News and Comment

Big Dish: How Haste and Secrecy Helped Navy Waste $63 Million in Race To Build Huge Telescope

On the basis of a detailed and official autopsy report on the Navy's 7-year attempt to build the world's largest radio telescope, it appears that the most promising piece of salvage from $63 million in outlays might be a libretto for a musical comedy.

The Department of Defense, which killed the trouble-ridden project in 1962 despite Navy protests, has offered assurances that newly devised management techniques make further cases of this sort unlikely. And, since Defense Secretary McNamara has demonstrated an unprecedented ability to blend rationality with the uncertainties of military research and development, the assurances command respect. Nevertheless, the telescope venture—even if it can't happen again—makes it easy to understand Congress' flourishing skepticism toward research and development proposals, and it also throws some illumination on the corrosive effects that the cold war has had on scientific and technical enterprises. The other side of the coin—namely, the nonmilitary benefits accruing from R&D motivated by East-West rivalry—has been amply publicized; but it is long overdue for equal time to be given to the fact that a lot of talent, money, and spirit go to waste when technological foolishness is permitted to gallop under a national security banner.

Although the telescope episode ended in July 1962 with a brief cancellation announcement by the Navy, the first detailed account of this security-bound project was not available until last month, when the General Accounting Office, Congress' financial investigatory arm, issued a 53-page report titled, *Unnecessary Costs Incurred for the Naval Radio Research Station Project at Sugar Grove, West Virginia.*

Sugar Grove, as the telescope was conveniently referred to, was conceptualized, in 1948, as a purely scientific undertaking by personnel of the Naval Research Laboratory (NRL). The proposal, to build a large, steerable radio telescope for detecting radio emanations from outer space, had shaped up by 1956 to a design calling for what would have been the largest movable land-based structure in the world: a reflector dish 600 feet (180 m) in diameter—more than 7 acres in area—that would rise to a maximum height of 675 feet above its foundation. To maintain its parabolic configuration in all environmental conditions, including high winds, icing, and bright sunlight, the surface of the dish was to be covered with hydraulically motivated and electronically controlled aluminum panels, 50 by 50 feet.

In the spring of 1956, Congress was told that the construction cost would be $20 million, and, without a quibble, it appropriated an initial $1.3 million for architectural and engineering services. By the winter of 1957, Congress was told that the cost had risen to an estimated $52.2 million. Not long afterward it was told that it would be desirable to combine highly classified military functions with the instrument's scientific capabilities, and that this would raise the cost to $79 million. (These military functions have never been publicly spelled out, but it appears that they involved using the moon as a relay point to monitor Soviet radio transmissions.) Later estimates raised the cost to $126 million, and then to $200 million and possibly as much as $300 million. In September 1961, even Congress' generally boundless indulgence for military research was insufficient for Sugar Grove's requirements, and a ceiling of $135 million was placed on the project. Shortly thereafter, the Defense Department concluded that the military tasks prescribed for Sugar Grove could be attended to by other means, presumably space satellites, and it directed the Navy to end the project. At that point, expenditures totaled $63 million, for which the Navy had a lot of plans, a large clearing in the West Virginia mountains, a 17,000-cubic-yard concrete foundation, a 550-ton pintle bearing, and a few other monumental odds and ends that will surely baffle archeologists of some coming century unless a copious explanation is carefully left behind.

In examining how and why it happened, the General Accounting Office spells out a story that Lewis Carroll might have envied. From the start, the Navy was in a desperate hurry, a fact that the GAO attributes to Sugar Grove's military potential, but which also may have had something to do with the Navy's desire, early in the space age, to get a piece of space jurisdiction for itself. In this spirit of haste, the Bureau of Yards and Docks (BuDocks), which was managing the project, decreed that construction would proceed concurrently with design. Work on the foundation then got under way, while design on the superstructure proceeded. Meanwhile, various scientific advisory bodies were expressing doubts about the costs and technical capabilities of the telescope, but BuDocks attended to that problem by keeping the scientists out of the project.

Heavier and Heavier

"After structural design was initiated," the GAO reports, "early results indicated that, if the instrument were to retain its configuration automatically . . . a complex control system would be required. It was found that any increase in rigidity to prevent deflection of the reflector would be self-defeating since the added weight of steel would in itself cause more deflection. Accordingly, the design for the superstructure was changed from a simple to a novel and highly complex form. Conventional methods for the necessary check analysis of structural stresses could not be used. . . . BuDocks decided on a machine [computer] computation for the analysis of the unique design problem. . . . Normally detailed structural design would have been delayed until the computer results were known, but BuDocks considered that the military urgency of the project made it necessary to proceed with the preparation

of the bid requests and procurement of steel. . . . By the summer of 1960, studies of the computer results showed that much of the prior design had been inadequate. The overall moving weight of the instrument was calculated to approximate 36,000 tons which would be far in excess of the designed capacity of the supporting structure already under construction. The weight calculation was, even then, based on estimates for several highly important areas for which design had progressed to only a concept stage. Many major problems for which no precedent existed were still unsolved."

