

# Mariner Mars 1971 Mission Support

G. P. Textor

DSN Engineering and Operations Office

*On February 12, 1972, Mariner 9 completed its 180th revolution about the planet Mars and its 90th day of scientific data gathering from orbit. This marked the end of the nominal mission, which was to obtain data from orbit for a minimum of 90 days, and marked the beginning of the Extended Mission. This article presents the objectives, constraints, profile, and present DSN coverage plan for the Mariner Mars Extended Mission.*

## I. Extended Mission Objectives

The Extended Mission of *Mariner Mars 1971* differs from past *Mariner* missions in that the spacecraft remains at the planet. Data-taking capabilities equal to the nominal mission remain, plus the solar geometry affords a chance to obtain unique data. Table 1 indicates the Extended Mission objectives and the experiments that will achieve them. Key milestones during the Extended Mission are shown in Table 2.

## II. Constraints

Ground and spacecraft operations must compensate for the constraints caused by increased Earth–Mars distance and unfavorable Sun–Earth–Mars geometry. The constraints primarily impact three spacecraft functional areas: telecommunications, attitude control, and power management.

### A. Telecommunications

During the Extended Mission, *Mariner 9* distance relative to Earth increases from about  $250 \times 10^6$  km at the beginning to  $400 \times 10^6$  km at superior conjunction in Sep-

tember 1972. The corresponding decrease in communication performance severely constrains mission operations. Whereas a data rate of 16.2 kbps was used to return data during the nominal mission, only rates of 8.1 kbps and later 4.05 kbps are available for the Extended Mission. Even to achieve these rates requires the maneuvering of the spacecraft to point the high-gain antenna (HGA) at Earth. The reduced data rates will significantly increase the time required to play back data from the spacecraft recorder.

### B. Attitude Control

Spacecraft maneuvers to point the HGA at Earth along with the control necessary during the additional scan platform slewing will require moderate budgeting of the attitude control gas expenditure. Excessive control gas usage may restrict data-taking toward the end of the Extended Mission period.

### C. Power

The spacecraft is subjected to periods of Sun occultation during April and May of 1972. During occultation the spacecraft must operate on battery power alone. In order to conserve battery power and minimize recharge time, the

spacecraft will be placed in a minimal power consumption state with reduced or no data acquisition during this period.

Power may also constrain the playback time if large maneuvers (about 40-deg cone angle) are required to point the HGA toward Earth. Battery-sharing will result, which will require allocating sufficient battery charging time to replenish battery power.

### III. Profile

The Extended Mission began with no change in operating mode from the nominal mission. The prime objective of the first few weeks was to continue the mapping of the Martian surface. As telecommunications performance degraded, selected features of Mars were re-examined.

Presently the spacecraft is encountering the Sun occultation period, which will continue until June. During this period the celestial mechanics experiment will have a unique opportunity to acquire the best possible data on the Martian gravity field. Also the S-band Earth occultation experiments will begin again as once more Earth occultations occur.

When the spacecraft is reconfigured for full operation following the solar occultation period, data-taking and playback operations will resume. Two data-taking days and two playbacks will occur each week during June and July 1972. Since only the 64-m-diameter antenna at Goldstone, California can acquire the spacecraft signal, ground-controlled operations must occur during the DSS 14 view-period.

During the last part of August through September and the first part of October, the celestial mechanics experiment will have another opportunity to gather valuable data as solar conjunction occurs. Data taking and playback will be reduced to once a week during this period and for the remainder of the Extended Mission.

### IV. DSN Support

Project requirements for DSS 14 coverage and the planned DSN support are shown in Table 3.

While the DSN cannot meet the total requirements for coverage due to previous commitments of a higher priority, the level of support provided will allow *Mariner Mars 1971* to fulfill the Extended Mission objectives.

**Table 1. Extended Mission objectives**

Objective	Experiment
Acquire unique data	Solar conjunction [S-band, Celestial Mechanics Experiment (CME)]
	High latitude coverage [TV, Infrared Interferometer Spectrometer (IRIS), Infrared Radiometer (IRR), Ultraviolet Spectrometer (UVS)]
Acquire long-time base data (>90 days)	Meteorology (TV, IRIS, IRR, UVS) Celestial Mechanics
Acquire data supplemental to 90-day observations	Repeated spot coverage of areas of interest (TV, IRIS, IRR, UVS) Monitor <i>Viking</i> landing sites (TV, IRIS, IRR, UVS) Earth occultation (S-band) Cooling data (IRR)

**Table 2. Mariner Mars 1971 Extended Mission**

Event	Date, 1972
Start Extended Mission	Feb 12
Complete pre-solar occultation science-taking sequences	Mar 27
Start solar occultations	Apr 1
Start orbit edge-on celestial mechanics mass concentration (mascon) period	Apr 22
Start S-band occultations of polar regions	May 6
Complete orbit edge-on period	Jun 1
End solar occultations	Jun 4
Start weekly cycle of high-gain antenna maneuvers with one or two playbacks per week	Jun 5
End Earth occultations	Jun 24
Start solar conjunction period (relativity)	Aug 19
Solar conjunction	Sep 7
Complete solar conjunction period	Oct 18
Complete Extended Mission	Approx Mar 1, 1973

**Table 3. DSS 14 coverage and planned DSN support**

Date, 1972	DSS 14 passes required by <i>Mariner Mars 1971</i>	Present DSN coverage plan
Apr 1	7 passes/week	Average 5½ passes/week <sup>a</sup>
Jun 24	5 passes/week <sup>b</sup>	3 passes/week
Aug 19	7 passes/week	7 passes/week
Oct 18	7 passes/week <sup>b</sup>	3 passes/week
End of mission		

<sup>a</sup>During the *Apollo 16* mission, the average will not be met.

<sup>b</sup>New project requirement; DSN coverage plan reflects original requirement. The plan will be modified when final approval of the Extended Mission is received.