Document III-18

[1] December 19, 1965

Mr. J. L. Atwood, President
North American Aviation, Inc.
1700 E. Imperial Highway
El Segundo, California

Dear Lee:

In my letter of October 27, 1965, I conveyed to you the seriousness with which I viewed the state of affairs in both the Apollo and S-II Programs at your Space and Information Systems Division. Phillips' report has not only corroborated my concern, but has convinced me beyond doubt that the situation at S&ID requires positive and substantive actions immediately in order to meet the national objectives of the Apollo Program.

Since I am not sure that you see the performance of S&ID in the same light that I do, let me give you a perspective from my point of view.

When I joined NASA in the Fall of 1963, I restructured the Apollo Program to bring its several elements into balance and to establish a schedule that could be achieved based on the state of development at that time. Since that time, in the spacecraft project, we have found it necessary to:

a. Omit several sub-systems from 009.

b. Delay flight of 201 from November 65 until probably February or March 66 due to late delivery of 009 and its GSE together with the many difficulties of getting things [2] to work together at the Cape.

c. Reschedule the first manned flight from 203 to 204 to relieve the spacecraft schedule. NAA ability to support the 204 flight scheduled in October 66 now looks doubtful.

d. Reschedule 202 from April to June 1966 because 011 is several months behind schedule. NAA ability to support the June schedule now looks doubtful.

e. Reschedule the first Block II spacecraft flight from 206 in April 67 to 207 in July 67. Late last year, when the Block II Program was defined, your people agreed that they could and would do a better job on Block II engineering and that they would meet their design review and drawing release schedules. I'm very disturbed to learn now that Block II engineering has been neglected and that it is some months behind schedule. To me, considering performance to date, it looks like the danger flags portend delay of the critical 207 flight.

f. Delay the delivery of 008 by several months. This is a critical vehicle to perform thermal vacuum tests in the Houston Chamber as a prerequisite to manned flight. People will argue that the Chamber isn't ready, but we urgently need that spacecraft to get it working as a system vehicle and with its ground equipment and crews.

g. Delete seven boilerplate and flight spacecraft from the Block I Program to reduce cost growth and relieve the schedule to minimize slippage.

I could go on; there are other things that we've had to accommodate such as cost growth, but I believe this list gives you some insight into my evaluation of performance in the spacecraft project. Now, regarding the S-II Project:

a. I am facing the probability that the flight of 501 will be delayed between three and nine months. I [3] assure you that this is due entirely to the status of the S-II stage. It is clear to me that it didn't have to come out this way, and I regret now that I wasn't more

insistent a year and a quarter ago when you and I discussed the danger flags then flying, and the possibility of such far reaching actions as transferring the project to your Los Angeles Division.

b. The cost proposal which S&ID presented to MSFC in October of this year was shocking in light of cost projections reported only one month earlier. Perhaps I should even go so far as to suggest that it was irresponsible; in any case, it surely was a gross demonstration of management shortcomings.

c. The Battleship Program is another significant case. You got behind it personally and an ignition test in November 64 resulted; but that achievement was one year behind the original schedule and the test fixture was so devoid of systems as to be little more than a facade. Further, the firing record indicates that only about one-third of the firings really achieved their objectives. The firing program was stopped last April to incorporate flight systems; it has not yet resumed firing.

d. S-II-T is a real problem. It was delivered late with what was stated to be approximately 21,000 manhours of work to incorporate EO's and perform work that was not completed in the factory due to parts shortages. Today, the work stands at over 50,000 manhours and the firing scheduled for January 66 will most likely occur in March or April. Based on what I have seen so far, I am very concerned that the engineering on which S-II-I is based will require many changes when S-II-T is fired, and further delays of 501 will result.

It is hard for me to understand how a company with the background and demonstrated competence of NAA could have spent 4 1/2 years and more than half a billion dollars on the S-II Project and not yet have fired a stage with flight systems in operation. [4] Again, I could go on and enumerate additional problems, but the points I have discussed should show you how I see the performance of NAA on these two programs.

I have been in this business long enough to understand quite well the difficulties and setbacks that occur and manifest themselves in many forms in government-industry programs which have as their objective the development, building, and operation of sophisticated systems involving advanced technology and real forward projection of thought. My experience indicates that results are a function of management and technical competence. I submit that the record of these two programs makes it clear that a good job has not been done. Based on what I see going on currently, I have absolutely no confidence that future commitments will be met.

I can see no way of improving future performance, and meeting commitments which NAA must meet if we are to achieve the national objectives of Apollo, except to improve the management and technical competence of your Space and Information Systems Division.

Sam Phillips is convinced that S&ID can do a better job with less people. He and his team discussed the reasons why they believe this in their briefing.

I suggest that you can go even further to concentrate management and technical talent on the two programs that constitute 98 percent of the business of S&ID. For example:

a. Eliminate or transfer to another Division those activities at S&ID that are not contributing directly to the progress of the Spacecraft and S-II projects. Examples are the Federal Programs Group, parts of the Information Systems Division, and parts of the Advanced Systems Division. This should make possible a substantial consolidation of central engineering and insure that [5] available talent concentrates on the two important programs.

b. Take a hard look at the competence and effectiveness of individuals, especially in the upper echelons of the organization; and move out those who are not really contributing, due either to the organization or to their own competence.

I urge you to consider the potential payoff of extending the project management principle beyond the "designated subsystems project manager" as now practiced in Dale Meyers' organization. I am convinced that there is no substitute for clear assignment of responsibility and accountability to individuals for delivering results. Work packages can be defined quite clearly in both projects and I am sure it is possible to assign responsibility to individuals who are given control of the applicable budget and who are held accountable for delivering on schedule and within budget.

I had hoped that a letter such as this would not be necessary. However, I consider the present situation to be intolerable and can only conclude that drastic action is in the best national interest. I assure you that I have only one purpose, and that is to carry out the Apollo Program on schedule and within planned costs.

I have instructed Sam Phillips to keep his team together so that they can visit S&ID again in March to see if progress is consistent with that required to achieve program objectives.

Sincerely,

George E. Mueller
Associate Administrator
For Manned Space Flight

Document III-19

Document title: James E. Webb, Administrator, to Dr. Frederick Seitz, President, National Academy of Sciences, December 20, 1967.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

In this letter, NASA Administrator James Webb thanks the National Academy of Sciences for its advice regarding the establishment of a Lunar Science Institute to be a central location for the analysis of samples returned from the Moon. He also attempts to clarify NASA's reasoning behind its decision to establish such an institute. Essentially, Webb sought the creation of this institute under NASA funding but with academic management. This arrangement, he believed, was critical if the institute were to achieve the stature Webb wanted for it.

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[1] December 20, 1967

Dr. Frederick Seitz
President
National Academy of Sciences
Washington, D. C.

Dear Fred:

We have your letter of November 1, 1967 and the report of the Academy of NASA/University Relations Committee. Will you please give them my thanks for the work they have done so far to help resolve the problems of the "Lunar Science Institute" we are thinking of establishing near the Manned Spacecraft Center (MSC) in Houston. We also deeply appreciate the help you and the National Academy are giving us in this matter.

We asked the Lunar and Planetary Missions Board (LPMB) to review the needs and plans for this "Institute," which they did at their last meeting. The Board did not take any formal action pending further clarification and discussion of the nature of the Institute at their next meeting in January. Several of the members still have grave reservations about the usefulness of the proposed Institute; its method of operation; and its effect on academic scientists interested in lunar exploration. Specifically, they are concerned that the establishment of the Institute might weaken the position of the university scientist either by encouraging him to participate only if he is a member of the Institute or by forcing him to come to the Institute to do his research. They were also concerned about the name, "Lunar Science Institute," which they felt implied a more substantial institution with a larger staff than [2] that described to them. In the discussion at the Board and in later consultations with the concerned members of the Board, it seems that we can alleviate much of this concern if it is made clear that:

1. NASA plans to continue the policy of encouraging all competent scientists to compete for participation in the lunar exploration program and that membership or non-membership of his parent institution in the Institute will not be permitted to affect the standing of his proposal in NASA's evaluation of it and others in that competition.
2. The selection of the principal investigators in the Lunar Exploration Program or for lunar sample analysis will continue to be made as they have in the past by the highest level and most competent personnel in NASA.
3. The "Lunar Science Institute" is being established to help those scientists who consider it desirable to come to MSC from time to time either to plan or conduct their research and to provide an easy access to scientists who have an interest in considering participation or in the pattern of relationships which will grow from this pilot model experiment in the continuing NASA effort to find the most satisfactory basis for scientists to participate in its programs.
4. Selection as a principal investigator automatically makes the facilities of the Institute available to him when he needs to come to Houston.
5. NASA will continue to follow the policy of encouraging an academic scientist to conduct his research at his home institution to the fullest extent possible and with as little interference with his academic responsibilities as possible.

[3] It is also apparent that what we are thinking of is not so much an "Institute" as it is a "Facility for Continuation Study" in a location that provides some benefits over and beyond those heretofore available. Therefore, we should seek a name which more accurately describes such a facility and its functions.

An interim arrangement whereby the National Academy of Sciences has a prime contract from NASA for the operation of the facility, and where it, in turn, negotiates a sub-contract with Rice University to operate the facility seems a reasonable arrangement provided the following matters, in addition to those above, are worked out to our mutual satisfaction and to the satisfaction of the LPMB and specified in the appropriate contracts or memoranda of understanding:

1. The administrative arrangements and agreements necessary to bring the facility into being and operate it. Careful attention must be given to the role of the LPMB, which is the principal group we look to for advice on the content of the lunar program and to represent the interests of the scientists involved in that program. Careful attention must also be given to the role of the Science and Applications Directorate at the Manned Spacecraft Center.
2. The size and type of staff required (should be small).
3. The location, size, and nature of the buildings and equipment to be utilized. Presumably, this would be the West Mansion located on the Rice property adjacent to MSC.

