COMMONWEALTH OF AUSTRALIA

U.S. NATIONAL AERONAUTICS
AND SPACE ADMINISTRATION

DEPARTMENT OF
SUPPLY

ISLAND LAGOON TRACKING STATION
SOUTH AUSTRALIA

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1. INTRODUCTION

In February, 1960, the Governments of Australia and the United States of America formally agreed to co-operate in space flight programs being conducted by the U.S.

Australia undertook to establish and operate a number of tracking stations which would form part of a world-wide network under the control of the U.S. National Aeronautics and Space Administration (NASA).

The Department of Supply is responsible for fulfilling the Australian commitment under this agreement.

The construction and operation of these tracking facilities in Australia is financed by NASA.

Design, construction, management and operation are provided from Australian resources, either directly by the Commonwealth Government or by contract to private industry.

Major stations already established are:

. Island Lagoon (S.A.), for deep space probes and optical tracking of scientific satellites.

. Carnarvon (W.A.), manned space flights and scientific satellites.

. Tidbinbilla (A.C.T.), deep space probes and manned space flights.

. Orroral Valley (A.C.T.), scientific and applications satellites.

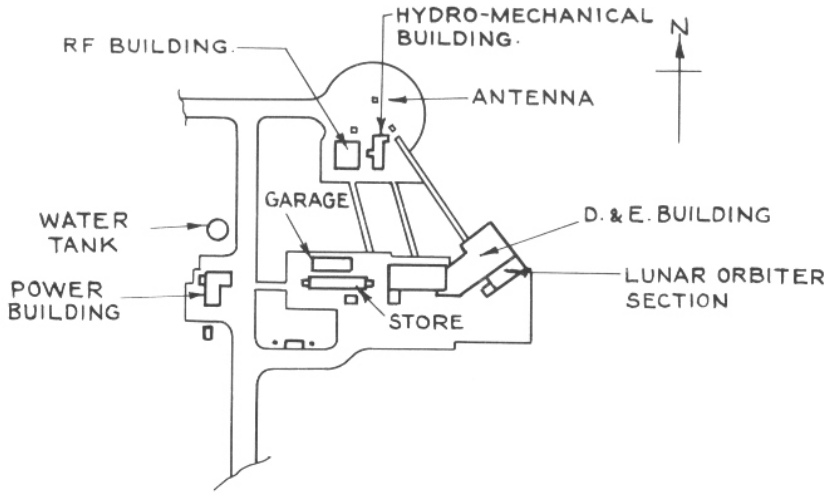
. Cooby Creek (Q'ld), applications technology satellites.

. Honeysuckle Creek (A.C.T.), manned space flights.

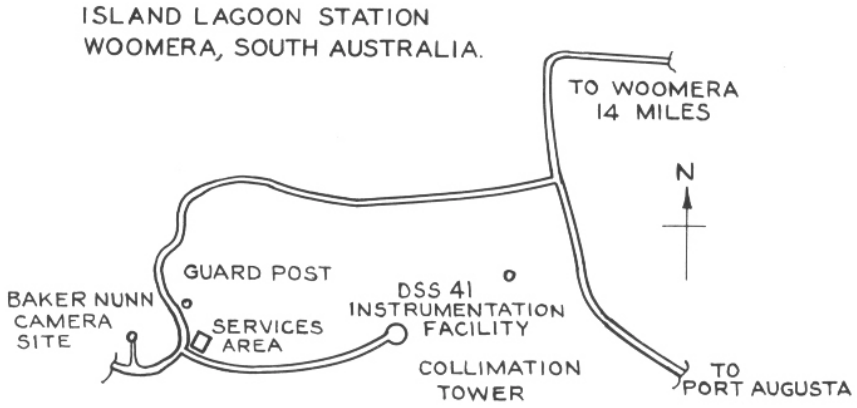
Outside the U.S., Australia has the largest number of space tracking and communications stations in the world. NASA's capital investment in Australia is about $64m; $52m. for equipment and $12m. for buildings, communication networks and roads.

The cost of operating the six Australian stations is currently about $13.5m. a year.

Together, they employ more than 700 Australian scientists, engineers, technicians and supporting staff.



DSS. 41 INSTRUMENTATION FACILITY.



STATION LAYOUT

2. STATION LOCATION

The Island Lagoon Tracking Station, 14 miles south of Woomera, comprises the Deep Space Station DSS 41, which is part of the NASA Deep Space Network (DSN) managed by the Jet Propulsion Laboratory (JPL), Pasadena, California, and the Baker-Nunn camera which is part of the Satellite Tracking Network managed by the Smithsonian Observatory, Cambridge, Massachusetts.

Administrative, library, transport, logistics and catering facilities, and a power station with a 1,000-kW generating capability, are on site for both units.

DSS 41 is located in a natural depression which shields it from man-made radio-frequency interference and provides the noise-free radio environment necessary for the reception of extremely weak signals from spacecraft at great range.

Construction of the station began early in 1960, the electronic equipment being mounted in trailers. Since then, permanent buildings have been provided and the station has passed through continual changes of equipment and building development to meet the needs of a variety of missions.

