Mariner Venus/Mercury 1973 Mission Support

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During May and June 1973 the Deep Space Network concentrated on completion of open hardware and software implementation tasks. Particular attention was given to the Telemetry and Command Data Subsystem software problem reported in the previous article. DSN system testing was initiated and support was provided for Project Ground Data System tests.

I. Planning Activities

A. NASA Support Plan

The NASA Support Plan (NSP) for Mariner Venus/Mercury 1973 (MVM'73) is en route from NASA Headquarters, being returned for update prior to approval. Advanced verbal guidelines regarding the update were provided by NASA Headquarters during a visit to JPL in June 1973. Work on the required revision has been initiated.

B. DSN Operations Plan

The final version of the Network Operations Plan for MVM'73 was distributed to all users for comments and use during DSN test activities. Recommended changes are being incorporated in preparation for signoff in early July 1973.

C. DSN Support Team

The DSN Support Team for MVM'73 continued to meet every two weeks during this period. Primary attention was given to open implementation tasks and initiation of DSN Ground Data System testing using interim capabilities.

D. Mission Design and Sequence Planning Support

The DSN continued support for Project mission sequence design activities in preparation for the Mission Sequence Design Review held on June 27, 1973. The DSN Manager for MVM'73 presented Deep Space Station coverage plans which support the sequence design (Fig. 1). Deep Space Station configurations which represent limitations in tracking and data acquisition capabilities were also discussed (Table 1). The DSN Operations Manager served as a member of the Review Board. Concern was expressed regarding the serious conflicts which would result between MVM'73 and Pioneer 10 should the MVM'73 launch slip to late in the launch period. Deep Space Station configuration freezes for Pioneer 10 would preclude 64-m Deep Space Station coverage of MVM'73 Earth-moon TV calibrations during November 1973. Contingency planning has been initiated.

E. DSN-Spacecraft Compatibility Test Planning

The Ad Hoc committee for planning integrated spacecraft, DSN, and Mission Operations System tests during thermal vacuum testing at JPL in July 1973 held a final meeting at The Boeing Company on June 19, 1973. DSN detailed test procedures were distributed in May 1973 for review. Questions regarding procedures, schedules, and CTA 21 staffing plans were resolved. In view of CTA 21's two-shift staffing level, this will be a difficult support period. Split shifts and overtime are planned to provide 24-hour per day coverage for short periods. Actual test operations must be held close to the plan to avoid problems.

II. Program Control

A. Telemetry/Command Data Subsystem Software Acceptance Review

The subject review was conducted by the DSN on June 22, 1973 following transfer of software program DOI-5050-OP from development to operations on June 15, 1973. Presentations were made by DSN engineering and operations members of the Software Development Project in accordance with the agenda given in Table 2. Additional details are covered under Paragraph III, Implementation Activities.

B. Project Integrated Test and Training Schedule

The DSN has participated with other project elements to produce an integrated test and training schedule reflecting detailed plans for the June–November 1973 period. DSN, Ground Data System, Mission Operations System and Mission Control and Computing System test dates and cross support requirements have been phased to avoid conflicts between MVM'73 activities. This schedule shall serve as the top document for test control and status monitoring throughout the test period.

C. Spacecraft Pre-Shipment Review

The Project conducted the subject review at The Boeing Company June 19-20, 1973. Both spacecraft radios require some additional tests and rework to achieve flight certification and configuration. The 35-W traveling-wave tube (TWT) has not performed to specifications during bench tests; therefore, its inclusion in the radio configuration is questionable at this time. In the absence of major anomalies, the Review Board granted permission to ship the spacecraft.

III. Implementation Activities

A. GCF Status

Ground communication high-speed data implementation for MVM'73 has been completed. This includes high-speed data terminal equipment provided by the NASA Communications Network (NASCOM) for Project Remote Information Centers. Wideband coded multiplexer installation has been delayed approximately 30 days due to contractor manufacturing problems and as a result of work slowdown to meet GCF FY'73 cost ceilings. This slip has not impacted Project/DSN test activities, since existing wideband equipment was modified at CTA 21, DSS 14, and the Central Communications Terminal to provide interim test support. Implementation of the 230-kbits/s wideband circuit between DSS 14 and JPL is on schedule. The common carrier has supplied data sets and preliminary circuit tests are in progress.