4. If it is the West Mansion, the nature and cost of the modifications which will be required.
5. If the arrangement with the Academy and Rice is to be regarded as temporary, then plans [4] leading to a permanent arrangement should be outlined.

Even though the arrangement for Rice to operate the facility may be temporary, these arrangements should specify the role that Rice will play in the administration, the fee considered proper, and any plans or actions which Rice expects to take to help evolve new and better relationships between graduate education in the disciplines involved and the space program.

Dr. John E. Naugle, Associate Administrator for Space Science and Applications, will be my representative in working out these arrangements with you as President of the Academy and Dr. Kenneth S. Pitzer in his dual role of Chairman of the Academy Committee on NASA/University Relations, and as President of Rice. Dr. Newell and I will be following these matters very closely.

Sincerely yours,

James E. Webb
Administrator

Document III-20

Document title: John E. Naugle, Associate Administrator, NASA, Memorandum to Administrator, "Space Astronomy Institute," February 4, 1976.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

This memorandum to Administrator James C. Fletcher from NASA Associate Administrator John E. Naugle reflects the lengthy debate over form and control of the proposed Space Astronomy Institute, soon to be renamed the Space Telescope Science Institute. The astronomy community was concerned about playing a role in the telescope project, and envisioned an institute separate from NASA and managed by a university or a university consortium. Dr. Hinners is Noel W. Hinners, NASA's Associate Administrator for Space Science and the key individual in deciding the institute's final form.

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[1] February 4, 1975

Memorandum

TO: A/Administrator
FROM: AA/Associate Administrator
SUBJECT: Space Astronomy Institute

On February 2, Dr. Richard Goody called on behalf of the International Astronomy Group with which we met on January 29 in Williamsburg, Virginia. Goody said a matter had come up after we left which he had been asked to discuss with NASA on behalf of the group.

The group discussed the so-called "Space Astronomy Institute" (SAI) and concluded that SAI would very likely become the key or certainly one of the two or three key astronomy institutions of the western world in the 1980's. The astronomers assembled in Williamsburg wanted NASA to know of their interest in the SAI and also they were concerned that there would be the necessary interaction of astronomers with NASA in developing the plan so this would indeed become such an institution. Goody said he had been empowered by that group to approach NASA to offer to help in this matter and he felt a group could be organized to represent the National Academy of Sciences (NAS), the American Astronomical Society [AAS] and the European Science Foundation (ESF).

I told Goody that: we certainly felt that the SAI was exceedingly important; we hoped it became precisely the kind of institution he envisioned; and Dr. Hinners had laid out a very careful approach in planning for the SAI which allowed for considerable interaction and review of our plans with and by astronomers. I told him that Dr. Hinners and I would need to discuss this matter with you before any commitment could be made, but that it would be helpful to have a small group [2] of senior astronomers designated as the spokesman for NAS, AAS and ESF. I told him there were precedents for NAS helping to organize such a facility—noting that Mr. Webb had worked closely with the then President of NAS, Dr. Seitz, in establishing University Space Research Association (USRA) and the Lunar Science Institute, and that AEC had also worked closely with Dr. Seitz in creating the Universities Research Association, Inc. (URA) in getting the big accelerator under way.

At our meeting with you on February 9, Dr. Hinners will outline the present strategy and plan of action for bringing the ASI [sic] into being. I told Dr. Hinners of Dr. Goody's call and asked that he consider how a group such as the one proposed by Goody could be brought into that plan of action.

John E. Naugle

Document III-21

Document title: Memphis Norman, Budget Examiner, SET, to Mr. Loweth, "National Academy of Sciences Report Regarding Institutional Arrangements for the Space Telescope," April 6, 1977.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

In attempting to determine the best form of management organization for the Space Telescope Science Institute, NASA requested that the National Academy of Sciences (NAS) study the issue and provide a recommendation. The resulting report would play an important role in the decision to have a university-led consortium manage the institute. This document, an internal Office of Management and Budget (OMB) memorandum, contains a summary of the report, as well as additional comments that reflect OMB's favorable disposition toward a non-NASA arrangement. Hugh Loweth was the head of that portion of OMB that oversaw the NASA budget, and Memphis Norman was one of his staff members. The name of the OMB division was Science, Engineering, and Technology (SET). PSAC stands for the President's Science Advisory Committee.

[1]

National Academy of Sciences Report Regarding Institutional Arrangements for the Space Telescope

The National Academy of Sciences conducted a Woods Hole Conference between July 19-30, 1976 to examine the institutional arrangements for the operational phase of the Space Telescope—the report was released in January 1977. The report was prepared in response to a request by NASA's Office of Space Science for the Space Science Board of NAS to examine organizational and management features of a possible Institute and to make recommendations for NASA's consideration. This memo summarizes the report, and provides NASA['s] and our comments on the subject matter. There is no action for use to take at this time, although we should keep it on our "watch list."

Background

- The Space Telescope will have the most complex organizational arrangement ever experienced on a NASA mission. The project will involve over a ten-to-twenty year period, two NASA centers, three headquarters program offices, NSF [National Science Foundation], the European Space Agency, other national and international organizations, and the complex of ground based observatories outside of NASA (the Space Telescope and ground telescopes will complement each other).
- NASA talked to us last fall about an Institute for the Space Telescope, but the details were sketchy. To assess the need for an Institute and plan it, NASA conducted an internal study last year, and asked the National Academy to conduct an additional study involving spaced-based and ground-based astronomers. NASA is establishing a working group (chaired by a NASA individual) to examine inputs from various groups regarding the Institute, and to make recommendations to NASA management.

Report Summary

- The fundamental point addressed by the report is how to maximize scientific return from a large investment for R&D and operations. The report proposes a strong role for the Institute and concludes that ST operations should move from engineers to the scientists and that central responsibility (a focal point) should be placed in a highly visible independent institute (free from organizational restrictions) and staffed by full-time astronomers.

[2]
- Key recommendations include:
  - The institute should organize and manage itself, and pick its own location—off a NASA installation.
  - The new organization should include space-based and ground based astronomers (including foreigners) and provide for extensive coordination.
  - The Institute should have direct involvement in the development and operation of the Telescope. The Institute should have its own laboratories, facilities, and computers, and plan and manage the science program (observations and instruments); participate in technical development by developing hardware and software systems for data handling and control capability on-board the ST, and being involved in contract negotiations, trade-off decisions and design modifications; perform data analysis at its own laboratories; and checkout the ST before and after launch.
  - Operational decision-making should be the responsibility of the Institute since the participation of all astronomers should make possible decisions in the context of a comprehensive astronomy program (overall strategy).

- The Institute should be similar to a university consortium with a Director, Board of Trustees, scientific staff, and advisory committees. Staffing would build-up to 90 positions by 1983 (ST launch year), and to 150-200 positions during operations.
- The Institute should be established as soon as possible and a Director appointed.
- Funding should be provided under contract with NASA with contributions from NSF, other public agencies, foreign governments, and private organizations. *Costs were not provided.*
- The Institute should maintain close liaison with NASA headquarters, NASA centers, engineering groups, contractors, and scientists.

NASA's Position

- NASA has not made a decision about the Institute—even whether to have one. A working group will be set up (chaired by Warren Keller—NASA Headquarters) shortly to review the NAS report as well as other inputs.

[3] • The study group will include NASA engineers, scientists, and operations specialists, and advisers from NSF and NAS.

- The review will probably start with the NAS concept, since scientists should be in a nucleus position and many aspects of the concept are good. However, NASA views the concept as too large and expensive—particularly if NASA should fund. NASA will cost out the NAS proposal and alternatives.
- NASA views the NAS report as an expression (particularly by ground-based astronomers such as Kitt Peak) to curtail NASA's influence because of fear of NASA. Astronomers want an NSF-type operation (independence).
- NASA plans to complete the study by July/August and recommend to NASA management whether to have an Institute and its size, structure, management, operations, budget, and timing. A budget request for the Institute would likely be in the 1980 budget—not 1979.

Staff Comments

- It appears that NASA is correct in sensing that astronomers (particularly ground-based) are afraid of NASA. We have heard numerous accounts before from PSAC members and NSF—perhaps there are good reasons for fear, particularly about the Marshall Center which will manage ST development.
- However, we do believe that an Institute is a good idea, particularly the involvement of ground-based astronomers. We have often talked about the need for coordination and a comprehensive strategy for astronomy. The Institute may be the beginning.
- We also believe that once the Shuttle becomes operational its new capabilities should allow for greater participation by scientists. Institutional arrangements to bring in more people is a consideration for NASA in the future—these new programs will not be "normal" NASA programs.
- We will need, obviously, to watch the funding arrangements and level of costs.
- Leo Goldberg feels very strongly that the science community should have a strong hand in the organization and management of the Space Telescope—you may want to formally ask NASA by letter to report to us on the NAS report and the Institute when they are ready. We can prepare a letter for the Director or Mr. Cutter, if you wish.

Document III-22

Document title: U.S. Congress, House, Committee on Science and Technology, Subcommittee on Space Science and Applications, "Space Telescope Program Review," 95th Cong., 2d sess., Report No. 85 (Washington, DC: U.S. Government Printing Office, 1978), pp. 3-7, 11-14.

Dr. Noel W. Hinners, NASA's Associate Administrator for Space Science, was the key player in resolving the dispute over whether a Space Telescope Science Institute should be operated by NASA or by a university consortium. Opting for the latter, Hinners presented to Congress NASA's reasoning behind its plans for the institute. This explanation was delivered in a filled hearing room before the Subcommittee on Space Science and Applications of the Committee on Science and Technology in the House of Representatives. Called by Hinners the "Space Telescope Program Review," his report on July 13, 1978, presented well the planning for the NASA-university partnership that governed the Hubble Space Telescope.