The estimated cost of establishing and modifying the station is $2m., plus about $5m. for technical equipment supplied by JPL.

Housing for staff and major support for the technical operation of the station are available in Woomera from facilities established by the Weapons Research Establishment (WRE) of the Department of Supply.

3. THE BAKER-NUNN CAMERA

The Baker-Nunn camera was designed for the International Geophysical Year in 1957. Basically a Schmidt camera on a triaxial mounting, it has a focal length of 20 in, a mirror diameter of 32 in and an aperture of f1.

Stars of the 15th magnitude are observable, and the camera is probably the most accurate optical system apart from an astronomical observatory. It has a field of view of 30 deg. along, by 5 deg. perpendicular to the track axis.

An electronic timing device can give the time with an accuracy of 1/10,000th second on each negative exposed.

The camera is used to photograph orbiting satellites which, for various reasons, have ceased to transmit radio signals, and/or satellites for which angular information is required to a higher accuracy than is obtainable from electronic tracking systems.

Obviously this is only possible when the satellites are high enough to be illuminated by the sun, although the ground below is in shadow (night). Some satellites have their own internal illumination.

Since it began operating in 1958, the Island Lagoon Baker-Nunn camera has photographed more than 45,000 satellite passes.

The camera also supports various research and development programs. It provides simultaneous observations of flare stars in conjunction with the CSIRO's 210-ft. radio telescope at Parkes (NSW); supports the Smithsonian Astrophysical Observatory comet investigation program; and provides specialist photographic coverage for upper-atmosphere research vehicles launched from the Woomera range.

4. THE DEEP SPACE STATION DSS 41

The 85-ft.-diameter, 200-ton antenna — the station's predominant feature — is at the northern end of the station area where it has an unobstructed view of the sky.

The antenna can rotate about two axes. The lower one, the hour-angle axis, is aligned with the earth's axis; the upper one, the declination axis, is perpendicular to the hour-angle axis.

Thus, the antenna can be driven about these axes to provide hemispherical coverage. Two drive speeds are available, the maximum providing an angular rate of one degree a second.

The antenna reflector, commonly known as "the dish", has to be maintained accurately paraboloidal to within $\pm$ 1/8 in.

In the interests of efficiency, the antenna structure itself houses the low-noise amplifiers and the transmitter. This equipment is housed in a cone attached to the centre of the reflector and in rooms under it.

Near the antenna is a support building which provides services for the antenna and equipment mounted on it.

The hydraulic pumps, which power the hydraulic servo-motors mounted on the antenna structure, and the high-voltage power supplies for the transmitters are housed in the antenna support building.

The operations building, south of the antenna, houses the operations room where the technical equipment, laboratories and station offices are located.

The building is connected to the antenna by an underground cable duct which carries the signal cables from the control room to equipment mounted at and on the antenna structure.

Extremely sensitive receivers detect the down-link signal from the spacecraft and pass it to the data-handling and decoding equipment.

This information is displayed, recorded and/or sent directly via high-speed data links and teletype circuits to the control centre in the U.S.

Conversely, up-link signals to the spacecraft are encoded by the equipment in the control room and passed to the high-power transmitter at the antenna for transmission to the spacecraft.

5. FUNCTION AND PROJECTS

The station is involved in NASA's deep space probes which extend beyond 10,000 miles from the earth, ranging from lunar exploration to investigations of the environmental conditions of the nearest planets, such as Mars and Venus, and of the sun itself.

In between NASA missions, the station is available for Australian scientific purposes. For example, it has been used - in association with NASA stations in the U.S. - to pioneer observations on certain quasars.

This followed evidence suggesting that quasars may be energetic objects in the furthermost reaches of the universe, so incredibly powerful that they may be seen through a telescope.

New equipment and techniques are constantly being developed to enable these distant fields to be investigated.

The major projects in which the station has participated are:-

Ranger I-IX: This program (August 1961 to March 1965) involved the hard landing of a capsule on the moon and the transmission of narrow and wide-angle television pictures of the lunar surface before impact of the main spacecraft.

Extremely good pictures were received of the lunar surface, and these were used to determine possible landing sites for the Surveyor and Apollo spacecraft.

Mariner II: This spacecraft was tracked between August 1962 and January 1963. In this period it flew past Venus, providing the first reliable information on the clouds obscuring the planet's surface and extensive data on the interplanetary environment.

Mariner IV: This deep-space probe flew by Mars (July, 1965) at a distance of about 6,000 miles and recorded 20 TV pictures of the Martian surface for the first time. Soon after the probe passed Mars, the pictures were transmitted to the DSN stations.

Mariner IV took eight months on the Martian journey and travelled about 325 million miles in that time. At the time of fly-by, Mars was about 140 million miles from the earth.

Mariner IV will remain in solar orbit almost indefinitely and will periodically come within range of the 85-ft.-antenna stations. It was reactivated for the first time in October, 1967, and sent TV pictures to Island Lagoon and other DSN stations.

Mariner V: Launched in June, 1967, this 540-lb spacecraft travelled 212 million miles in four months to pass Venus within 2,500 miles.

The capsule's task was to obtain information on the origin and nature of Venus and its environment, including data on atmosphere density, temperature and magnetic fields.

