DSN Research and Technology Support

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The activities of the Development Support Group in operating and maintaining the Venus Station (DSS 13) and the Microwave Test Facility (MTF) are discussed and progress noted. Activities noted include planetary radar experiments, station automation demonstration development, weak radio source observations, 26-m antenna pattern sidelobe measurements, and testing of an adhesive planned to be used for construction of an insulated subreflector for the overseas 64-m antennas. Support for the Block IV receiver/exciter at DSS 14 is noted; a capsule progress report on the 400-kW X-band planetary radar is given; and high-power transmitter maintenance at DSS 14 and testing of DSN klystrons are discussed. Differential very long baseline interferometry (VLBI) transmissions and Pioneer 10 science support are also discussed.

During the two-month period ending February 15, 1974, the Development Support Group, in its operation of the Venus Station (DSS 13) and the Microwave Test Facility, made progress on projects as discussed below.

I. In Support of Section 331

A. Planetary Radar

Continuing with mapping of the planet Venus (as part of the support of the Mariner Venus/Mercury 1973 Project), the Venus Station, in cooperation with the Mars Station (DSS 14) and the National Radio Astronomy Observatory (NRAO) (Greenbank, West Virginia), received signals reflected from the planet Venus. The planet was illuminated with the 400-kW Transmitter at DSS 14 using the 64-m antenna, and simultaneous reception was accomplished by DSS 13 and DSS 14 or DSS 13 and NRAO. Excellent data were obtained and a total of 253 signal runs was received during the 49 hours devoted to this activity.

B. Station Automation (Pulsars)

As part of the overall DSN Station Automation Project (RTOP 68, "Station Monitor and Control"), a demonstration is planned using the Venus Station to perform a pulsar track under remote control from JPL in Pasadena. A new receiver designed to be interfaced with a computer has been installed at DSS 13 for pulsar reception. The necessary computer programs are undergoing testing, so pulsar reception is being accomplished using the new receiver with manual control while awaiting the installation of the necessary computer and completion of the

appropriate programming. Pulsars as tabulated in Table 1 have been received during the 68 hours of development and observation devoted to this project during this period.

II. In Support of Section 333

A. Weak Source Observation

This project, which gathers data on radio sources that might be useful for calibration sources for 64-m antennas, received 75 hours of tracking during this period. The data are collected using the 26-m antenna with right circular polarization selected and the maser/receiver tuned to 2295 MHz. The receiver feeds a semiautomatic data collection system under the control of a computing counter. The overall receiver gain is stabilized by a noise adding radiometer and the data are recorded by a digital printer and analog chart recorder. The radio sources whose fluxes have been measured during this period are listed in Table 2.

B. Radio Star Calibration

As part of a program to measure the gain of the 26-m antenna at DSS 13, longterm calibration on selected radio sources is performed. During this reporting period a total of 44 hours was devoted to the reception at 2278.5 MHz, right circular polarization of the radio sources 3C123 and Cygnus A.

C. 26-m Antenna Sidelobe Measurements

As part of a project to measure the angular distribution and amplitude of the sidelobes on the DSS 13 26-m antenna pattern, before and after covering the quadripod with sheet metal, a computer program was developed to control the pointing of the antenna using the station SDS-930 computer. This program moves the antenna in circles about the sun and the receiver noise output power is recorded as a function of angular position. By changing the radius of the circles traversed, the sidelobe structure of the antenna pattern can be examined as far out as the strength of the signals from the sun will permit. The project has been completed through the prequadripod covering phase, and a total of 127 hours of tracking and computer program testing was carried out during this reporting period.

D. Adhesive Testing

It is planned to construct, for noise abatement purposes, a subreflector for the overseas 64-m antenna, which would have its reflecting surface insulated from the support/back-up structure. In preparation for this construction, samples of the proposed adhesive were tested on the 26-m antenna. With the power densities adjusted to be appropriate to a 64-m antenna operating at 400 kW, tests were made with the samples suspended in free space above the main reflector and then fastened to the subreflector itself. Data were collected during a total test time of 20½ hours.

E. Sky Survey

With an automatic data collection system, the 26-m antenna at Venus is used to record data on radio sources that the rotation of Earth carries through the antenna pattern with the antenna fixed in angle pointing. This data collection is done at night, weekends, and during holiday periods when the station is closed. The 26-m antenna is moved to an azimuth of 180 deg and fixed at various elevation angles from 80 to 90 deg for each data run. Data are collected using the noise adding radiometer to stabilize receiver gain at 2295 MHz with the antenna receiving right circular polarization. A total of 632 hours of data were recorded during this period.