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[3]

Statement of Dr. Noel W. Hinners Associate Administrator for Space Science National Aeronautics and Space Administration before the Subcommittee on Space Science and Applications Committee on Science and Technology House of Representatives

Mr. Chairman and Members of the Subcommittee:

I welcome the opportunity to review with you the status of the Space Telescope Program. Following my brief overview including some discussion of our planned approach to science operations, Mr. William C. Keathley, the NASA Space Telescope Project Manager at Marshall Space Flight Center, will give a more detailed description of the development program and its cost performance, and schedule status.

The Space Telescope is being designed as a general-purpose, astronomical observatory in space with an anticipated lifetime of more than a decade. To be launched in late 1983 by the Space Shuttle, it will be the first long term national astronomical observatory in space. . . . The availability of the Space Shuttle will allow in-orbit repair of the observatory, exchange of experiments by Shuttle crew members, and, if necessary, return of the entire system to Earth for refurbishment and subsequent relaunch.

The Space Telescope, by being outside the Earth's atmosphere, will enable us to image objects that are ten times smaller than possible with ground-based optical telescopes. This will permit us to study nearby objects in much greater detail or to detect stellar counterparts at about ten times greater distance than is now possible from Earth.

If the universe has a beginning, we should be able to see some objects as they were near the beginning of time. The Space Telescope will allow us to observe light over the entire range from the far ultraviolet to the far infrared (from wavelengths of approximately 1100 angstroms to about 1 millimeter = 10,000,000 angstroms). Most of this range is inaccessible from ground observatories.

[4] The spacecraft facility is a cylinder of about 14 meters (46 feet) in length and 4.3 meters (14 feet) in diameter, weighing about 9,000 kilograms (10 tons). The mirror size will be 2.4 meters (94 inches), comparable to the larger Earth-based telescopes. The mirror is sufficiently large that experiments requiring large, light-gathering power can be carried out with this Telescope that have been impossible with smaller predecessors. The high resolution of the Space Telescope will permit the detection and measurement of stars as faint as the 27th or 28th magnitude, some fifty times fainter than those which can now be detected from Earth. Spectra will be obtainable from objects as faint as 25th magnitude, which is 9 1/2 magnitudes (factor of approximately 7,000) fainter than is possible with the International Ultraviolet Explorer and 13 magnitudes (factor of approximately 100,000) fainter than with the Orbiting Astronomical Observatory.

Five versatile scientific instruments (four American and one European) have been selected for flight at the focal plane of the Telescope to carry out a wide range of observations. The Space Shuttle in-orbit maintenance capability, mentioned earlier, will permit the replacement of failed or outdated equipment at a small fraction of the cost of a new scientific mission. Thus, the Space Telescope can be operated with the best scientific instruments as they become available.

Preliminary design efforts of the scientific focal plane instruments for the Space Telescope are being carried out by Investigation Definition Teams, composed of participating scientists who were tentatively selected by NASA on November 8, 1977. Final evaluation and confirmation of the payload selection will occur in early FY 1979, based on the results of the preliminary design reviews. We are confident of our ability to develop the instruments on a time scale consistent with the Space Telescope Project schedule, which assumes a late 1983 launch.

As has been indicated in previous testimony, negotiations with the European Space Agency (ESA) covering their participation in the Space Telescope Program have resulted in a Memorandum of Understanding, signed on October 7, 1977, by the NASA Administrator and the ESA Director General. ESA will supply, without cost to NASA, one of the scientific instruments, the Faint Object Camera; the solar array, which will provide power for the spacecraft facility; and, a number of personnel for science operations support. In return, observing time on the Telescope will be provided for European Scientists.

NASA's Marshall Space Flight Center is responsible for overall management of the Space Telescope Project. . . .

[5] As you are aware, the Space Telescope Program was approved as a new start in NASA's FY 1987 budget. The Program, because of its very complex and interactive nature, has been carefully planned and well defined. Currently, the major hardware contracts have been awarded, and all elements of the development work are on schedule and within the cost estimate.

As indicated in the past testimony, the development program for the Space Telescope does not include funding for the operation and maintenance of the Telescope beyond thirty days after launch nor for the establishment of the hardware and software capabilities required for science operations. As I indicated in February, during the Hearings on the FY 1979 Budget, we must begin to budget for science operations in FY 1980, if we are to have the required operational capability at the time of launch. In the remainder of my time, I would like to discuss this area of science operations which has been left open in previous testimony. I promised that we would get back and discuss our plans with you.

As indicated earlier, the Space Telescope is planned for operation for more than a decade with attendant in-orbit maintenance; recovery, refurbishment, and relaunch; and update of the focal plane scientific instruments. . . . During the operational period, the Space Telescope will be used the majority of the time by "general observers" who will be selected on the basis of proposals submitted in response to periodic solicitations. In developing observing schedules for the Telescope, the requirements of these observers will be integrated with those of investigators who are involved with development of specific focal plane instruments. The Space Telescope operations, including the investigation selection, scheduling, maintenance, refurbishment, etc., can be viewed as quite analogous to the operation of a large, ground-based telescope.

An important consideration with respect to the science operations for the Telescope has been the question of whether or not a Space Telescope Science Institute will be established, rendering the operation similar to that for a number of large, ground-based facilities. Over the years, a growing number of astronomical groups have studied the question of Space Telescope science operations. While these considerations have been carried out to widely varying depths, all such groups have made recommendations in favor of the Science Institute approach. . . . The 1976 National Academy of Sciences study group, chaired by Professor Donald. F. Hornig, studied the problem at our request. This group, which consisted of an ad hoc group of independent scientists, strongly recommended the establishment of a Space Telescope Science [6] Institute and outlined, in some detail, the functions, structure, and implementation mode for the recommended Institute. This study served as the point of departure for our in-house study group in considering the possible establishment of a Science Institute.

After studying this question at considerable length, using inputs from both the in-house and external study groups, we have come to a conclusion that the most efficient and scientifically satisfactory approach to science operations would involve the establishment of [a] Space Telescope Science Institute which would be operated under a long-term contract with NASA. Our approach, however, would not be identical to the National Science Foundation's approach to operation of large, ground-based facilities, since NASA must retain operational responsibility for the spacecraft/observatory. . . .

We feel that the science operations concept for the Telescope must reflect a long-term commitment as would be accomplished by a dedicated "independent" institute, giving astronomers and science operations personnel access to computer and other facilities, based on Space Telescope priorities. There is no doubt that the science impact of the Space Telescope will be comparable to that of major laboratories, which are being operated efficiently as national facilities in the "institute" mode. Such laboratories have proven to be responsive to the user community and, at the same time, able to work well with the funding Agency. The Space Telescope is the first planned, long-life, NASA science flight project, and we feel that operational procedures used on past flight projects do not necessarily constitute the most efficient way to handle this program. We are, in a sense, taking our cue from the people who have been successfully operating the analogous, ground-based observatories over a large number of years. Another obvious advantage of the "institute" mode is that it is an operational mode with which the world-wide astronomical community is familiar and confident. . . .

The Space Telescope Science Institute would have independent management and staff and its own computer hardware, which, in order to minimize cost, would begin operation using software developed by NASA.

[7] The Science Institute would conduct science operations activities in three major areas: planning and management, Space Telescope scheduling, and data activities. Within the planning and management function, the Institute would implement those policies

established by NASA which pertain to Space Telescope use. In this endeavor, the Institute would solicit, evaluate, and select observational proposals received from the scientific community and would formulate, for NASA review and approval, yearly activity goals which are in consonance with the overall policy established by NASA.

The Science Institute, in addition to a long-term planning function, would generate the generalized observing schedules. To accomplish this function, computers would be located at the Institute to develop the target selection sequence while, at the same time, observing such factors as target availability, sky constraints, and spacecraft design constraints. The Institute would generate observing instructions as required. In turn, the Space Telescope Operations and Control Center (STOCC) at Goddard Space Flight Center would convert the observing instructions into space commands that would properly point and control the Space Telescope.

In the data activities areas, the Institute would provide equipment enabling visiting scientists and staff to perform analyses of Space Telescope data, as well as to conduct basic research in the field of astronomy. Further, it would evaluate science productivity of the Space Telescope research program. It would help coordinate both correlative research with ground observing facilities and international participation in the overall activity. Finally, it would be responsible for informing the public of research results, as well as for archiving all Space Telescope data for dissemination as requested.

In view of the use, initially, of NASA-generated software, the computer complex would be designed to be compatible with the computers in the STOCC at Goddard Space Flight Center. Consequently, the complex at the Institute would be designed by NASA prior to the establishment of the Institute.

No compelling reasons have been identified for locating the Science Institute close to any existing NASA facility, so long as appropriate Institute personnel are collocated at Goddard Space Flight Center to interface with the STOCC. It is anticipated that the operational site of the Institute would be included as part of the proposals for its operation. Only general site criteria would be specified by NASA. These criteria might include such factors as proximity to an active astronomical center of excellence, a major airport, etc.

We currently would anticipate release of a Request for Proposals early in FY 1980 for the operation of the Institute. The Institute would be built up slowly to full strength prior to launch of the Telescope in the first quarter of FY 1984. . . .

