

**Negotiating a Worldwide Space Communications Network:
NASA's Discussions with the Australian and South African Governments for the
Establishment of Overseas Deep Space Instrumentation Facilities, 1958-1960**

Paper presented at the
"Technologies, Technologists, and Networks:
A Symposium on the History of Communications Technologies"
organized by the Mercurians special interest group of SHOT
at the Smithsonian National Postal Museum,
Wednesday, 17 October 2007

Craig B. Waff, Ph.D.
Historian
Air Force Research Laboratory History Office (AFRL/HO)
2130 Eighth St.
Bldg 45, Room 040B
Wright-Patterson AFB, OH 45433-7003
937-255-5095 (work phone)
craig.waff@wpafb.af.mil (work e-mail)
937-904-5079 (work fax)

2340 Mallard Lane – Apt. 4
Beavercreek, OH 45431-3624
937-431-1919 (home phone)
cbwaff@sbcglobal.net (home e-mail)

410-858-0945 (cell phone)

The U.S. government's first publicly stated commitment to launch spacecraft that would escape from the Earth's gravity and scientifically explore interplanetary space and the other bodies in the solar system was made on March 27, 1958, nearly six months after the Soviet Union had launched *Sputnik 1*, the world's first Earth-orbiting satellite. On that day, Secretary of Defense Neil McElroy announced that his department's newly formed Advanced Research Project Agency (ARPA) would proceed with several programs for launching a number of small unmanned spacecraft. The programs that he authorized, with the prior approval of President Dwight D. Eisenhower, included not only scientific Earth-orbiting satellites, but also "efforts to determine our capability of exploring space in the vicinity of the moon, to obtain useful data concerning the moon, and provide a close look at the moon."¹ These five initial authorized lunar-probe attempts, which would shortly receive the *Pioneer* name designation, were originally slated to be launched by the U.S. military—the first three by the Air Force and the other two by the Army. They were, however, mostly launched (1958-1959) under the auspices of the new civilian space agency, the National Aeronautics and Space Administration (NASA), established later in 1958, and they initiated a long series of space-probe missions that NASA has conducted in the subsequent nearly half century.

The Jet Propulsion Laboratory (JPL), at the time an Army facility located in Pasadena, California, received the assignment to construct the two "Army" space probes and install the necessary ground stations for tracking, commanding, and communicating with these probes. Even before the issuance of the ARPA order, however, Eberhard Rechtin and other telecommunication engineers at JPL began envisioning the establishment of a worldwide network of three major antenna stations that ideally would be located approximately 120 apart from each other in order to permit, as the earth rotated on its axis, constant monitoring of not only the Army lunar probes, but also future probes that would explore the Moon, the planets, the Sun, and interplanetary space. The urgency of the Pioneer program permitted the installation of only a single major 85-ft-

diameter antenna, at a site called Goldstone in an Army training facility in the Mojave Desert about 150 miles or so east of Pasadena before the initial “Army” lunar probe was launched in December 1958, but ARPA did authorize JPL to contract for the manufacture of two additional similar antennas. Soon after the formation of NASA, the agency embraced the vision, if not the precise scope, of JPL’s planned deep-space probe program, and JPL, while remaining a contract facility, would, despite Army protests, shortly be transferred to NASA. A January 1959 NASA-DOD tracking agreement, through its designation of South Africa and Australia as areas for the location of additional space-probe ground stations, clearly signaled NASA's intention to establish a permanent network.

The search for suitable sites for the planned overseas space-probe-supporting ground stations and the subsequent installation of the stations themselves would in some ways be similar to the selection and development of the Goldstone station. The principal criteria that survey-team members would consider in making an initial site selection would be the same: (1) The underlying soil at the site had to be capable of supporting large structures; (2) The surrounding terrain should ideally be hilly to provide natural shielding for the station against most ground-level radio sources; and (3) The area around the site (both at ground-level and in the overhead airspace) should be relatively free of radio interference in the frequency regions useful for space communication.² Also, the stations upon completion would in composition (that is, antenna and associated equipment and buildings), if not in specific layout, be virtually identical to Goldstone.

Several factors, however, would make the selection of suitable sites for, and installation of, the two planned overseas stations more complicated than that of Goldstone. The station sites would of course not be relatively close to JPL, as Goldstone was, but rather a third of the way around the world and in foreign countries. This circumstance would not only complicate the initial search for suitable sites (given the relative ignorance of JPL engineers about local topography and radio-noise conditions),

but also would require an extremely long logistical line for antenna components, associated electronic equipment, and other specialized materials coming from the United States. It would also necessitate lengthy overseas visits by JPL engineers and contractor workers experienced in the erection of the antennas and the installation of associated electronics equipment.

