DSN System Testing: A Critical Review of the Pioneer 10 Test Program

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The Pioneer 10 test program was unique since the majority of DSN testing was conducted during the Mariner 9 encounter and orbiting. The importance of both programs to the NASA effort required special emphasis to assure that successful programs can be supported simultaneously. This critique lists the major problems encountered and the solutions used for a successful Pioneer 10 launch, while fully supporting all Mariner Mars 1971 requirements.

I. Introduction

This article covers the DSN test activities from the start of DSN system testing through the launch attempts (three aborts due to adverse weather conditions at Kennedy Space Center), launch, spacecraft ΔV and Conscan activation and the first midcourse correction. The bar chart in Fig. 1 illustrates the test activities during this period. The test span covered 81 calendar days or 55 normal 24-hour working days and 26 days of Sundays and holidays. Of the total available test time (81 24-hour days), 46.5% was used for *Pioneer 10* testing while maintaining the multimission DSN capability of supporting the high-activity *Mariner* Mars 1971 mission with no degradation. The difficulty in the performance of this type of a compressed program is:

(1) The usual pre-test and post-test activities are curtailed due to the requirement to test and train.

(2) New changes in software are implemented prior to adequate pre-test.

(3) Configuration control is difficult to maintain due to the discovery of new problems requiring immediate solutions.

The success of the program may be measured by a successful launch and the ability to track and control the spacecraft within the required accuracy. However, this approach must be analyzed to determine how to perform these tasks better, more efficiently, and during the normal working periods.

Figure 1 does not show the pre- and post-test activities accompanying the testing. There were very limited pre-test meetings and post-test critiques because of the concentration of test and training during the final 81 days.

Quick Look Reports were limited and often not very "quick" due to the continued pressure of testing, test support, training, scheduling, and retesting modified configurations.

II. Test Problems

The major problems encountered during this program were as follows:

(1) The DSN and Project documentation required for preparation of detailed test planning was not available with sufficient lead time.

(2) The final launch support configuration was not available at the start of system testing. Formal configuration control was not implemented until about 30 days before the planned launch. These two conditions led to inconclusive testing until the system was frozen and tightly controlled.

(3) Although early Project and DSN requirements were established, late software programming changes negated much of this planning. These changes included different display requirements and overcomplicated software solutions.

(4) An idealized test program was planned instead of recognizing the lateness of support documentation and the absolute requirement for supporting *Mariner*.

(5) The simulation mathematical model occupied an excessive amount of core storage in the assigned computer causing many unnecessary scheduling problems and computer downtime.

(6) Knowledgeable project personnel were not always available to support on-the-spot decision making. This was further complicated by the physical distance between NASA centers.

III. Plans for Future DSN Multi-mission System Test and Operational Training Support

(1) Systems test and operational training documentation integrating multi-mission requirements is being prepared and will support concurrent programs.

(2) Systems Engineering is preparing and maintaining network test schedules integrating total program requirements. Problems that could arise from overlapping project testing will be reduced due to the improved visibility.

(3) Configuration control of both software and hardware will be implemented prior to systems testing.

(4) DSN Systems Engineering and DSN Operations are documenting the methodology and standard test and training procedures which will eliminate or greatly reduce the test problems encountered with *Pioneer 10*.

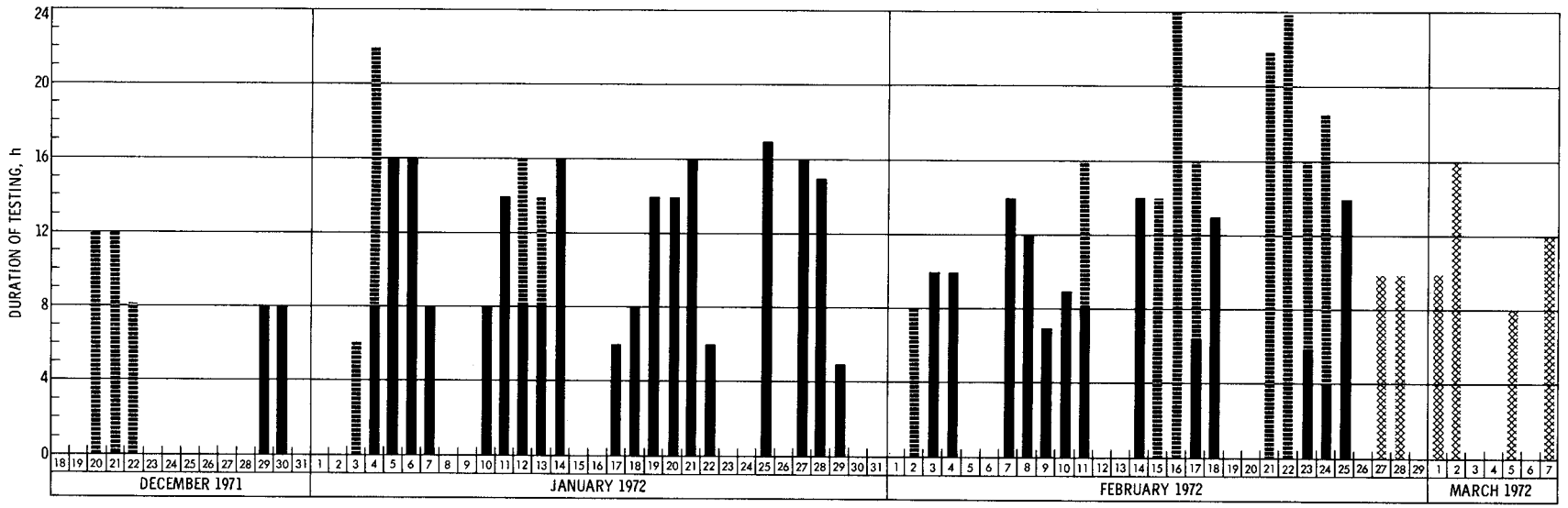

Fig. 1. Pioneer 10 DSN test and test support summary