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OF

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NASA, in Congress and by the general public. However, in development centers such as GSFC and JPL, requirements for development, test and operations facilities were also developed and met. And, over the past decade, many of the facilities specifically funded and built in NASA's programs of science, applications, and advanced research and technology have contributed significantly to developing or upgrading the nation's overall basic research capability.

The importance of adequate basic research facilities was emphasized by Dr. Raymond L. Bisplinghoff in testimony before the House Committee on Science and Astronautics in defense of NASA's FY 1965 authorization:

> The technical program I have described is critically dependent upon the existence of research facilities which represent one of the Nation's strongest resources in its bid for pre-eminence in aeronautics and space. The very existence of advanced research facilities such as high speed wind tunnels or environmental chambers has spelled the difference between success and failure in projects in the past. Interestingly, many of our new facilities must themselves be evolved through research since they usually have little or no precedent . . . .
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> One of the fundamental premises of NASA's program of advanced research and technology is that of performing as much ground research and development as possible before undertaking flight experiments. A continuous upgrading of our research facilities is mandatory if we are to maintain the effectiveness of our research and development programs.[12]

A fundamental requirement of NASA's research facilities was to provide simulation of the full range of environmental conditions to which aeronautical and space vehicles would be exposed. Experience has illustrated that the timely construction of research facilities which permit the simulation of flight environment on the ground have reduced costly flight programs and saved valuable time. Hence, wind tunnels, environmental chambers, centrifuges, flight simulators were indispensible tools in research programs in such areas as propulsion, aerodynamics, materials, structures, controls, guidance and life support. Facilities were needed to simulate the effects of space in order to examine and solve operating problems of

these systems, and also to provide an understanding of the physical phenomena underlying this operation.

The decision to create NASA's newest field center -- the Electronics Research Center (ERC) in Cambridge, Massachusetts -- brought into focus basic issues of how best to meet a defined research need. In his letter to Congressman George P. Miller, Chairman of the House Committee on Science and Aeronautics, Mr. Webb described the problem and the solution (the establishment of ERC) proposed in the President's FY 1964 budget request as follows:[13]

> During the first few years of NASA's existence, the Agency relied heavily on existing electronics technology and electronics research being conducted in industry and in universities for the aeronautics and missile fields. Electronics research and development within the Agency has been conducted on a decentralized basis, primarily as an adjunct to the major booster, spacecraft, or ground-support system developments. As a consequence, most of the NASA centers developed a limited electronics research competence closely related to those specific technical areas and development missions comprising their primary missions.
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> By 1961, a number of top NASA space scientists and engineers began to recognize the need for additional electronics research and advanced development. The accumulated flight experience was beginning to show the significant differences between the atmospheric and the space environments for electronics components and systems. The magnitude and importance of the problem is reflected in the fact that electronics components account for over 40 percent of the cost of our boosters, over 70 percent of the cost of our spacecraft, and over 90 percent of the cost of the resources going to tracking and data acquisition. It was becoming clear that the existing technical base was not adequate to the growing electronics requirements.
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> Following discussions with members of the NASA staff and others about this problem, I took a number of steps to correct this deficiency. A separate office

of electronics and control was created with the Office of Advanced Research and Technology during the NASA Headquarters reorganization of November 1961. This office, under the leadership of Dr. Albert J. Kelley, was asked to study in detail NASA's present resources and capabilities in electronics research, the long-range needs of the overall space program in this field, and to recommend a plan to meet these needs.

Dr. Kelley's group found that, although NASA was involved deeply in developmental projects covering almost all segments of the electronics field, NASA's in-house research efforts were diffused and comprised a relatively small cumulative effort. Our program for contractual research in electronics was handicapped by NASA's lack of a group of able scientific and engineering personnel, concentrating on electronics and associated physics research, and relating such contracted research effectively to the overall space program. Early in the fall of 1962, Dr. Kelley reported that NASA's long-range requirements for in-house competence required a substantial increase in electronic research efforts, and strongly recommended the establishment of a new research center. This matter was carefully reviewed by Dr. Bisplinghoff, the Director of the Office of Advanced Research and Technology, Dr. Seamans, Dr. Dryden, and myself. We were unanimous in our judgment that the best interest of NASA, and of the Nation, would be served by the establishment of a new electronics laboratory to fulfill the requirements of the Nation's aeronautics and space program.

Before reaching this judgment, consideration was given to several ways of creating an in-house electronics research capability. One was to increase the present electronics research capability at several NASA research centers. A second was to create a major electronics subcenter at an existing NASA center. The third was to create a new electronics research laboratory. Although the estimated costs in personnel and facilities for these three approaches is similar in magnitude, our judgment was based on other factors. The first course of action was not adopted, primarily because the total program would remain diffused and electronics research would not

permit the creation of an essential "critical mass" or concentration of electronics capability which is needed to perform the many advanced efforts in electronics research and technology facing NASA and the Nation. We rejected the concept of a satellite or appendix to an existing NASA laboratory, because we were concerned that the addition of a satellite facility would adversely affect both the quality of performance in the ongoing effort of any center charged with this additional responsibility as well as of the electronics research we urgently need.