The remaining construction tasks (such as the construction of access roads and permanent buildings and the installation of utilities lines), however, would, given the great distance of the stations from the United States, likely be less expensive if done with local personnel, equipment (earth-moving and construction), and building materials. Also, for the most efficient operation of the completed overseas stations, Rehtin and his colleagues strongly felt that local personnel should be used. JPL engineers and NASA officials would quickly conclude that contractual arrangements for such work could be best handled through a partner agency in the host countries. The identification and selection of an appropriate partner agency in each country--an agency ideally that was and would continue to be strongly interested in the development of space communications--would become an essential early task for those involved in the planning of the stations.

The permanent and nondomestic characteristics of the planned overseas stations, which came to be initially called Deep Space Instrumentation Facility (DSIF) stations, would necessitate that the U.S. Department of State & NASA, and the Australian and South African governments & selected partner agencies in the host countries, negotiate, to their mutual satisfaction, formal agreements for the construction, operation, and maintenance of the stations. This diplomatic activity had not been necessary for the installation and operation of the Minitrack antennas and Baker-Nunn cameras set up originally on a temporary basis in Australia and South Africa to track the initial earth-orbiting satellites launched during the International Geophysical Year (IGY) (July 1957-December 1958).

Several considerations and events would complicate the process by which such agreements were obtained in the 1959-60 period. Most importantly, the DSIF stations were not the only ground stations that NASA officials in 1959 hoped to begin or continue operating in these countries. The Naval Research Laboratory and the Smithsonian Institution, with the cooperation of Australia's Weapons Research Establishment (WRE) and South Africa's National Telecommunications Research Laboratory (NTRL), had, as just mentioned, already installed Minitrack stations and Baker-Nunn cameras in both of these overseas countries for the radio and optical monitoring of Earth-orbiting satellites launched during the IGY.³ NASA had assumed overall management responsibility of the network of Minitrack stations when the Vanguard satellite program, and the Naval Research Laboratory group that was managing the program, were transferred to the new space agency during the summer of 1958.

As IGY cooperative activity was coming to a close in the last few months of 1958, there was little doubt that NASA would have an ongoing, major earth-orbiting satellite program, and thus on October 1, 1958, the agency's first official day of business, NASA Administrator T. Keith Glennan requested the assistance of the Department of State in obtaining agreements with the governments of Australia and South Africa that would insure the continuing operation of the Minitrack stations located at Woomera and Johannesburg, respectively. An accompanying draft note, which Glennan suggested be exchanged between the United States and each of the host countries, called for five years of continued operation of the stations (with possible later extensions) by the host country. Such a note, if formally agreed to, would allow NASA to provide "from time to time" improved equipment that cooperating agencies in each country would install at the existing sites. The note also proposed that these cooperating agencies would continue to provide equipment and services required to maintain and operate the station. Such equipment and services included (a) the station site itself, complete with power, water, and required utilities; (b) any required logistical services; and (c) services for operating

the station and transmitting the data generated there to a NASA control center in the United States. Significantly, Glennan's note made no mention of the overseas DSIF facilities that JPL had envisioned for monitoring space probes.⁴

Glennan and his staff undoubtedly expected that the proposed note might be slightly modified by the State Department so that it would conform to the formalities of international diplomacy. They were, however, shocked at the redraft of the Australian note produced by the department's Legal Office. According to one NASA official, the redraft

1) obscured the purpose of the note, 2) omitted the point that responsibility on the part of the U.S. for the program was being put in the hands of a civilian agency, 3) de-emphasized the designation of NASA as the cooperating agency on the part of the U.S., 4) confused the "cooperative tracking program," which is a cooperative venture between a number of nations, with the operation by Australia of the tracking station in that country, which is a contribution to the cooperative program, and 5) in general reduced the effectiveness of the note as a device to persuade the Australians that they should continue to operate the station at their own request.⁵

In response to these complaints, which of course applied to the similar note being prepared for South Africa, State Department officials prepared a new draft note, closely following NASA's original proposal, that they placed before Acting Secretary of State Christian Herter in late November. Just before Christmas, Herter instructed the U.S. Ambassadors to Australia and South Africa to transmit the note to the governments of these countries, and both did so on December 30.⁶

Government officials in both countries quickly perceived two major deficiencies in the transmitted notes. By the time they had officially received the documents, they each had become aware that their countries were being considered as sites for overseas DSIF stations as well. Quite naturally, both Australian and South African government

officials would question whether the "new equipment" that the note would allow NASA to provide "from time to time" at the existing Minitrack sites included the proposed DSIF antennas. These 85-ft-diameter antennas would be far larger than the Minitrack apparatus.

