DSN Research and Technology Support

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The activities at the Goldstone Venus Station (DSS 13) and the Microwave Test Facility (MTF), during the period Dec. 8, 1975 through Feb. 15, 1976, are discussed and progress noted. Continuing testing and refinement of the remote controlled automated pulsar observing station is noted, along with routine pulsar observations of 22 pulsars. Automatic stability-reliability testing of the station receiver/maser noise-adding radiometer (NAR) combination is described. An updated discussion of the data being collected by the 24-hour-per-day, seven-day-per-week Solar and Microwave Data Acquisition System (SAMDAS) is presented in which currently available data types are tabulated.

Supporting research activities in support of the X-band radar and stability tests on semirigid coaxial cables are discussed along with preparations for testing of a new design diplexer for future DSN use. The activities of the DSN High-Power Transmitter Maintenance Facility are discussed, and continuing observations of Jupiter at 2295 MHz are reported along with the radio calibration sources used in this program. Routine clock synchronization transmissions are noted along with some engineering measurements and changes directed toward energy conservation.

During the period Dec. 8, 1975 through Feb. 15, 1976, the Development Support Group, in operating the Venus Station (DSS 13) and the Microwave Test Facility (MTF), supported various programs as discussed below.

I. Station Automation

In support of RTOP 70 "Network Monitor, Control & Operations Technology," demonstration of a remotely operated automated station is planned using DSS 13 as the test station. A successful demonstration has been conducted (*DSN Progress Report 42-30*, pp. 214–221), and refinement of software and equipment reliability testing is continuing.

Including automated tracking, 38.5 hours of station support have been provided. The automated tracking has been directed from the on-site computer rather than the JPL-located computer. An unsuccessful remote-controlled test was terminated after computer communications problems.

II. Pulsar Observations

In support of the radio science experiment "Pulsar Rotation Constancy," DSS 13 provided 61.25 hours of observations during which the emissions from the pulsars listed in Table 1 were recorded. These data, recorded at 2388 MHz, left circular polarization (LCP), are used to determine precise pulse-to-pulse spacing, pulse shape, and pulse power content of the signals emitted by these pulsars.

III. Maser/Receiver/NAR Reliability-Stability Testing

Reliability and stability testing of the DSS 13 receiving system is conducted automatically during nonoperational station periods. The 26-m antenna is prepositioned to a fixed azimuth and elevation, and the noise adding radiometer (NAR) automatically records total receive system temperature as a function of time. The rotation of Earth sweeps the fixed antenna beam across the sky, resulting in generation of a radio brightness temperature sky map in addition to collecting data on stability and reliability of the system. During this reporting period, 659.5 hours of such data were automatically collected with the 26-m antenna at 360 deg Az and progressively positioned from 52.6 to 51.5 deg El. This testing is done at 2295 MHz, using right circular polarization (RCP) on the 26-m antenna.

IV. Solar & Microwave Data Acquisition System (SAMDAS)

Continuous operation of the data collection system continued. Tape changes and emergency corrective maintenance were provided by the Development Support Group. At the end of the reporting period, substantial maintenance had been performed by the Communication Elements Research Section, and the system was again functioning and collecting data shown in Table 2.

V. Microwave Power Transmission

The Venus Station provided eight hours of testing at various output powers up to 250 kW, during which tests were performed on reflected power vs subreflector position with the antenna at zenith, and various measurements were made while illuminating the rectenna arrays. The system was also operated and exercised in support of a NASA-directed film crew.

Near the end of this period the first shipment of magnetrons arrived for the investigation into the feasibility of obtaining inexpensive phased array power by using commercially available oven magnetrons in a phase-locked mode. The large power supplies with which to conduct this investigation have arrived and are being put into operation.

At the end of the reporting period, a total of 500 kWh of energy has been transmitted from the 26-m antenna and converted to direct current by the rectenna array.

VI. X-Band Radar

Although plagued with various problems, operation with two klystrons continued, with available power gradually being increased until, at the end of the period, 300 kW was available with good reliability.

A spare VA-949J klystron, S/N 33R1, was received, partially tested and returned to Varian upon request because of possible improper focusing. Klystron S/N 31R4 was received, and vacuum and filaments were tested after being assembled into a magnet and support.

Among the problems encountered were multiple failures of the Logimetrics traveling wave tube (TWT) power supplies and improper operation of the master combiner control panel. The Varian TWT was replaced with the ITT TWT, and the system was operational at the end of the reporting period.