Mariner V subsequently was to continue in an orbit to within 54 million miles of the sun - the closest to the sun of any U.S. spacecraft.

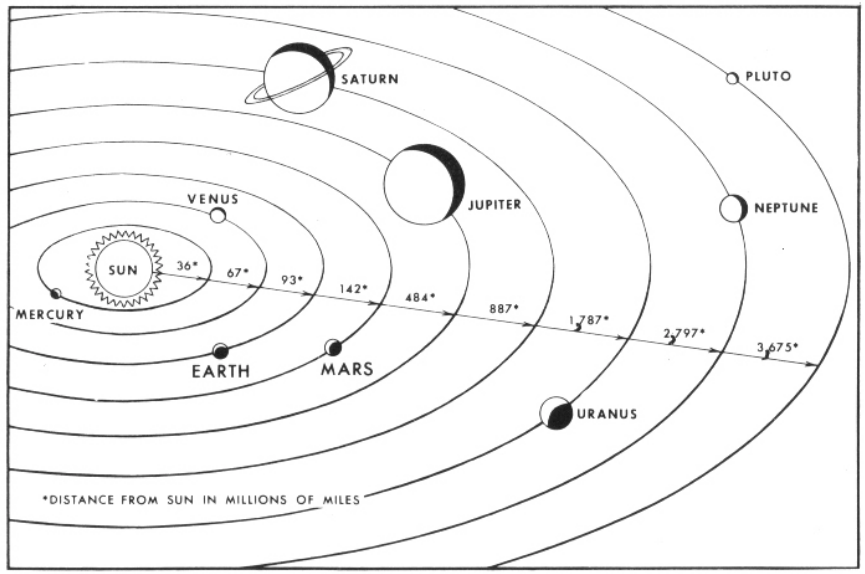
Pioneer: These spacecraft are in a solar orbit to investigate - among other things - solar flares and solar winds. This knowledge is vital to manned space flights because of the possible hazards to man from these phenomena.

The DSN stations are involved in long-term tracking of, and communications with, Pioneer missions.

Lunar Orbiter I-V: These successful missions (August 1966 - October 1967) supported the Apollo lunar landing program by obtaining photographs of the lunar surface to enable the selection of future landing sites.

The spacecraft - flying photographic laboratories - were placed in a pre-determined orbit around the moon. They were equipped with control systems to adjust the height above the surface, compensate the photographs for spacecraft movement, and transmit to earth the processed photographs.

Precision tracking of the spacecraft provided data on the shape and gravitational field of the moon; instruments on the vehicle provided data on meteoroids and radiation near the moon.



SOLAR SYSTEM

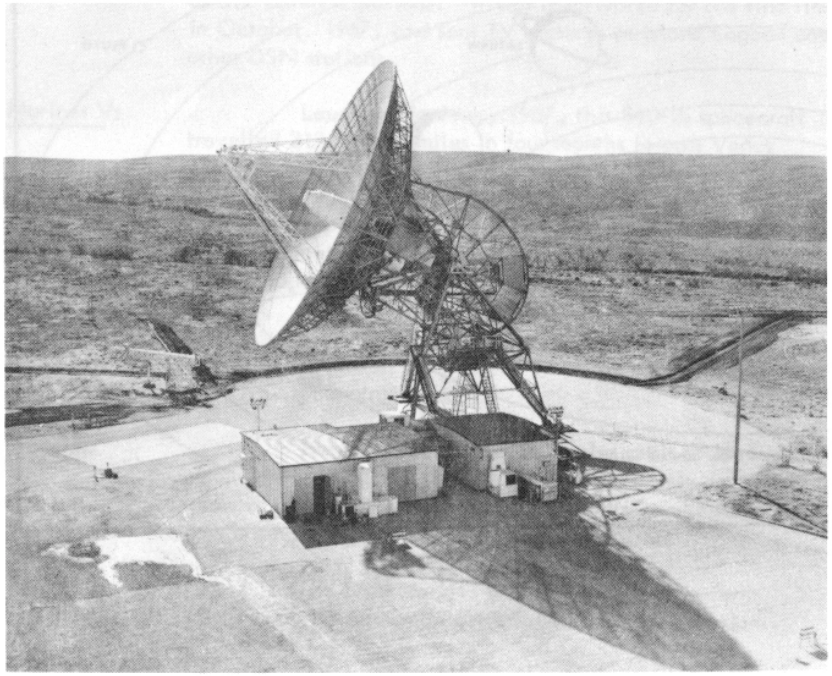
6. STAFFING

At Island Lagoon the managerial and operational responsibility is vested in a station director who is a senior officer of the Weapons Research Establishment of the Department of Supply.

The Australian Government policy of using the resources of private industry in this sphere of activity has been extended to DSS 41 by letting a contract to SpaceTrack Pty. Ltd. (a wholly owned subsidiary of Hawker de Havilland (Australia) Pty. Ltd.) for the provision of operating staff.

All other station activities are undertaken by Department of Supply staff.

About 140 professional, technical and administrative people are engaged on this task.



ISLAND LAGOON'S "BIG - DISH"