The second deficiency related to the costs that would be involved in implementing the proposed agreement. Although the draft note indicated that NASA would pay for the shipment of new equipment to the port of entry in each country, it seemed to imply that the cooperating agencies in the host countries, by agreeing to "continue to provide equipment and services required to maintain and operate the station," would provide, as they had during the IGY, the funds necessary to cover the operating costs. These costs were likely to increase as the American earth-satellite program expanded and more continuous operation of the Minitrack stations was required. The costs would become even greater if the proposed DSIF stations were to be covered by the agreement. Even if the likely cooperating agencies (WRE and NTRL) were enthusiastic about operating the stations, as indeed they were, they would need to obtain a reasonably accurate estimate of their potential financial responsibility and determine whether their governments would allocate sufficient funds to cover the expected increase in expenses.

WRE financial concerns had undoubtedly intensified after several of its officials that were visiting in the United States near the end of 1958 had been briefed about the planned stations by engineers at JPL, which at this time was still an Army facility. With some encouragement from ARPA, JPL officials had at one point during 1958 envisioned the DSIF stations, which each might eventually have as many as three 85-ft-diameter antennas, to be part of a so-called World Net of three primary stations and a number of secondary stations that would support a wide variety of space programs—not only interplanetary and lunar probes, but also manned spaceflight, and communications relay, weather, and reconnaissance satellites.

In South Africa, a major concern was whether the United States might surreptitiously use the DSIF station for military purposes. Suspicion of such a use was fostered by JPL's original military status, the originally secret use of the Minitrack stations in the collection of data concerning the Project Argus high-altitude nuclear-bomb tests in 1958, and a tentative proposal by the Department of Defense to use the proposed DSIF antenna to obtain data from the forthcoming Discoverer reconnaissance-satellite program.

Despite the financial and political concerns, WRE and NTRL officials were enthusiastic about not only continuing operation of the Minitrack stations and the Baker-Nunn cameras, but also the prospect of a DSIF station being located within their respective countries. Bill Boswell, the Controller (head official) of the WRE, reminded his superiors in the Department of Supply that Australia, together with the United Kingdom, had been able to make use of the Minitrack and Baker-Nunn equipment to observe high-altitude missile firings from the Woomera range, and "the unique occurrence of radio and optical tracking instruments on the one site" had enabled the country to "tackle several fundamental research problems which are of considerable scientific interest." Boswell anticipated that the Minitrack equipment and Baker-Nunn camera would make "quite a contribution" to the observations of forthcoming launches of the British Black Knight and Blue Streak missiles, and he foresaw that the addition of "such a magnificent tracking dish," as he termed the proposed 85-ft-diameter DSIF antenna, would enable engineers at Woomera to extend the range of telemetry reception from the Blue Streak from approximately 150 to 1,000 miles. In South Africa, Frank Hewitt, head of the NTRL, discerned its potential both as a radio-astronomy research tool and as a test-bed for techniques that would be useful in improving intercontinental telecommunications; the latter was important for a country that was geographically distant from not only the United States, but also Europe.

Further complicating the development of overseas tracking stations was the initiation of Project Mercury, the United States' first manned spaceflight program, in late 1958, and officials of that program would soon identify a need for two new ground stations in Australia. Because Australia and South Africa would each be potentially hosting several different types of ground stations on their soil, NASA and the overseas cooperating agencies would have to determine whether one overall agreement, or separate ones for each type of station, would be the most appropriate means for specifying the responsibilities each country would have in the installation, operation, and maintenance of the stations.