III. In Support of Section 335

A. Block IV Receiver/Exciter

While DSS 14 personnel are being trained to operate and maintain the Block IV receiver/exciter installed at DSS 14 for the support of the Mariner 10 and subsequent spacecraft, personnel from DSS 13 provide emergency and routine maintenance of the system. Additionally, we provide operation of the system during testing, particularly testing that took place in preparation for the encounter of Mariner 10 with Venus on February 5, 1974. During the period, a total of 275.5 manhours of support was provided.

B. X-Band Planetary Radar

As part of the development and construction of a 400-kW X-band planetary radar transmitting system, component testing and dual klystron test setup fabrication continued. After achieving stable 200 kW RF power output for a few hours, two (VA-949J, S/Ns 29, 31) of the three klystrons available failed. All three klystrons have been returned to the manufacturer (Varian Associates) for analysis. Narrowband testing of the repaired waveguide directional couplers, as well as the 150-kW waterloads, was accomplished. The dual klystron test setup was approximately 73% completed at the end of the reporting period.

A traveling wave resonator has been assembled at the Microwave Test Facility to be energized by the X-band klystron used for transmission of clock synchronization

signals during the development phase. Initial energization at input power levels up to 10 kW at approximately 8500 MHz will take place during the latter days of February 1974.

C. DSS 43 and DSS 63 100-kW Transmitter Testing

In preparation for commencement of testing of the first transmitter system, the 1-MW dc water-cooled load was cleaned up, the insulating oil purified and the load moved into position north of Building G-53A. A protective enclosure 3.66×4.88 m was procured for enclosing the transformer rectifier, crowbar cabinet, filter choke, and vault junction box while undergoing testing. These items, with the enclosure around them, will be situated on a concrete pad north of G-53A. The transmitter cabinet to be tested has been positioned inside of G-53A, on the western-most cone hoist, and testing is scheduled to commence on February 18, 1974 with the arrival of the control cabinet.

IV. In Support of Section 391

In cooperation with DSS 42, differential VLBI observations were made of radio sources OP-192 and OQ-151 paired with one of the Apollo Lunar Surface Experiments Packages (ALSEPs) left on the Moon by the Apollo project. Good data were received for a total of 5½ hours while switching between sources every two minutes.

V. In Support of Section 422

A. Clock Synchronization Transmissions

Only one transmission, to DSS 51, was made during this period.

B. DSS 14 High-Power Transmitter Maintenance

A problem was encountered with the filament voltage on the 100-kW transmitter at DSS 14. The system was restored to operation by repair of instrumentation printed circuit boards. During this repair ECO 73-056 was also installed to provide correct indications of filament voltage and current applied to the 100-kW klystron.

C. DSN Klystron Testing

DSS 12 experienced difficulty with their 10-kW transmitter and delivered a klystron to the MTF for checkout. This klystron proved to be gassy and other klystrons were delivered for testing to discover one suitable for use as a replacement at DSS 12. A total of four klystrons, 4KM50SI, S/Ns H4-71, J4-45, K4-25, and F7-28 were tested to find a good replacement and one additional spare klystron.

In appreciation of the importance of the 100-kW transmitter at DSS 14, a spare 100-kW klystron, X-3060, S/N K5-24, was fully tested and prepared for use as a spare.

Subsequent to the Mariner 10 encounter with Mercury, the 100-kW transmitter at DSS 14 will be converted back to a 400-kW transmitter. In anticipation of that changeover, a repaired klystron, X-3075, S/N H101-R1, received from Varian Associates, has been installed into the DSS 13 High-Power Maintenance Facility for acceptance testing.

VI. In Support of Section 825

With the encounter with Jupiter now past, support to this project has decreased. The radiation from Jupiter at 2295 MHz, right circular polarization, was monitored for 22 hours, while radio star calibrators, as enumerated in Table 3, were observed for 46 hours.

Table 1. Pulsars selected for test reception at DSS 13

0031 − 07	1604 − 00	1929 + 10
0329 + 54	1642 − 03	1933 + 16
0355 + 54	1706 − 16	2021 + 51
0525 + 21	1749 − 28	2045 − 16
0628 − 28	1818 − 04	2111 + 46
0823 + 26	1911 − 04	2218 + 47

Table 2. Weak radio sources observed at Venus Station

3C48	3C147	3C348	Virgo A
3C123	3C286	NGC 7027	
3C138	3C309.1	PKS 0237-23	

Table 3. Radio star calibrators used for Pioneer 10 science support

3C48	3C353
3C123	NGC 891
3C286	NGC 4736
3C309.1	Virgo A
3C348	