DSN Research and Technology Support

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The major current activities of the Development Support Group, at both the Venus Deep Space Station and the Microwave Test Facility, are presented and accomplishments and progress for each are described. Activities include pulsar observations, planetary radar (including a general relativity experiment), 100-kW clock synchronization implementation, SDS 930 computer installation into the Mars Deep Space Station, precision antenna gain measurements, very long baseline interferometry, electromagnetic field survey at the Pioneer Deep Space Station, and new phase-lock receiver installation at the Microwave Test Facility.

The Development Support Group, Section 335, is currently engaged in the following activities at DSS 13 and the Microwave Test Facility (MTF) at GDSCC:

I. DSS 13 Activities

A. In Support of Section 331

*1. **Pulsars.*** The twenty pulsars tabulated in Ref. 1 continue to be regularly observed and data on pulse-to-pulse spacing, power density spectra, and pulse arrival time continue to be collected.

*2. **Planetary radar.*** The program continues with the planet Mars being nominally ranged thrice weekly, with an rms range resolution of a few microseconds, and ranging of the planet Venus also. Ranging of the planet Venus is being done in order to obtain data during the period when the signals to and from Venus must pass close by the sun, and thus may be used to further development of the technology of propagation and communications/tracking of signals through the sun's atmosphere. These ranging measurements are being made every third day as schedule time on the 64-m antenna at DSS 14 permits.

*3. **SDS 930 Installation at DSS 14.*** The SDS 930 computer which was installed in the engineering building at the Echo Station was relocated into the alidade control room (the old DSN control room) at the 64-m antenna of DSS 14. Development Support Group personnel effected the relocation, installation, and maintenance required to restore the computer, three magnetic tape units, paper tape reader and punch, and input/output typewriter to service.

B. In Support of Section 332

*1. **100-kW Clock synchronization coolant system.*** The 450-kW heat exchanger and coolant water circulating system were tested for periods of time up to 8 h with power levels reaching 490 kW. The 490-kW test was limited to 4 h due to overload considerations on the DSS 13 electrical power substation. Support was also given to fabrication and installation onto the 9-m antenna of the entire system along with its piping and heat ex-

changers after which full-load testing was again performed. As a result of the first series of tests, the heat exchanger thickness was doubled, and the fan drive motors were increased from 2.24 to 7.46 kW (3 to 10 horsepower) in order to provide lower exit water temperatures as required in the design specifications.

2. Subreflector temperature measurements. In a continuing investigation of the burning of a laminated subreflector on the 26-m antenna last year, the existing subreflector has been stripped of paint and liberally instrumented with thermocouples. After measurements of the subreflector temperature in the unpainted condition while observing the sun, while being radiated with 400-kW RF, and both together, the subreflector was painted in the manner required by JPL Standard 1006D and the temperature measurements were repeated. The data are now in the hands of Section 332 for analysis.

C. In Support of Section 333

1. Precision antenna gain measurement. Data collection by Section 333 personnel with which a precision antenna gain measurement can be made continue, using the Sample and Average (SAVAGE) program. This experiment utilizes the *Apollo* lunar surface experiments package (ALSEP) left on the Moon by *Apollo 12* and the Radio Star Cygnus A as sources of signals for calibration purposes. Data collection was turned over to Development Support Group personnel on August 15, 1971.

2. Weak source observation. Data collection utilizing the noise adding radiometer (NAR) technique continue. Radio sources regularly observed (weekly) by Section 333 personnel include 3C218, 3C270, 3C348, 3C353, Cassiopeia A, the planet Jupiter and the Sun.

D. In Support of Section 335

1. 100-kW Clock synchronization transmitting system. Installation of the coolant circulating system and heat exchangers has been completed, the Cassegrain feed cone has been installed, the high-voltage power supply has been completed and tested, the klystron installed into its mount and tested in conjunction with its control cabinet, and the buffer amplifier has been completed and tested. After complete testing, installation onto the antenna is scheduled to start September 5, 1971.

2. Block IV receiver installation. In preparation for the arrival of the Block IV receiver, twelve semiflexible and one multiconductor cables have been installed between the Operations Building and the 26-m antenna electronics room.

3. Very long baseline interferometry. In cooperation with the National Radio Astronomy Observatory, 37 h were devoted to observation of various radio stars. A total of 144 observations were made, with a new observation being made every 15 min.

II. Microwave Test Facility

A. In Support of Section 335

1. 100-kW Clock synchronization transmitter. The buffer amplifier for the 100-kW clock synchronization transmitter has been completed and tested.

2. Phase-lock receiver installation. A complete phase-lock receiver has been acquired from Section 337 and installed at the MTF. This allows testing and measurements which will be compatible with receivers now installed in the DSIF stations.

3. Electromagnetic field survey at DSS 11. The National Bureau of Standards has developed an electromagnetic field probe using three mutually orthogonal antennas which are electrically short at S-band. Using this probe, a detailed survey of the electromagnetic field strength at DSS 11, using the 20-kW transmitter, has been made and compared with readings made simultaneously using a standard gain horn and power meter detector. The new probe has better response to small diameter "hot spots" while the horn antenna responds properly only to pure plane waves.

Reference

1. Jackson, E. B., "DSN Research and Technology Support," in *The Deep Space Network Progress Report,*" Technical Report 32-1526, Vol. III, p. 158. Jet Propulsion Laboratory, Pasadena, Calif., June 15, 1971.