That one or more formal technical agreements, rather than informal arrangements, would be needed was determined by the increasing scale and complexity of the stations that NASA planned to operate in Australia and South Africa. The new stations for the DSIF and Mercury programs would require equipment and instrumentation far more elaborate than those of the Minitrack and Baker-Nunn facilities. Officials of NASA, WRE, and NTRL would all quickly realize in early 1959 that operation of these new types of stations would involve significantly higher costs, greater numbers of personnel, and a more complex management structure than had been required during the IGY period. In addition, NASA officials were planning in early 1959 to make significant modifications to the stations in the Minitrack network. All of these requirements indicated that NASA ground stations in the future could not be operated under the informal arrangements between the United States and the host countries that had existed during the IGY.⁷

More than just interagency technical agreements would be needed, however, before the new overseas stations could be installed. Because large amounts of American-owned equipment and instrumentation would be placed on foreign soil, officials of the foreign-affairs agencies of the countries involved--the Department of State in the United States and the Departments of External Affairs in the two host countries--would have to

negotiate formal diplomatic agreements before the technical agreements could be implemented. The length of the negotiating process would be determined by both internal factors (the concerns of other agencies of the governments of the United States and the host countries) and external considerations (the overall state of bilateral relations existing between the United States and each of the host countries).

NASA's urgent requirement to complete the network of DSIF ground stations prior to the first flights of the Ranger lunar-probe program, coupled with the aforementioned concerns of the host countries and a perceived slowness of the State Department in negotiating appropriate agreements with the governments of the host countries, led to the space agency's formulation of a new approach in seeking the cooperation of Australia and South Africa. This approach involved (1) a formal diplomatic "umbrella" agreement between the governments of the United States and each of the host countries that would spell out the general principles of cooperation in operating NASA ground stations in the latter, and (2) separate technical agreements between NASA and the cooperating agencies that would detail the specific responsibilities of each in installing, operating, and maintaining the DSIF, Minitrack, and Project Mercury stations.

The umbrella agreement would spell out general principles and procedures covering activities common to all of the facilities, such as the admission into Australia and South Africa of United States personnel and equipment and host-country use of station equipment, during non-operational periods, for independent scientific study. Such an agreement would relieve the State and External Affairs departments from having to negotiate a separate diplomatic agreement for each NASA facility, and thus allow NASA and WRE to negotiate directly on an agency-to-agency basis for the DSIF station and other facilities. A more immediate advantage of an umbrella agreement, was that it could be "pushed through the State Department under the urgency of Project Mercury," which, on April 27, 1959, had received from President Eisenhower the "DX" rating in the

Department of Defense's Master Urgency List. Placement in this category meant that Project Mercury was among those government programs that had the highest industrial procurement priority. Arnold Frutkin, director of NASA's International Programs Office, undoubtedly anticipated that State Department officials would be among those impressed by the DX rating.

Following the formulation of this approach in September 1959, the Australian and South African negotiating processes contrasted sharply. The lack of sharp conflicts in the bilateral relations between the United States and Australia, and perhaps Project Mercury's high national priority, enabled the agreements between these two countries to be signed within a few months—the interagency agreement on 15 December 1959 and the umbrella agreement on 26 February 1960. In South Africa, on the other hand, external events played a significant role in slowing down the negotiating process. The worldwide condemnation of the South African government's reaction to a racial disturbance in the black township of Sharpeville, during which South African police fatally shot 69 blacks and wounded 180 others, led to temporary second thoughts by NASA officials about installing the DSIF station in that country, whose ruling political party in recent years had implemented a policy of *apartheid*, or separation of the races. In the other direction, NASA's association with the U-2 spy plane incident in May 1960 reinvigorated a lingering suspicion by South Africa's Department of External Affairs that United States might surreptitiously use the DSIF station for military purposes. These events led to a negotiation that would take a full year to conclude, with the umbrella agreement signed on 13 September 1960 and the interagency agreements two months later.

Fortunately, the drawn-out negotiations with Australia and especially South Africa had not prohibited preliminary visits of site-survey teams to the two countries, which occurred in February and September-October 1959, respectively. WRE officials, not surprisingly, urged the team to consider Woomera (some 270 mi northwest of Adelaide), where a British-Australian missile testing range had been established in 1947

and where the IGY Minitrack and Baker-Nunn equipment had been installed. Despite the relative flatness of the area, the survey-team engineers eventually identified an area known as Island Lagoon that would apparently satisfy JPL engineers. In South Africa, NITR officials suggested two possible regions to explore for a suitable site: a very mountainous area at Nelspruit about 225 miles east of Johannesburg and an area about 30 miles northwest of Johannesburg and 18 mi west of Pretoria where two valleys ran approximately east and west for about 20 mi. Locating in the former would require a long communication line, and the team was understandably not comfortable with the South African Post Office Department's admission that outages might occur due to "storms, a giraffe walking through the line, or an elephant pulling up the pole." In any case, none of the sites explored by the survey team in either region proved satisfactory, but a site in the latter region, near the settlement of Hartebeesthoek, found by NITR officials shortly afterward was eventually accepted by JPL and NASA as having the desired shielding provided by surrounding terrain.