[11] [Briefing Charts]

RECOMMENDATIONS ON THE METHOD OF SPACE TELESCOPE SCIENCE OPERATIONS
(ALL IN FAVOR OF THE SCIENCE INSTITUTE APPROACH)

Date	Organization
1966	REPORT OF STUDY HEADED BY NORMAN RAMSEY
APRIL 1975	ST SCIENCE WORKING GROUP—BODY OF SENIOR SCIENTISTS SELECTED BY ANNOUNCEMENT OF OPPORTUNITY TO PARTICIPATE IN THE PRELIMINARY DESIGN PHASE OF ST
AUGUST 1975	COUNCIL OF THE AMERICAN ASTRONOMICAL SOCIETY—ELECTED COUNCIL OF THE ONLY PROFESSIONAL ASTRONOMICAL SOCIETY IN THE UNITED STATES
NOVEMBER 1975	LST STUDY GROUP—AD HOC BODY OF SCIENTISTS CONVENED BY THE ASSOCIATE ADMINISTRATOR TO PROVIDE AN OVERVIEW OF THE ST PROGRAM
FEBRUARY 1976	SHUTTLE ASTRONOMY MANAGEMENT AND OPERATIONS WORKING GROUP—SCIENTIFIC WORKING GROUP CHAIRED BY THE CHIEF OF THE ASTRONOMY AND RELATIVITY OFFICE OF THE OFFICE OF SPACE SCIENCE
DECEMBER 1976	NATIONAL ACADEMY OF SCIENCES—REPORT OF THE SPECIAL STUDY HEADED BY PROFESSOR HORNIG

[12]

SPACE TELESCOPE SCIENCE INSTITUTE CHARACTERISTICS

- LONG-TERM COMMITMENT TO SCIENCE OPERATION
- COMPUTERS AND OTHER FACILITIES ACCESSIBLE TO ASTRONOMERS AND SCIENCE OPERATIONS PERSONNEL
- EFFICIENT MODE OF OPERATION WHICH HAS PROVEN TO BE RESPONSIVE TO THE USER COMMUNITY AND AT THE SAME TIME TO WORK WELL WITH FUNDING AGENCY
- ANALOGOUS TO THE OPERATING MODE EMPLOYED AT LARGE GROUND-BASED OBSERVATORIES OVER A LARGE NUMBER OF YEARS
- OPERATIONAL MODE WITH WHICH THE WORLDWIDE ASTRONOMICAL COMMUNITY IS FAMILIAR AND CONFIDENT

[13]

SPACE TELESCOPE SCIENCE INSTITUTE
SOME KEY OPERATIONAL FUNCTIONS

- SCIENCE PLANNING AND MANAGEMENT
  - IMPLEMENT NASA ST SCIENCE POLICY
  - SOLICIT, EVALUATE, AND SELECT OBSERVATIONAL PROPOSALS
  - COORDINATE CORRELATIVE RESEARCH
  - COORDINATE INTERNATIONAL PARTICIPATION

- SCHEDULING
  - GENERALIZED OBSERVING SCHEDULES
    - TARGET SEQUENCE
    - TARGET AVAILABILITY
    - SKY CONSTRAINTS
    - SPACECRAFT CONSTRAINTS
  - GENERATE OBSERVING INSTRUCTIONS

- DATA ACTIVITIES
  - REDUCE AND ANALYZE DATA
  - CONDUCT BASIC RESEARCH
  - EVALUATE SCIENCE
  - INFORM THE PUBLIC
  - ARCHIVE AND DISSEMINATE ST DATA

[14]

SPACE TELESCOPE SCIENCE INSTITUTE
SUMMARY

CHARACTERISTICS—
- INDEPENDENT MANAGEMENT AND STAFF
- DEDICATED FACILITIES (INCLUDING COMPUTERS)
- INITIAL SOFTWARE DEVELOPED BY NASA
- LONG-TERM CONTRACT WITH NASA

LOCATION—
- NO COMPELLING DATA-HANDLING, MANAGERIAL, OR COST REASONS FOR LOCATION AT ANY EXISTING FACILITY
- SITE TO BE INCLUDED AS PART OF PROPOSALS FOR INSTITUTE OPERATION/GENERAL SITE CRITERIA

IMPLEMENTATION—
- FIRST BUDGET YEAR—FY 1980
- RFP RELEASED—EARLY FY 1980
- FULLY OPERATIONAL—AT LAUNCH—FIRST QUARTER OF FY 1984

Document III-23

Document title: R. W. Gutman, Director, General Accounting Office, to Robert A. Frosch, NASA Administrator, November 11, 1977.

Document III-24

Document title: Robert A. Frosch, NASA Administrator, to Associate Administrator for Space and Terrestrial Applications, *et al.*, "NASA/University Relations," May 18, 1978, with attached: "Policy for Academic Involvement in the NASA R&D Program."

Source: Both in University Affairs Files, NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

These two memoranda discuss the review and reform of NASA's university relations efforts during the latter 1970s. In these documents, NASA Administrator Robert Frosch, in concert with others, sought to delineate the relationship between NASA and academia, as well as the activities that were appropriate for each to undertake. Essentially, Frosch directed that NASA rely on university expertise to provide basic research relative to the mission of the agency, and he interpreted NASA's role in this arena as being one of facilitator. He was also responding to concerns expressed by the General Accounting Office (GAO) that NASA was conducting its university affairs program as basically open-ended support for scientists and engineers without clear program definition. By tying the research sponsored by NASA much more closely to aerospace research and development activities under way at the agency, Frosch helped resolve many of these concerns.

Document III-23

[1] The Honorable Robert A. Frosch November 11, 1977
Administrator, National Aeronautics and Space Administration

Dear Dr. Frosch:

The General Accounting Office just completed a survey under assignment code 952174 of NASA's administration of research grants and contracts to colleges and universities. During this survey, several aspects of NASA's university research program were identified which we believe could be improved. Before planning additional work in this area we believe it would be mutually beneficial to both NASA and GAO to meet with you and your representatives. The purpose of the meeting would be to present to you our survey results and observations and to obtain your views thereon.

The specific areas we would like to discuss are:

— increasing university competition for research projects;
— improving the negotiation process and detailed support for the number of hours included in a proposal;
— the possibility of requiring NASA technical monitors to visit research sites to see what progress is being made;

— corrective action that NASA could take when the cognizant Federal audit agency reports accounting system deficiencies at universities having NASA research grants and contracts; and
— acquiring and disseminating technical information.

Another area to be discussed relates to administrative differences between grants and contracts. It is not always clear as to whether a grant or a contract is the proper instrument to fund a project. In the case of grants, grantees are not required to report how funds were spent, grants are not audited prior to closing, and grantee-acquired equipment is not entered in NASA's Equipment Visibility System although NASA has the option to obtain title to this equipment upon completion of a grant.

In summary, NASA's grant and contract administration practices give the appearance that a university assistance program is being conducted rather than a mission-oriented research program to further the agency's [2] mission. Several NASA officials told us that a grant is a gift and that if a university fails to comply with grant provisions, action taken by NASA is limited to "friendly persuasion." It may be a valid position that universities should be treated differently than commercial entities dealing with the Government; however, this should be balanced against the responsibility Federal agencies have for stewardship of public funds entrusted to them.

We would like to schedule a meeting at your convenience soon after the first of December. Arrangements for the meeting can be made with Mr. Chester S. Daniels, Assistant Director of this Division. He can be reached by telephone on 275-3191.

Sincerely yours,

R. W. Gutman
Director

Document III-24

[1] May 18, 1978

Memorandum

TO: E-1/Associate Administrator for Space and Terrestrial Applications
R-1/Associate Administrator for Aeronautics and Space Technology
S-1/Associate Administrator for Space Science
L-1/Associate Administrator for External Relations

FROM: A-1/Administrator

SUBJECT: NASA/University Relations

We have completed our review of the role of academic institutions in the NASA R&D Program, and it is our intention to continue to have strong academic involvement in the NASA R&D Program.

NASA intends to enhance and strengthen the academic participation in its research program, particularly in those disciplines supporting our aeronautical and applications programs.

It is NASA policy to involve academic scientists primarily in basic research. NASA encourages a growing independent academic research program; in particular, academic scientists will be given the opportunity to help advance the frontiers of science and technology in all disciplines of interest to the Nation in aeronautics and space. Cooperative programs between academia and in-house NASA research groups are beneficial and will continue. NASA will encourage the use of facilities at NASA centers by university scientists.

NASA's policy shall be to encourage centers of excellence in universities and to cooperate with academic groups to strengthen them as required in research and education in aerospace science, engineering, and management.

[2] NASA's relations with the university community will be conducted in a manner that reflects concern and understanding for the role of universities in education and research; avoids undue imposition of burdensome requirements; and does not tax an institution's financial resources.

Enclosed is a draft of policy guidelines for university relationships which will be converted into an appropriate policy statement by the Office of External Relations.

Each Associate Administrator, working with the appropriate Center Directors, shall prepare and submit by July 1, 1978, an action plan for my approval for accomplishing the goals of this policy. The action plan should define the current program with academic institutions, the plans to increase emphasis on independent research, and the management approach designed to place these policies into action. After acceptance of these action plans, the Associate Administrators and the Center Directors will be held accountable for the conduct of all academic activities under their control and, in particular, for strengthening academic programs in basic creative, and independent research in the area of applications, aerospace science and engineering.

The Associate Administrator for External Relations will be responsible for necessary coordination activities among program offices and should be kept appropriately informed.

It is my firm belief that judicious application of these policies will result in a combined stronger in-house and academic research establishment, and a stronger and more creative NASA research program in the decades ahead.

Robert A. Frosch

[Attachment 1]

POLICY FOR ACADEMIC INVOLVEMENT IN THE NASA R&D PROGRAM

- Academic scientists will conduct a substantial portion of the basic research in all disciplines in the NASA program.
- Academic scientists will participate directly, or through advisory groups, in all phases of the basic research activity: conception, planning, programming, execution, analysis and interpretation of the data, and publication of the results.
- Academic basic research groups will be encouraged to show independence and creativity in their work which will be subject to periodic peer evaluation.
- Basic research opportunities using specified NASA spacecraft and/or specified instruments aboard a NASA spacecraft will be available to academic scientists on the basis of open competition, evaluation of their proposal by their peers and selection by the appropriate Associate Administrator.
- NASA's research facilities will be available for basic research by academic scientists. The appropriate Associate Administrator and Center Director will assure access of suitable facilities, broad notification, and proper selection of academic research projects.

