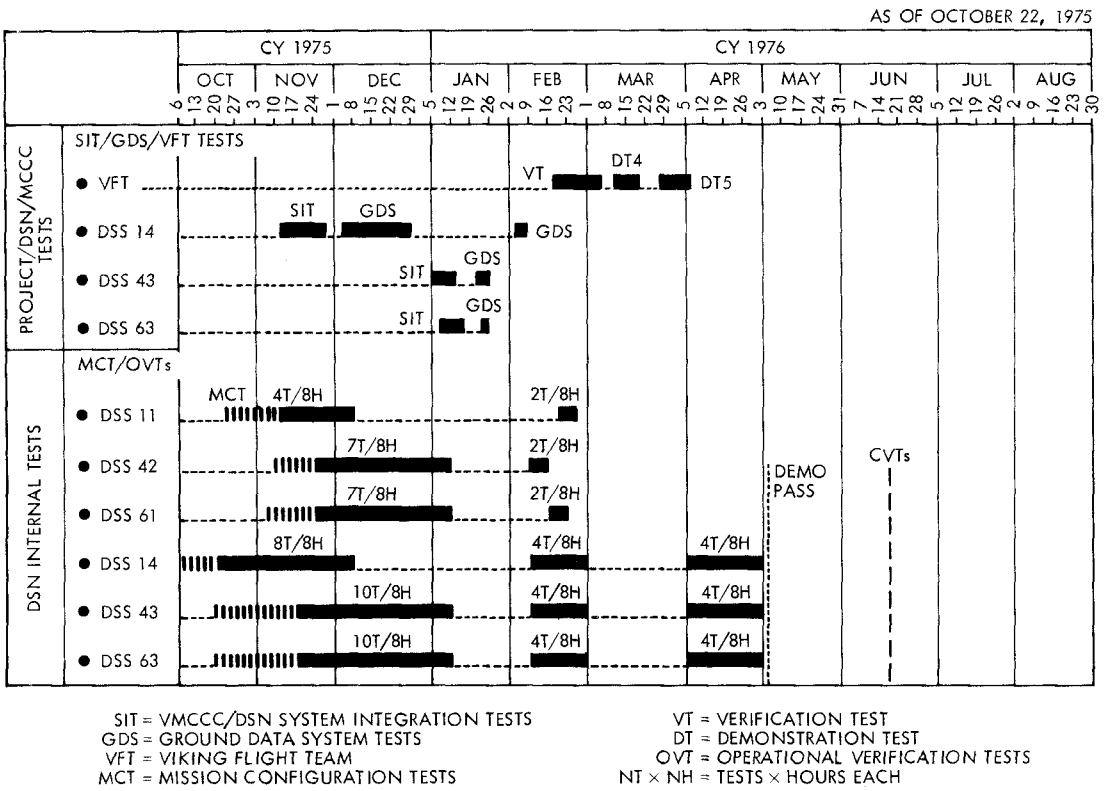

Fig. 1. Viking operations test schedule