The separate conclusion of negotiations with Australia and South Africa finally allowed the official installation of the DSIF stations and other NASA tracking stations and new equipment in the months following the signings. Although NASA would ultimately abandon both the Woomera and Hartebeesthoek stations (the former because of its isolation, which made hiring of operating personnel difficult, and the latter because of increasing U.S. Congressional criticism of South Africa's apartheid policies), the negotiations for their use in the late 1950s and early 1960s would set the stage for later international cooperative space agreements between the United States and foreign countries. As we have seen in the case of the initial tracking and communication stations installed in Australia and South Africa, successful negotiation of mutually acceptable agreements had to take into account not only the schedules and requirements of various U.S. space programs, but also the political, financial, and scientific concerns of the foreign partners. It seems likely that the experience gained during the negotiations for

the station agreements proved useful to NASA in later years when it actively sought joint participation by foreign counterpart agencies in various satellite, space-probe, and manned spaceflight programs. Although such cooperation has expanded in recent years, the negotiations and agreements that govern such activity have unfortunately still been little studied by historians of NASA's activities.

¹ "Secretary McElroy Announces New Space Programs," Department of Defense (hereafter: DOD) News Release No. 288-58, Mar. 27, 1958; Jack Raymond, "U.S. Plans Moon Rockets; Initial Outlay Is 8 Million," *The New York Times*, Mar. 28, 1958, pp. 2 & 8.

² Henry L. Richter, Jr., Eberhardt Reichtin, & Walter K. Victor, *National Ground-Based Surveillance Complex* (JPL Publication No. 146), Feb. 15, 1959, p. 9.

³ For further information on the WRE and the NTRL (later NITR), see, respectively, Peter Morton, *Fire Across the Desert: Woomera and the Anglo-Australian Joint Project 1946-1980* (Canberra: Australian Government Publishing Service, 1989) and D.G. Kingswill, *The CSIR: the first 40 years* (Pretoria, South Africa: CSIR, 1990), pp. 174-86.

⁴ Glennan to Walter Rudolph (Office of the Science Advisor, Dept. of State), Oct. 1, 1958, "South Africa-Tracking-Thru Dec. 1959" folder.

⁵ Clotaire Wood to John A. Johnson (NASA General Counsel), "Revised version of proposed note to Australia and to the Union of South Africa re continued operation of radio tracking stations," Nov. 19, 1958, "South Africa-Tracking-Thru Dec. 1959" folder.

⁶ J.C. Satterthwaite to Herter, "Request for Circular 175 Authorization to Negotiate and Sign with the Union of South Africa an Agreement to Permit Continued Operation of an Earth Satellite Radio Tracking Station in that Country," Nov. 28, 1958, "South Africa-Tracking-Thru Dec. 1959" folder; Herter to U.S. Embassy, Canberra, "Proposed Agreement for Operation of Satellite Tracking Station," Dec. 16, 1958, "Australia 1959" folder, acc. no. 255-73-636 box 1, RG 255, FRC, Suitland; Herter to U.S. Embassy, Pretoria, "Proposed Agreement between the United States and the Union of South Africa for the Continued Operation of the Earth Satellite Radio Tracking Station Near Johannesburg," Dec. 23, 1958, "South Africa-Tracking-Thru Dec. 1959" folder; U.S. Ambassador to Dept. of External Affairs, Dec. 30, 1958, Dept. of Supply folder no. 187/101/7 pt. 3, Australian Archives, Victoria; Amb. Henry A. Byroade to Eric H. Louw (Minister of External Affairs), Dec. 30, 1958, folder no. 2/1/29 pt. I, CSIR Archives, Pretoria.

⁷ The Australian "arrangement" regarding the Minitrack station was governed by a letter from Capt. P.H. Horn, U.S. Navy (Director, Naval Research Laboratory) to Capt. J.N. Armstrong, Royal Australian Navy (Defence Research & Development Representative, Australian Joint Service Staff, Washington), June 7, 1957, copies in folder no. 187/101/7 pt. 3, Australian Archives, Victoria (AAV), and "South Africa-Tracking-Thru Dec. 1959" folder, acc. no. 64A736 box 3, RG 255, FRC, Suitland. The South African government's agreement to host a Minitrack station was confirmed in a letter from Wentzel B. du Plessis (South African Ambassador, Washington) to John Hagen (Director, Project Vanguard), Oct. 11, 1957, copy in the latter of the above-named folders.