- Cooperation in basic research between academic research groups and NASA in-house groups will be encouraged.
- Continuing research programs will be subject to peer evaluation at least once every three years involving reviews by a group of academic and in-house scientists with recognized research competence in the discipline.
- NASA's relations with the university community will be conducted in a manner that reflects concern and understanding for the role of universities in education and research; avoids undue imposition of burdensome requirements; and does not tax a university's financial resources.

Document III-25

Document title: NASA/University Relations Study Group, "The Universities and NASA Space Sciences," Initial Report of the NASA/University Relations Study Group, July 1983.

Source: University Affairs Files, NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

By the early 1980s, the entire NASA-university space science relationship was still experiencing difficulties. In March and April of 1983, a special group of NASA and university representatives met to discuss the problems in the relationship and to discuss possible short- and long-term policy solutions. The study group was co-chaired by Thomas Donahue of the University of Michigan and Frank McDonald of NASA Headquarters. Their initial report, reprinted here, contained a series of recommendations on ways to put the relationship back on a productive footing.

The Universities and NASA Space Sciences

[1] **I. Introduction**

From the beginning of the space program, university scientists have played a vital role in all phases of NASA's basic space research activity. It continues to be NASA's policy that a substantial portion of the basic research in space science should be conducted by university groups. The contributions from these groups have been an essential factor in the vitality of our nation's space program. Universities not only help generate new missions, design and build experiments, and interpret data, but most importantly, they are the essential conduit in transferring new knowledge and technology to other elements of society through the education and training of students.

A. NASA/University Relations: The NASA space science program has evolved over 25 years from one with a high frequency of exploratory missions, to one based primarily on long-lived observatories and planetary orbiters. During the 60's, NASA's space science program involved an average of 4 or 5 flight missions per year. The scientific investigations for most of these missions were selected by a competitive process with the university groups historically supplying some 60% of the experiments. NASA further encouraged university participation through continuing multi-disciplinary research grants to more than 40 universities and through the construction of 37 space science buildings or additions. To increase the number of research workers, there was a nationwide program of NASA fellowships for graduate students. By the late 60's, more than 5,300 students had received 3 year graduate fellowship awards. The establishment of the Space Science Board, under the auspices of the National Academy of Sciences/National Research Council, provided university research scientists with a major role in advising NASA on science goals and policy for the U.S. space program.

By the early 80's the NASA launch rate of scientific satellites had declined to 1 or 2 per year. The graduate fellowship program had been dropped and the sustaining university grants were terminated. The Office of Space Science and Applications' [OSSA] budget, when measured in 1982 dollars, has decreased from a peak of 1.63 billion dollars in 1964 to .95 billion in 1984. Despite this decrease, the NASA science and applications budget remains one of the major funding sources for basic research in the United States. There have also been programmatic changes with a natural evolution toward larger and more complex missions as the exploratory phase of space studies has been completed. These new missions are taking the form of long-lived observatories such as Space Telescope and the Gamma Ray Observatory and planetary orbiters such as Galileo and the Venus Radar Mapper. A similar evolution has taken place with Explorers and the very exciting but technologically challenging missions such as IRAS [Infrared Astronomical Satellite] and COBE [Cosmic Background Explorer]. This sharp decrease in flight opportunities, accompanied by significant decreases in supporting research and data analysis funding have had the most deleterious effect, forcing drastic reductions in many university space research groups. Furthermore, contrary to original expectations, frequent opportunities to carry out scientific investigations on the Space Shuttle have not yet developed.

[2] **B. The Role of the University:** The elements of space sciences are a part of broader scientific disciplines, such as astronomy and astrophysics, earth and planetary sciences, and solar and space plasma physics. In their complete form, these provide both the rationale for the NASA programs and a framework for interpreting, incorporating, and communicating the results of those programs. It is through the continuing development and evolution of this disciplinary framework and the education of new scientists and engineers, that the universities play their unique and essential role in NASA's space program.

There are many facets to the universities' role in the space sciences which result naturally from its place in this broader spectrum of science and engineering research. In the universities, the space sciences maintain contact with related disciplines, benefiting from and contributing to the cross-fertilization of creative activity that stimulates innovation. Contact between disciplines in the universities also leads to the development of new areas of research. For example, high energy astrophysics emerged from such contact between physics and astronomy. Similarly, space plasma physics grew out of physics, geophysics, and solar physics. Within the universities there is the flexibility to respond to the opportunities offered by new developments in related fields of study, and there are young, innovative students anxious to develop and exploit new approaches to scientific endeavors.

Perhaps the most obvious role of the universities is in the education and training of graduate students. Students are an integral part of university research programs which are directed toward the increase of fundamental knowledge in the various scientific and engineering disciplines. The infusion of new talent, ideas, and innovation through the education of young people in the relevant disciplines is essential in maintaining the long-term vitality of space sciences. Equally important is the transfer of knowledge and technology that occurs when students trained in these disciplines move to industry and the national laboratories, taking with them research skills and familiarity with advanced technology characteristic of the space sciences.

The universities educate more than just space scientists. As the results from the space sciences are distilled and incorporated into coherent bodies of knowledge, they become part of the general education of all students and are eventually woven into the fabric of society.

C. The Requirements of University Space Science: The ways in which universities participate in space science can be broadly characterized as the formulation of new con-

cepts and ideas, the development of new observational and experimental techniques, data analysis and interpretation, laboratory studies and theory. The relative importance of these various modes tends to differ among disciplines and to change with time. Organizationally, university participation has taken many different forms, from the creation of large research centers on some campuses to the involvement of small investigator groups at other institutions. The vitality of NASA's space science program is dependent on establishing an adequate research base at universities as well as at the NASA centers. It requires adequate research and analysis funding, a proper level of support for mission operation, data analysis and theoretical research, and continuing opportunity for participation in flight experiments.

[3] *Continuity of support is a very key factor in sustaining the vitality of university research groups.* To be effective, a typical university research activity must include professional faculty, key senior research faculty, postdoctoral fellows, and graduate students. Many activities also require a small core staff of engineers, programmers, and technicians in order to carry out the technical and managerial tasks characteristic of space science programs. Continuity is also important in the many cases where the innovations of subsequent programs often arise from the experience gained in previous programs.

Continuity of support for graduate students and postdoctoral fellows is also essential. The key element of graduate education is learning to be a researcher, a process that takes on average 6 years in space sciences, culminating in a doctoral dissertation. Undertaking such a lengthy educational process is feasible only if there is dependable continuity of support not only for the student, but for the university group's research program.

As a postdoctoral fellow, for a period of 2 to 3 years, the scientist continues to develop as a researcher, seeking to establish a solid research program and gaining recognition as an effective and independent scientist through the publication of research results. Since these objectives can be accomplished only with a sustained effort over several years, continuity of support is required during this important phase of an emerging scientist's research career.

Effective university programs also depend on the availability of modern instrumentation and computing facilities. Modern laboratory test equipment is critical not only in the development of new observational techniques, but also in training graduate students in the technology which is current in industrial and federal laboratories. Effective progress in space research depends on the existence of appropriately staffed and maintained major laboratory facilities, which must be periodically upgraded in order to address the scientific questions of greatest interest with the most modern techniques.

All of these attributes, including the provision of adequate flight opportunities, continuity of support, and the need for modern instrumentation and computing facilities, are necessary if the space sciences are to be sufficiently challenging to retain the interest of senior researchers, to offer realistic career opportunities to the most innovative younger researchers, and to attract capable, motivated graduate students.

D. NASA/University Study: Both NASA and the university scientific community have recognized for some time that a significant and undesirable erosion has occurred in the funding level of many university space research groups. (See Appendix 2 for a brief discussion of long-term funding trends in both NASA and in NASA funding to educational institutions.) After consultation with the Space Science Board, NASA felt that the best approach to defining the problem was to conduct a study with broad representation from NASA and the university community. The terms of reference and list of participants are included as Appendix 1. This group had meetings in March and April 1983. The strategy developed was to first explore short-term problems and issues and then spend the next year examining longer-term policy considerations and changes that might be made to reaffirm and/or redefine the NASA-university space science program.

[4] A letter describing the study and requesting comments from the community was sent to some 120 scientists. Thirty percent sent written responses. A representative sample of these letters is included in *Appendix 3*. Members of the group also had lengthy discussions with many university and NASA scientists. The Headquarters science discipline chiefs were also consulted in a series of meetings on the principal needs of their research areas.

In summary, the most important areas identified by the community and the discipline chiefs were:

1. Increase the availability of low to moderate cost flight opportunities on the Space Shuttle, Explorers and the sub-orbital programs.
2. Improve and modernize the university space science laboratories.
3. Provide additional data analysis funding.
4. Examine the adequacy of the research and technology base for the space science and applications program.

Three of these areas were identified where immediate steps could be taken which would have a positive impact on the health of university research groups. These were:

1. University Equipment Grants to provide standard laboratory equipment, as well as larger facility instruments, to university groups actively engaged in NASA research.
2. Graduate Student Fellowships to provide financial support to graduate students working on NASA related programs.
3. Increased Funding for Data Analysis which many programs including Voyager, IUE [International Ultraviolet Explorer], Landsat and others, could greatly benefit from.

The specific recommendations and their rationale are given in the next three sections. Looking beyond these immediate steps the following longer range studies are planned for the coming year:

- The Space Shuttle offers great promise for creating new experiment opportunities on a timely basis which can be exploited at a reasonable cost. A group will be established under the auspices of the NASA-university relations study group to examine how these objectives can be met.
- It is recommended that the NASA Space and Earth Science Advisory Committee examine the research and analysis program to ensure that the various discipline areas are being properly supported both in the development of new detectors, advanced analysis systems, and theoretical research.
- The NASA-Center-university relations should be examined to consider means by which this partnership could be made more effective.