BuDocks then obtained the services of a new design firm, which found, as GAO put it, that "prior design assumptions could not be relied upon and that a total reanalysis and redesign of the project would be required. . . . In the meantime, much of the construction of the supporting structure had been completed."

Speed and Secrecy

While BuDocks was pleading military urgency and pouring concrete, it was also hanging out top secret signs to fend off the participation of the very scientists who had helped originate the project. Although work at the Sugar Grove site was going full blast, the GAO concluded, "the scientific problems involved in the construction of a 600-foot radio telescope had not been solved, nor was there any prior experience in constructing an instrument of this size with the required mobility and close tolerances in all its parts. Therefore, the successful fulfillment of the project required close collaboration and the best efforts of the scientific and the construction agencies of the Department of the Navy.

"This need for close collaboration . . . was not adequately recognized until about the end of the history of this project. Rather, the record shows that BuDocks . . . almost completely eliminated effective scientific participation in the Big Dish project by scientific personnel until it became very clear to BuDocks that assistance from the scientific community was essential to solve several of the scientific problems.

"After BuDocks had been given responsibility for construction . . . communication with the scientific and research engineering community outside the Government diminished or was completely closed by the security classification of significant elements of the project and actions of BuDocks personnel, and liaison with Naval Research Laboratory and Office of Naval Research scientists and research engineers deteriorated."

In 1959, the GAO report continues, "despite evidence that design problems were getting out of hand," BuDocks proposed disestablishment of the Sugar Grove Steering Committee, whose representatives—from NRL, ONR, and BuDocks—were supposed to coordinate research, design, engineering, and construction. When the Chief of Naval Research protested that the committee was ONR's only formal link with the project's planning, BuDocks agreed, in July 1959, to retain the committee. The records show, however, that the committee held only one meeting after that date.

In that same year, the Office of the Secretary of Defense appointed an advisory group that the GAO described as "the country's outstanding experts in fields allied to those comprehended by the Big Dish." The group reported back that "the project is cloaked in a mantle of security which precludes participation by the scientific community in the formulation of the design for the dish."

BuDocks versus the Experts

A few months later, the Defense Department's director of research and engineering brought together a group of specialists to consider the project. BuDocks, however, was not interested. A memorandum to the director from a member of his staff stated, "I have been informed that . . . the Bureau of Yards and Docks area commander, Norfolk, has intervened and stated that he will take charge of the meeting from the Navy side and that none of the experts mentioned above will be included. . . ." The Secretary of Defense had to take the matter up with the Navy to bring about the meeting with the expert group.

As for the NRL scientists who had first developed the concept for the telescope, they found that BuDocks and its original designers had little patience for their opinions. Although GAO concluded that "NRL had an abundance of structural engineering capability," NRL scientists found that their reservations about construction matters were not appreciated, and they were also told that BuDocks "could not wait for the 'scientific approach'. . . ."

By early 1960, it was clear that the project had acquired a vitality of its own and that it would not be easily responsive to the will of men. When NRL first worked out its plans, it assumed that a staff of 30 would do nicely, to man the telescope, its computers, the library, and other facilities. The Navy, the GAO found, "revised this concept to a planned complement of 1146 people with all the additionally required housing, commissary, and other support facilities. . . ."

As for GAO's contention that the project should have been slain in 1960, rather than in 1962, it was informed by the Secretary of Defense that—in GAO's words—"cancellation was tardy to some extent . . . but in almost all cases resulting in cancellation there is a significant delay between the date of the decision and the date that cancellation is actually effected. However, they stated that such a delay normally should not exceed about six months."

Perhaps the most disturbing thing about the Sugar Grove debacle is that it apparently has not driven anyone in Washington to raving anger. Part of the reason, of course, is that McNamara—over the violent protests of the military services—has since instituted review and management procedures that would make it difficult for a similar octopus to get loose. But the principal reason for the ho-hum attitude is that when a national security tag is hung on a project, sound judgment often goes out the window. It might be useful to speculate what would have happened in Congress if, let's say, the National Science Foundation had been responsible for what happened at Sugar Grove.

—D. S. GREENBERG

RAND: R&D Nonprofit Pioneered a New Kind of Organization, Served as a Model for Others

The RAND Corporation is the archetype of the nonprofit research and development organizations formed after World War II to help the American military establishment with planning and problem solving by enabling scientists, engineers, and other professionals to work for the government but not in it.

What moved the Air Force to establish its Project RAND after the war