The basic purpose of the laboratory is to provide this Agency with the in-house competence it requires to properly plan, conduct, direct, and supervise a major segment of electronics research and advanced development in our aeronautical and space program. As much as possible of this will be under contract or grant to universities or industries capable of performing the work required. Existing NASA centers will continue to carry out some electronics research, and will conduct those developments necessary for their primary missions. These centers will draw heavily on the proposed center for electronics technology, components, subsystems, and prototype systems, required for their projects . . . .

With regard to the selection of a site for the proposed new research center, there were several basic criteria that had to be satisfied. A community having adequate utilities, services, communications, and transportation facilities was, of course, basic. In addition it would be very desirable to be assured of adequate housing and the related family welfare, education, and recreation facilities, as well as adequate land in a reasonably convenient location not in conflict with local metropolitan planning. However, in addition to these considerations, there were two overriding criteria which carried the greatest weight in the selection. The first of these was to have the research center located in close proximity to institutions, of graduate and postgraduate scientific and engineering education, which are already deeply immersed in the forefront of the electronics basic research and technology over a broad range. The second was to be located in an area

that they had rejected, for the time being, any support for plans for a manned lunar landing. The letter, which became public, was interpreted in some quarters as indicating the NASA program could be slowed.[215]

The international climate had improved in the summer of 1963 with the agreement on a treaty to ban nuclear tests. On September 20, 1963, President Kennedy proposed at the United Nations that the world make "the most of this moment and the momentum" through additional agreements, including a joint manned lunar landing program.[216]

The President's speech was interpreted by many Congressional leaders as a move away from support of the concept of achieving pre-eminence in space. The House of Representatives reacted on October 10, 1963, with an amendment to the NASA appropriation bill barring any such agreement without Congressional approval. The Senate agreed with the House. In its final form, the provision forbade the expenditure of any part of the appropriation for participation in a manned lunar landing program carried out jointly with any other country without the consent of Congress.[217]

Considerable controversy on the new electronics center had been under way since January, when President Kennedy proposed in his budget for fiscal year 1964 that it be established in Boston. The location and -- to a lesser extent -- the necessity of the center were debated extensively. NASA felt there was a need because, during the first five years of the space program, the greatest single cause of failure in spacecraft and rockets was difficulty in electronics. The agency had asserted that existing government facilities, either within or outside of NASA, could not properly meet the need. NASA stated that dozens of potential sites were considered during an extensive evaluation process. Boston was preferred because of its proximity to electronics research-oriented graduate-level educational resources, as well as an established science-engineering community in the area.

Critics from other regions of the country maintained that their areas should have been selected. Some contended that Senator Edward M. Kennedy of Massachusetts, brother of President Kennedy, had influenced the selection.

Amendments to delete the $3.9 million initial appropriation for the center were defeated in the House votes on the NASA authorization and appropriation. However, the authorizing

legislation required NASA to submit to the Congressional committees a detailed report on the need, nature and location of the center, and prohibited expenditure of the funds until 45 days afterward.[218]

In its action on the budget for fiscal year 1964, Congress made a substantial cut in the requested appropriation. The $5.712 billion request was reduced to 5.1 billion by the time the House and the Senate had completed work on the authorization and appropriation bills in December 1963.[219]

In terms of program growth, this decision brought the NASA expenditure level to $4.17 billion for the fiscal year that ended in June 1964. Two years of continued stressful growth remained ahead before the expenditure total was to reach its peak 40 percent higher than 1964.[220] But in five years, NASA had succeeded in extablishing a new agency of government that carried out extensive activities in the private sector of the economy, carrying to completion several major programs, planning a decade of activities, expanding and accelerating in response to the Soviet challenge and the resulting public and Congressional demands, surviving severe tests of its ability to grow, initiating construction of new facilities valued at $3 billion, and organizing for full implementation of the manned lunar landing program. It had created a strong, capable in-house technical and managerial staff. And it had established effective working relationships with industry, the scientific world, and the regions and communities of the country in which the program was conducted. Altogether, NASA had developed in five years into an agency of the government that could carry out its assigned tasks and hold its own in dealing with external forces.

As autumn leaves fell, the debate continued on Apollo and cooperation with the Soviets. On November 14, 1963, Vice President Johnson took up the question in an address at Huntington Beach, California. He said:

> Today in our land -- and in the world -- there are those who argue for the view that we should not push forward into new realms or new enterprises unless there is clear and compelling evidence of competition from other nations and other systems. I beleive the American people reject the concept that their future -- or the future of freemen everywhere -- shall be defaulted to the vision and ambition of the totalitarians.