[5] **II. Laboratory Tools for the Space Sciences**

University scientists, with their students and staff, have made major contributions during the past quarter century in establishing the position of leadership in the space sciences and exploration that the United States enjoys. This achievement was made possible by the unique collaboration, or partnership, between the university community and NASA, that provided the resources, planning, and long-range objectives for our national space program. Central to this success was the recognition by NASA at the beginning of the Space Age (e.g., 1958-64) that university scientists needed the "tools" and equipment to design and develop innovative instrumentation for space flight, and to process and analyze the data returned from space missions. Thus, through the purchase of equipment and facilities with funds provided by NASA, and pooling of laboratory equipment existing in the university laboratories at that time, there came into existence well equipped facilities that generated a program of imaginative scientific research in space and permitted the training of a new generation of investigators, engineers and managers. However, during the past decade the equipment and special facilities acquired in the early 1960's and

70's became obsolete and increasingly difficult to maintain. Dramatic technological advances in space flight instrumentation made it very difficult, or impossible, to develop "state of the art" space flight instruments with the laboratory equipment of the 1960's and early 70's. As aging instruments have fallen into disrepair, it has become all but impossible to obtain replacement parts from industry. Consequently, technicians in the laboratories are preoccupied increasingly with repair of instruments, side-tracking them from more important tasks.

The development of experiments for future space missions requires full access to modern technology. All too often we are now training our next generation of scientists and engineers and designing new experiments with equipment from a past generation—instead of equipment that will keep them and our technology on the forefront of the engineering and experimental sciences. Indeed, many European and Japanese laboratories, with which we compete, are equipped with much more modern tools than those possessed by our own laboratories.

How did NASA and the universities fall so far behind in equipping university laboratories for space research and teaching of the next generation—after such an auspicious beginning? Two factors, both based on financial support, appear to be at the root of the problem:

1. NASA support for space experiments by university investigators is in the form of a contract which provides for the design, fabrication and testing of the instrument, followed by funds for data analysis. However, the contracts exclude funding for the acquisition of new capital equipment or facilities to carry out the commitment;

[6] 2. Since the principal support is through mission contracts, university scientists look to supporting Research and Technology (now Research and Analysis) grants for research and equipment funds. However, over the past decade the real level of support in these areas has steadily declined. Consequently, as the support declines, an ever-increasing fraction of the funds must be used to keep students and staff—with the result that funds for equipment become non-existent, especially for state-of-the-art equipment.

The time has come to take extraordinary steps to rectify this situation and again bring university laboratories into the same competitive position as laboratories in other countries, or even laboratories in our own NASA centers. Clearly, this will require an infusion of funds over a period of a few years devoted to this objective, but an early beginning is urgently needed.

In working out a program, we may define three general classes of equipment and facilities needed as follows:

1. Commercial laboratory equipment (e.g., oscilloscopes, test equipment, spectral analyzers, micro-processor development systems, etc.);
2. Small and medium sized computational equipment of the micro and minicomputer class (e.g., computers and peripheral hardware, tape and disc drives, terminals, couplers to national networks, commercial software, etc.), and interactive hardware which becomes especially important with the evolution of "observer class" space missions (e.g., Space Telescope, IUE, etc.);
3. Major facilities for use by several investigators collaborating at an institution (e.g., vibration and shock testing equipment), or for establishing interdisciplinary research (e.g., micro-ion probes, gas analyzers, etc.) which would be used by different groups of investigators within an institution. Another example would be large, fast computer facilities of the Cray class, which would be used by several investigators and jointly by investigators at several institutions. Major facilities of

this type require periodic technical support; and it is recognized that the necessary funding support for these facilities should be provided by NASA as part of this program.

Clearly, the NASA Discipline Chiefs within OSSA are closest to the needs of the investigators and their institutions, and are in the optimum position to make judgments on which institutions, investigators, and researchers would benefit the most from equipment funds. Therefore, we recommend that a line item be identified in each Discipline Chief's budget which would be available only for this purpose and would be funded through augmentation of current budgets by the appropriate amount.

[7] A preliminary survey by NASA staff indicates that the following annual budget levels for this purpose would be:

Astrophysics	$3.000M
Planetary Sciences	2.000M
Environmental Observations including Space Plasma Physics and Solar Terrestrial Theory	4.000M
Life Sciences	1.000M
Communications, etc.	1.000M
TOTAL Annual Commitment:	$11.000M

In view of the urgency, it is recommended that this program be instituted in the FY 1985 budget and continued at this, or higher level, for at least five years—with a somewhat lower level in future fiscal years.

How should the NASA Discipline Chiefs decide on which institutions to focus their attention? Suitable criteria might include:

a. The proven record of the investigators at institutions with regard to innovative instrumentation, discovery, and exploration in their disciplines;
b. The proven record of their training graduate students;
c. Evidence that the institution has demonstrated a commitment to the space sciences as an integral part of teaching, research, etc., in the departments of the institution;
d. New institutional support where a novel and important direction of research of interest to NASA has been identified.

A program of this type is essential for revitalizing—indeed retaining—those institutions and individuals and groups within institutions concerned with the space sciences, if they are to continue their vital role in space research and training for the 1980's and 1990's.

[9] **III. Graduate Research Fellowships**

The education and training of graduate students is one of the vital roles of the University. Training these students in space science is important to NASA and to the technology base of the country. They bring dedication and new insight to the ongoing research program and will design and build tomorrow's new generations of spacecraft, instrumentation, telescopes and rockets.

To attract the best students into the challenging areas of NASA activities and to reaffirm its commitment to graduate education, it is proposed that NASA re-establish a program of graduate research fellowships on a smaller and more focussed [sic] scale. Such a program would initially have 50 fellowships and would build to an annual steady state program level of 200 students.

The existence of such a fellowship program would constitute an announcement by NASA that the Agency is interested once again in seeing students of the highest quality involved in its programs and, we believe, would be a mechanism for attracting the best students. The competitive nature of the program we propose (as well as an attractive stipend) would help ensure that these fellowships would be regarded as prestigious awards. Such a fellowship program would permit awardees the freedom and stability to concentrate on their studies and research and allow them to progress through their graduate studies without being dependent on a particular NASA grant or flight program.

The fellowship program would be designed to attract students at two stages in their careers. The first of these is at the transition from undergraduate to graduate school when the student is selecting a field of study and a university department in which he wishes to pursue those studies. The objective of the fellowship program is to influence the best graduating seniors to select some field of space science. The second group of students is that which is at the stage of selecting and being accepted by a faculty research advisor with a view to choosing a thesis research topic. The purpose of the fellowship award, is to induce the best students already in a department or a university that has a space science program to do his thesis research in that program.

The preliminary prospectus for such a program is outlined in the following paragraphs:

Graduate Research Fellowships

Eligibility—The first class of students eligible consists of those entering graduate school who are accepted for study in a university department with a recognized program in some phase of space science. A list of such departments will be prepared by NASA. Students with outstanding undergraduate records and a[n] aptitude for success in some field of space science will be sought. Their continuing eligibility would be dependent on their selecting a space related thesis topic. The second class are students with proven ability in graduate study.

[10] **Duration**—In no case will a student be eligible to maintain a NASA graduate fellowship beyond the sixth year of graduate study. For students in category (a), the initial award shall be for three years. Renewal for a second three year period will be contingent on the student's admission to candidacy for the PhD degree and acceptance by a faculty research advisor for a thesis research project in space science. For students in category (b), the award should be for three years, subject to annual certification that the student is making normal progress toward a degree and is continuing to work in space science.

Stipend—The stipend should cover the full calendar year (not only the 9-month academic year) and be comparable to the best graduate research assistantships. The stipend should provide full tuition at whatever university the student attends (so as not to prevent students from attending private universities having higher tuition) and a living allowance of $13,000 per year that would be increased by $1,000 per year after each additional year after the first, up to a maximum of $16,000.

Application—Selection of candidates entering graduate school should be based on a one-page statement by the student describing their career goals, a transcript, G.R.E. results, and three letters of recommendation. For advanced students, the statement should describe the proposed research topic and one of the letters of recommendation must be from the proposed research advisor.

Selection—Applications should be submitted to NASA Headquarters and fellows should be selected by a board consisting of 3 members of the academic community and 3 NASA scientists, all appointed by the NASA Administrator. NASA discipline chiefs will be asked to review and grade the proposals in the appropriate disciplines.

Number—Approximately 50 new awards per year, of which at least 25 should be to entering graduate students, leading to a steady state number of about 250.

Publicity—We would urge wide publicity for the selected students including, if possible, articles in *Science News, Science,* etc.

[11] **IV. Data Analysis and Mission Operations**

It is the interpretation and analysis of the data from space missions that frequently offers the greatest intellectual challenge to researchers, post-docs and graduate students. The scientist takes the information from these remote laboratories, analyzes the data, and uses the results to extend our knowledge of the universe. This seeking of "new knowledge" is the primary reason for undertaking these new missions. However, as the experiments and spacecraft have become more complex and the costs of mission operations and data analysis have increased, the available funding has not always reflected this change.

There has also been a very positive development over the past ten years as the average lifetime of the NASA science missions has significantly increased. This enhanced longevity is due in large measure to the increase in space engineering experience and the development of a sophisticated technology base. Despite the decrease in launch rate, there are now some 14 active satellites returning valuable new data to a large number of space experimenters and guest investigators.