VII. Block IV Receiver-Exciter Stability

Preparatory to making an extensive investigation into the phase stability of the Block IV receiver-exciter, preliminary measurements were made on the phase stability vs temperature of semirigid cables at DSS 13. Measurements were made at 2388 MHz on a coaxial cable loop 610 m in length. Techniques and results are described elsewhere in this issue (article by Buchanan and Price).

VIII. DSN High-Power Transmitter Maintenance Facility

The DSN High-Power Transmitter Maintenance Facility (HPTMF), located at DSS 13 and the MTF, continued to support the 10-, 20-, 100- and 400-kW transmitters used in the DSN, with particular emphasis on the 100- and 400-kW transmitters and the 20-kW transmitter klystrons. Klystron 5KM70SG, S/N H1-32, was tested for its ability to develop 20-kW output RF power. Additionally, bandpass curves were obtained and confirmation of the manufacturer's test data was obtained.

Klystron X-3060, 100 kW, S/N A617R2, which had been returned from Spain, DSS 63, was assembled and tested, and discovered to have excessive body current. However, klystron S/N J524R2 was assembled, tested, found to be fully operational, and successfully completed a 12-hour test at 100-kW RF output power.

Two complete dual ignitron decks (one spare) were assembled for installation into the Goldstone Mars Station, DSS 14, and tested at operational voltages in the HPTMF. Development of a complete Engineering Change Order (ECO) kit is underway. Additionally, a kit is being developed to expedite replacement of a 400-kW klystron with a 100-kW klystron if the DSN 400-kW transmitter at DSS 14 should suffer a klystron failure.

IX. Diplexer Testing

The RF Systems Development Section has a new design diplexer which should be less prone to generation of noise in DSN use. In preparation for testing of this diplexer at 100 kW, the diplexer has been assembled into the S-band megawatt transmit (SMT) feedcone which was removed from the DSS 14 64-m antenna. This feedcone has been installed into the cone testing area of Building G-53 at DSS 13. A Block II DSN maser has been connected and cooled and the waveguide has been connected with which to provide 100 kW of RF at 2115 MHz. Testing is expected to commence during the week ending Feb. 22, 1976.

X. Planetary Radio Astronomy

In support of the radio science experiment "Planetary Radio Astronomy," the Venus Station measures and records radiation received at 2295 MHz from the planet Jupiter and various radio calibration sources. These measurements use the 26-m antenna, the maser/receiving system, and the NAR. During this period 73.25 hours of observations were provided during which the radiation from Jupiter and the calibration sources tabulated in Table 3 were measured.

XI. Clock Synchronization System

Although failure of a transmitter phase modulator forced postponement of a scheduled transmission to Spain, DSS 63, operation was otherwise uneventful, with nine transmissions being made as scheduled by DSN scheduling, five to Australia, DSS 43, and four to DSS 63.

Insulated cover panels were installed on the antenna-mounted heat exchanger to minimize conduction heat losses and reduce power required to prevent distilled water freezing. A 15-channel temperature recorder was installed and temperatures were monitored throughout the system. With these data, including ambient temperature, heat loss rates, heat flows, etc., can be calculated and a different operational mode can be devised for the winterization control system. Although temperatures have not been extreme, it is interesting to note that, subsequent to installation of the insulating panels, the system electrical heaters have not been necessary. The energy input to the water from the circulating pump alone has been adequate to keep the water temperature above the heater thermostat setting.

Table 1. Pulsars observed at DSS 13, Dec. 8, 1975, through Feb. 15, 1976

0031 − 07	0823 + 26	1706 − 16	2021 + 51
0329 + 54	0833 − 45	1749 − 28	2045 − 16
0355 + 54	1133 + 16	1818 − 04	2111 + 46
0525 + 21	1237 + 25	1911 − 04	2218 + 47
0628 − 28	1604 − 00	1929 + 10	
0736 − 40	1642 − 03	1933 + 16	

Table 2. Data being acquired by SAMDAS as of 15 Feb. 1976

Environmental	Solar	Microwave
Air temperature	Tracking pyroheliometer (2)	X-band radiometer (8 GHz)
Soil temperature	Pyranometer (3)	Antenna temperature
Humidity		Azimuth
Pressure		Elevation
Rainfall		
Wind		
Speed, 30-m (100-ft) tower		
Direction, 30-m (100-ft) tower		
Peak, 30-m (100-ft) tower		
Mean-110 sec, 30-m (100-ft) tower		
Instantaneous, atop G-51		

Table 3. Radio calibrations sources observed at DSS 13, Dec. 8, 1975, through Feb. 15, 1976

3C17	3C286	NRAO 530
3C48	3C309.1	PKS 2134
3C123	3C345	Virgo A
3C273	3C348	VRO 4222
3C274	3C353	
3C279	3C454.3	