B. DSS Status

Telemetry and command software development problems reported in the previous report have been resolved. Major implementation tasks required to achieve capabilities committed to be operational by July 1, 1973 are near completion. However, a number of minor tasks carried on Engineering Change Orders are behind schedule and are causing test/training difficulties at the Deep Space Stations.

1. Telemetry and Command Data Subsystem (TCD). The previous report discussed in detail TCD software development problems and actions taken to resolve this major red-flag item. During this reporting period, tasks were accomplished in accordance with the revised plan and schedule. An interim revision of the TCD software was provided for DSSs 12 and 14 test support by May 1, as planned. An updated interim package (DOI-5050-IN) was shipped to all Deep Space Stations on May 15, 1973. Early Ground Data System Tests were supported using this version; known anomalies did not preclude meeting most test objectives. Final acceptance tests were initiated on June 1, 1973 and completed on June 14, 1973 as scheduled. The development to operations formal transfer agreement was completed on June 15, and TCD program DOI-5050-OP was shipped to all Deep Space Stations. It should be noted that this program still contains certain minor anomalies and undesirable operational characteristics. Attachments to the transfer agreement categorize and assign priorities for these, subject to correction in subsequent updates. TCD original data record tape replay capability is listed as a major deficiency for

MVM'73. Correction of transfer agreement exceptions pertinent to MVM'73 are in progress and will be delivered in an update to DOI-5050-OP by July 27, 1973. However, it is not planned that the July update will have the capability to switch between low-rate engineering and medium-rate science without TCD program reload. The TCD Software Development Project estimates that this capability will not be incorporated until October 1973 due to conflicting Helios and Viking software development activities. The subject data rate switching without reload is required to be available for MVM'73 test/training by August 15, 1973. Development resources and Helios/Viking requirements are being negotiated to permit accomplishment on the required date.

2. Digital Instrumentation Subsystem (DIS). Completion of DIS software acceptance in April 1973 was not accomplished as planned due to delays in the implementation of hardware interfaces with the Tracking Data Handling Subsystem and Deep Space Station monitoring devices. Five separate Engineering Change Orders were involved. The problems encountered indicate a need for better integration and coordination of minor implementation tasks required to complete major system/subsystem development activities. Installation was completed at DSSs 12 and 14 in May 1973, permitting acceptance of the DIS monitor and tracking data handling software and transfer to operations. DIS program DOI-5046-OP was shipped to all DSSs in June 1973. Interface modifications at other DSSs are in progress in preparation for operations with DOI-5046.

3. Tracking Data Handling Subsystem (TDH). TDH hardware modifications are 30 days behind schedule primarily due to slips in contractor delivery of new sample-rate selector drawers. A wiring error caused initial units to be returned for rework. These units have now been provided for DSSs 12, 14, and 62. Delivery to other DSSs will proceed rapidly now that production errors have been corrected. Implementation of Planetary Ranging hardware continues on schedule. However, DSN development of associated software appears to be falling behind schedule. Approval of the Software Requirements and initiation of coding were not accomplished on June 1 as planned. Close attention is being directed to this item.

4. S/X-Band Equipment. Block IV Receiver/Exciter implementation required for DSS 14 S/X-band research and development (R&D) experiment support continues on schedule. Tests of the assemblies have been initiated at JPL. The Block IV Receiver/Exciter will be installed temporarily at CTA 21 in late July 1973 for additional tests and DSN-Spacecraft compatibility tests. Removal of the S/X cone assembly at DSS 14 was approved to facilitate dual uplink carrier intermodulation products tests. After reinstallation of the cone, certain alignment tests must be re-run, but this should not affect the S/X band development task. A plan for installation of the coherent reference generator at DSS 14 during the last week of July 1973 has been developed and coordinated.