This increase in spacecraft lifetime frequently offers a very cost effective means of achieving new, high priority scientific objectives—objectives which were not part of the spacecraft's original intended mission. For example, ISEE-3 has been moved from the Lagrangian point 8,000,000 km in front of the Earth to a close lunar fly-by with repeated passes through the distant geomagnetic tail region. It will be the first detailed survey of this very dynamic portion of our magnetosphere. Later this year, ISEE-3 will be redirected toward the first encounter with a comet—Giacobini-Zinner in 1985. After completing its fly-by of Jupiter and Saturn, Voyager 2 has now been targeted for a Uranus encounter in 1986 and Neptune in 1989—thus making it possible to accomplish most of the objectives of the original "Grand Tour." Pioneer 10, now in its 12th year, is exploring the distant heliosphere beyond 30 AU and discovering a number of unexpected phenomena. ISEE I and II, Pioneer-Venus and IMP-8 [Interplanetary Monitoring Platform] are studying the changes that occur in the Earth's magnetosphere, the atmosphere of Venus and the interplanetary medium as the level of solar activity begins to significantly decrease. IUE has an almost unlimited number of classes of astronomical objects that are being observed for the first time in the ultra-violet portion of the electromagnetic spectrum. Nimbus-7 is in its fifth year of operation and its data set of earth observations is now long enough to permit study of long-term trends, interannual variations, and questions of climate. This fleet of active satellites is currently one of space science's greatest assets.

The Landsat programs produced vast quantities of high resolution imagery of the [E]arth's surface. As with the operational meteorological satellites, there is a significant need to analyze this data as part of scientific research into the functioning of the Earth. Extended analysis of this type of data must be established in the university community as an integral part of space science research or else this available wealth of information will not be adequately used for furthering the understanding of our own planet.

[12] The costs associated with the extended phases of these missions are generally modest, since most production and analysis programs have already been developed and only require updating. However, the funding levels for data analysis and mission operations have not been adequate to realize the full scientific return from this sustained and available flow of scientific data.

In fiscal year 1983, the data analysis and mission operation budget is about $155M or approximately 15% of the OSSA total budget. $14M of this was added by Congressional appropriations committees to ensure the continuation of such key programs as Pioneer-Venus and Pioneer 10. It is proposed that this be increased by $20M per year with most of this increased allocation going to University groups. This increase in data analysis funding will have an enormous impact on the vitality of the space science program.

A survey of the data analysis requirements was made by the NASA headquarter's [sic] discipline chiefs and the following augmentations were proposed:

Data Analysis Requirements

Solar System Exploration	
Inner Planets Data Analysis (Mariner 10, Lunar Orbiter, PVO)	$4M/yr
Outer Planets Data Analysis (Viking, Voyager, Pioneer 10/11)	$6M/yr
Astrophysics	
Solar & Heliospheric Physics (SMM Guest Investigators, 0S0-7, 0S0-8)	$1M/yr
Astronomy & Relativity (OAO 2 & 3, Increase IUE)	$1M/yr
High Energy Astrophysics (HEAO-l, 2, 3, SAS-3)	$2M/yr
Environmental Observations	
Space Plasma Physics (IMP-8, AE, ISEE-l, 2, 3)	$1M/yr
Climate Research (Nimbus 6 & 7, Sage l)	$1M/yr
Upper Atmosphere Research (Nimbus 4, 6 & 7, Sage, SME)	$1M/yr
Global Weather, Tropical Air Quality (GOES, GMS, TIROS-N, NOAA-D, E, F)	$3M/yr

[13] **V. Future Studies**

The most important area identified by the community was increasing the availability of low-cost flight opportunities via the Space Shuttle, Explorers, and the sub-orbital programs. This is a challenging task that requires more detailed study. The implementation of a more effective Explorer program should be pursued by the Space Science Board, NASA Headquarters and the NASA field centers. The current sub-orbital program is a good way for graduate students to conduct small but scientifically significant experiments which complement larger missions. The Space Shuttle offers great promise for creating new experimental opportunities. With the current flight plans, there should be frequent flight opportunities which can be exploited at a reasonable cost. The time scale from project approval to launch should be on the order of 18 months. It is not surprising that the great promise of the Shuttle for science has not been fully realized. The Shuttle itself has just reached operational status. Scientists and the manned program both need to learn how to use this new transportation system to greater advantage for science. The Study Group strongly urges that NASA establish a panel to study the Spacelab experience and

make recommendations on new approaches. It would be highly desirable to have this task completed over the next 8-10 months.

The research and analysis funding provides the research base for the NASA science program both at the universities and at the NASA centers. Over the years there have been substantial changes in the NASA program. The Study Group recommends that a re-examination of the R&A [Research and Applications] program be made to ensure that the various discipline areas are being properly supported both in the development of new detectors, advanced analysis systems and theoretical research. It is recommended that this study be undertaken by the Space and Earth Science Advisory Committee.

The NASA centers in managing the space missions and sub-orbital programs play a crucial role in the space science program. The centers also maintain strong in-house research programs. It is important to re-evaluate the University-NASA Center relationship, both in the management of space missions and experiments as well as their relative roles in the conduct of space sciences. In the longer term activity of the Study Group, a committee will be formed including representation from all the NASA centers strongly involved in space science and university representatives to consider ways in which the NASA-University partnership may be made more effective. Specific questions to be considered include the interchange of NASA and university personnel at several levels, methods of making center facilities, including large computer systems, more accessible to university users, and methods of providing center management and technical expertise to university principal investigators.

[1]

Appendix 1

Study of NASA-University Relations in Space Sciences
Terms of Reference

I. Motivation for Study

The agency recognizes that the benefits to the nation from a vital university space science program are large and diverse, and extend beyond the areas of scientific inquiry; that university-based space science research is a national resource which cannot be duplicated or obtained elsewhere; and that a healthy space science program at U.S. universities is essential to the agency space science program.

The nation's space science program has evolved so there is now greater emphasis on long-lived space observatories. These programmatic changes combined with a decline in the funding of the space science program has led to a marked decrease in new opportunities for flight experiments and to a decline in the viability of many long established research groups.

While there may have been early expectations that the university-based program could adjust itself at an appropriate level to support the agency space science program, there is now a growing body of evidence which strongly indicates that university relations and the resource represented in university space science will soon be insufficient to support current levels of the space science program in the agency.

II. General Approach to the Study

The agency, after consultation with the Space Science Board and other outside groups, feels that the best approach to the problem is a study with broad representation from NASA and the university community. The information resources (statistics, management personnel, and contract network to the universities) are on hand within the agency.

However, the programmatic changes related to both the evolution of the flight program and the decrease in the number of flight activities depends on a combined NASA/University discussion. Of greater importance is the understanding of conditions in the university laboratories that can only be supplied by representatives from all levels of university-based space science (researchers, program managers, university administrators), and they should possess knowledge of the problems adequate at their respective levels to serve as representatives of their communities. The agency will assume responsibility for the management of the study and the study report.

[2] **III. Tasks for Study Group**

A study group consisting of approximately 12 people drawn from NASA and the university community will:

- Assess the health of university space science research groups and identify the problems.
- Examine, and redefine if necessary, the role of university groups in NASA future space science program.
- Identify the essential steps which must be taken in the agency and universities to restore university space science to a viable level.
- Present conclusions and recommendations to appropriate outside groups for comment and assessment and to the Space Science Board and to NASA management for review and action.

IV. Methodology

- Organizational meeting to pose the problem and scope of the study (2 1/2 days—early March 1983).
- Period of information gathering (statistics, funding trends, student trends, program trends) (April-June 1983).
  - Individual visits
  - Regional meetings/workshops
  - Study groups, representatives meeting with appropriate groups (NASA centers, university research groups, research administrators)
  - Collection of statistics
- Synthesis of data and information (mid-July 1983, one week).
- Determine follow-on as necessary.

[1]

Appendix 2

Funding Trends in NASA's Space Science and Applications Program

In this appendix, the long term funding trends in both the total NASA appropriation and the Office of Space Science and Application's [sic] (OSSA) portion of that budget are briefly examined. All of these budget numbers have been converted to 1982 dollars in order to compare the variation of equivalent real purchasing power. In Figure 1, the total NASA funding is shown for the 1960-1984 period. The corresponding OSSA numbers are also shown, but have been multiplied by a factor of 10 to emphasize the relative variation of the OSSA budget to the total NASA appropriation. The OSSA data has been compiled by the Administration and Resources Management Division of NASA's Office of Space Science and Applications. They have taken into account the reorganization and changing program office responsibilities that have occurred during this time.

Over a period of 3-5 years, there can be large variations in the annual OSSA funding level. . . . The most disturbing trend is the decrease from 1.55 billion dollars in 1973 to 0.9 billion in 1982. Most of this decrease occurred in the planetary program. . . . These changes reflect the launch of the Viking and Voyager spacecraft and the stretch-out of the Galileo program. However, there are reductions in other areas that also have a large impact on the science program. There has been a steady decrease in the annual appropriations for research and analysis in the space science area . . . , while the level in space applications has remained relatively constant. As emphasized in the main body of the text, this support is of great importance in maintaining the vitality of research groups. . . . [2]. . . [3] NASA total funding to universities has been almost exactly 3% of the total appropriations from 1973 to 1984 (Table 1). However, in 1982 dollars, there is a decrease from 261.3M in 1973 to 177.6 in 1983. It is this very large decrease in the real funding level that is the key problem in maintaining NASA research programs at the universities.

The marked decrease in the number of flight opportunities, (see Table 2), has been an additional factor that has greatly affected space science research groups. This change is more complex, since it represents both a decrease in the available funding, as well as a move to larger, more expensive missions.