IV. Test and Training Activities

The Ad Hoc committee for DSN Mission Operations System Spacecraft compatibility test planning has completed detailed procedures and schedules for conducting tests while the spacecraft is in the thermal-vacuum chamber at JPL. An intensive test period of approximately 150 hours is planned between July 18 and 31, 1973.

In June 1973, GCF/NASCOM engineering conducted training courses for DSN/DSS communication operations personnel. Installation, operation, and maintenance instructions were provided for new wideband data assemblies.

On-site training for DSSs supporting MVM'73 was initiated in May 1973 through viewing of video tapes and review of MVM'73 documentation. Upon receipt of interim and operational software programs, DSS System Performance Tests were initiated at DSSs 12, 14, 42, and 62 in accordance with DSN Standard Test Procedures. These Deep Space Stations have also supported a series of Project Ground Data System long-loop data transmission tests. Due to slips in software delivery, it was necessary to conduct Ground Data System tests in parallel with DSN System Performance tests. The purpose of GDS testing is to verify *technical* performance of the systems rather than *operator* performance. Consequently, limited operator proficiency/experience was expected and acceptable. It is recognized that this approach put the Deep Space Station personnel in a difficult support position. However, most DSN and GDS test objectives were eventually met, and the DSN is approaching a state of readiness to support the GDS Demonstration Test on July 2, 1973 and to initiate DSN Operational Verification Tests.

Table 1. MVM'73 mission sequence design review DSN coverage plans

Configuration considerations	
DSS 12	Two telemetry strings
DSS 62	Two telemetry strings
DSS 42/43	One telemetry string each plus one shared
DSS 61/63	One telemetry string each plus one shared
DSS 14	Two telemetry strings
DSS 14 to DSS 12	Microwave is possible
DSS 43 and DSS 63	No planetary ranging until Jan. 1, 1974
DSS 14	Only station with S/X-band capability
Fast acquisition requirements	

Table 2. TCD software status review (MVM'73) agenda

- Introduction
- Development review
  - System tape concept
  - Plan versus accomplishments
- Verification and acceptance testing
  - Anomaly reporting system
  - Test plans and procedures
  - Test results
- Outstanding anomalies
- Status of transfer to operations
- Future plans

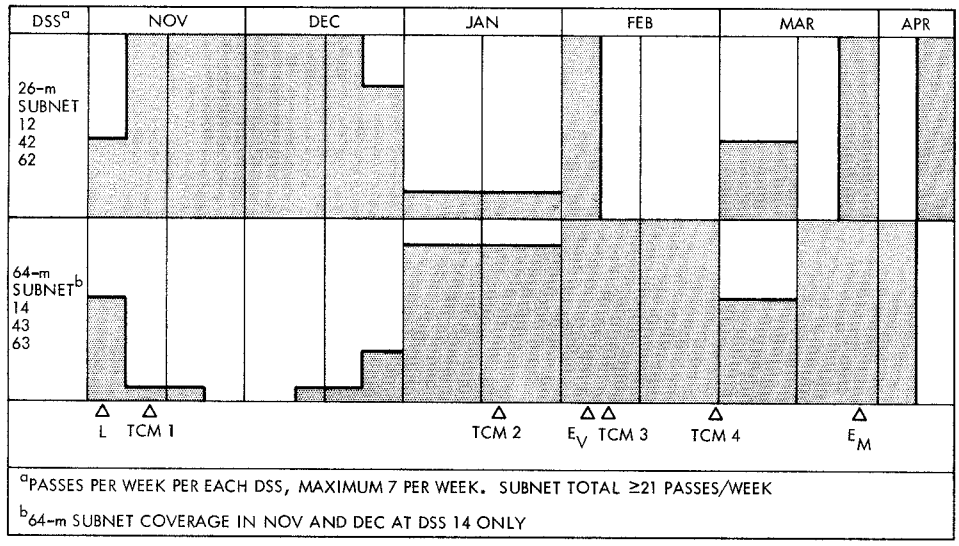

Fig. 1. MVM'73 mission sequence design review DSN coverage plan