Table 1
Total NASA Funding to Educational Institutions

Year	Total NASA R&D Obligations 1982 $(millions)	Real Year $(millions)	in Constant FY 1982 Dollars	% of Univ. Funding to Total NASA Funding
1973	7,710	114.9	261.3	3.0%
1974	6,420	100.9	214.0	3.0%
1975	6,160	112.4	215.1	3.0%
1976	6,210	122.5	215.1	3.0%
1977	6,030	124.9	198.0	3.0%
1978	5,950	135.3	199.0	3.0%
1979	6,100	147.8	198.5	2.8%
1980	6,330	177.3	215.1	3.0%
1981	6,010	191.1	209.1	3.0%
1982	6,020	185.6	185.6	3.0%
1983	6,210	197.2	177.6	2.8%

[4]

Table 2
NASA Space Science and Applications Launches

Year	# of Launches	5 Year Average/Year
1958	1	
1959	4	—
1960	2	
1961	3	
1962	4	3.8
1963	3	
1964	7	—
1965	7	
1966	5	
1967	8	6.2
1968	5	
1969	6	—
1970	2	
1971	4	
1972	4	4.2
1973	6	
1974	5	—
1975	7	
1976	1	
1977	5	4.0
1978	6	
1979	1	—
1980	1	
1981	2	
1982	0	1.0
1983	1	
1984	1	—

Document III-26

Document title: Section 201 of Title II of Public Law 100–147, "National Space Grant College and Fellowship Program," October 30, 1987.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

During the administration of Ronald Reagan, 1981 to 1989, Congress passed the "National Space Grant and Fellowship Act" as a means of making funding available to institutions of higher learning for the revitalization of the scientific and engineering disciplines. The act was deliberately modeled on the Morrill Land Grant College Act of the 1860s, which provided land for public sale with the proceeds going to public universities. The 1987 act created "space grant" universities and consortia eligible for public funds to foster aerospace research and development and education.

[no pagination]

Title II—National Space Grant College and Fellowship Program

Sec. 201. This title may be cited at the "National Space Grant College and Fellowship Act."

Sec. 202. The Congress finds that—

(1) the vitality of the Nation and the quality of life of the citizens of the Nation depend increasingly on the understanding, assessment, development, and utilization of space resources;

(2) research and development of space science, space technology, and space commercialization will contribute to the quality of life, national security, and the enhancement of commerce;

(3) the understanding and development of the space frontiers require a broad commitment and an intense involvement on the part of the Federal Government in partnership with State and local governments, private industry, universities, organizations, and individuals concerned with the exploration and utilization of space;

(4) the National Aeronautics and Space Administration, through the national space grant college and fellowship program, offers the most suitable means for such commitment and involvement through the promotion of activities that will result in greater understanding, assessment, development, and utilization; and

(5) Federal support of the establishment, development, and operation of programs and projects by space grant colleges, space grant regional consortia, institutions of higher education, institutes, laboratories, and other appropriate public and private entities is the most cost-effective way to promote such activities.

Sec. 203. The purposes of this title are to—

(1) increase the understanding, assessment, development, and utilization of space resources by promoting a strong educational base, responsive research and training activities, and broad and prompt dissemination of knowledge and techniques;

(2) utilize the abilities and talents of the universities of the Nation to support and contribute to the exploration and development of the resources and opportunities afforded by the space environment;

(3) encourage and support the existence of interdisciplinary and multidisciplinary programs of space research within the university community of the Nation, to engage in integrated activities of training, research and public service, to have cooperative programs with industry, and to be coordinated with the overall program of the National Aeronautics and Space Administration;

(4) encourage and support the existence of consortia, made up of university and industry members, to advance the exploration and development of space resources in cases in which national objectives can be better fulfilled than through the programs of single universities;

(5) encourage and support Federal funding for graduate fellowships in fields related to space; and

(6) support activities in colleges and universities generally for the purpose of creating and operating a network of institutional programs that will enhance achievements resulting from efforts under this title.

Sec. 204. As used in this chapter, the term—

(1) "Administration" means the National Aeronautics and Space Administration;

(2) "Administrator" means the Administrator of the National Aeronautics and Space Administration;

(3) "aeronautical and space activities" has the meaning given to such term in section 2452(1) of this title;

(4) "field related to space" means any academic discipline or field of study (including the physical, natural, and biological sciences, and engineering, space technology, education, economics, sociology, communications, planning, law, international affairs, and public administration) which is concerned with or likely to improve the understanding, assessment, development, and utilization of space;

(5) "panel" means the space grant review panel established pursuant to section 2486h of this title;

(6) "person" means any individual, any public or private corporation, partnership, or other association or entity (including any space grant college, space grant regional consortium, institution of higher education, institute, or laboratory), or any State, political subdivision of a State, or agency or officer of a State or political subdivision of a State;

(7) "space environment" means the environment beyond the sensible atmosphere of the Earth;

(8) "space grant college" means any public or private institution of higher education which is designated as such by the Administrator pursuant to section 2486f of this title;

(9) "space grant program" means any program which—

(A) is administered by any space grant college, space grant regional consortium, institution of higher education, institute, laboratory, or State or local agency; and

(B) includes two or more projects involving education and one or more of the following activities in the fields related to space—

(i) research,

(ii) training, or

(iii) advisory services;

(10) "space grant regional consortium" means any association or other alliance which is designated as such by the Administrator pursuant to section 2486f of this title;

(11) "space resource" means any tangible or intangible benefit which can only be realized from—

(A) aeronautical and space activities; or

(B) advancements in any field related to space; and

(12) "State" means any State of the United States, the District of Columbia, the Commonwealth of Puerto Rico, the Virgin Islands, Guam, American Samoa, the Commonwealth of the Northern Mariana Islands, or any other territory or possession of the United States.

Sec. 205. (a) The Administrator shall establish and maintain, within the Administration, a program to be known as the national space grant college and fellowship program. The national space grant college and fellowship program shall consist of the financial assistance and other activities provided for in this chapter. The Administrator shall establish long-range planning guidelines and priorities, and adequately evaluate the program.

(b) Within the Administration, the program shall—

(1) apply the long-range planning guidelines and the priorities established by the Administrator under subsection (a) of this section;

(2) advise the Administrator with respect to the expertise and capabilities which are available through the national space grant college and fellowship program, and make such expertise available to the Administration as directed by the Administrator;

(3) evaluate activities conducted under grants and contracts awarded pursuant to sections 2486d and 2486e of this title to assure that the purposes set forth in section 2486a of this title are implemented;

(4) encourage other Federal departments, agencies, and instrumentalities to use and take advantage of the expertise and capabilities which are available through the national space grant college and fellowship program, on a cooperative or other basis;

(5) encourage cooperation and coordination with other Federal programs concerned with the development of space resources and fields related to space;

(6) advise the Administrator on the designation of recipients supported by the national space grant college and fellowship program and, in appropriate cases, on the termination or suspension of any such designation; and

(7) encourage the formation and growth of space grant and fellowship programs.

(c) To carry out the provisions of this chapter, the Administrator may—

(1) accept conditional or unconditional gifts or donations of services, money, or property, real, personal or mixed, tangible or intangible;

(2) accept and use funds from other Federal departments, agencies, and instrumentalities to pay for fellowships, grants, contracts, and other transactions; and

(3) issue such rules and regulations as may be necessary and appropriate.

Sec. 206. (a) The Administrator may make grants and enter into contracts or other transactions under this subsection to assist any space grant and fellowship program or project if the Administrator finds that such program or project will carry out the purposes set forth in section 2486a of this title. The total amount paid pursuant to any such grant or contract may equal 66 percent, or any lesser percent, of the total cost of the space grant and fellowship program or project involved, except that this limitation shall not apply in the case of grants or contracts paid for with funds accepted by the Administrator pursuant to section 2486c(c)(2) of this title.

(b) The Administrator may make special grants under this subsection to carry out the purposes set forth in section 2486a of this title. The amount of any such grant may equal 100 percent, or any lesser percent, of the total cost of the project involved. No grant may be made under this subsection, unless the Administrator finds that—

(1) no reasonable means is available through which the applicant can meet the matching requirement for a grant under subsection (a) of this section;

(2) the probable benefit of such project outweighs the public interest in such matching requirement; and

(3) the same or equivalent benefit cannot be obtained through the award of a contract or grant under subsection (a) of this section or section 2486e of this title.

(c) Any person may apply to the Administrator for a grant or contract under this section. Application shall be made in such form and manner, and with such content and other submissions, as the Administrator shall by regulation prescribe.

(d) (1) Any grant made, or contract entered into, under this section shall be subject to the limitations and provisions set forth in paragraphs (2) and (3) of this subsection and to such other terms, conditions and requirements as the Administrator considers necessary or appropriate.

(2) No payment under any grant or contract under this section may be applied to—

(A) the purchase of any land;

(B) the purchase, construction, preservation, or repair of any building; or

(C) the purchase or construction of any launch facility or launch vehicle.

(3) Notwithstanding paragraph (2) of this subsection, the items in subparagraphs (A), (B), and (C) of such paragraph may be leased upon written approval of the Administrator.

(4) Any person who receives or utilizes any proceeds of any grant or contract under this section shall keep such records as the Administrator shall by regulation prescribe as being necessary and appropriate to facilitate effective audit and evaluation, including records which fully disclose the amount and disposition by such recipient of such proceeds, the total cost of the program or project in connection with which such proceeds were used, and the amount, if any, of such cost which was provided through other sources. Such records shall be maintained for three years after the completion of such a program or project. The Administrator and the Comptroller General of the United States, or any of their duly authorized representatives, shall have access, for the purpose of audit and evaluation, to any books, documents, papers and records of receipts which, in the opinion of the Administrator or the Comptroller General, may be related or pertinent to such grants and contracts.

Sec. 207. (a) The Administrator shall identify specific national needs and problems relating to space. The Administrator may make grants or enter into contracts under this section with respect to such needs or problems. The amount of any such grant or contract may equal 100 percent, or any lesser percent, of the total cost of the project involved.

(b) Any person may apply to the Administrator for a grant or contract under this section. In addition, the Administrator may invite applications with respect to specific national needs or problems identified under subsection (a) of this section. Application shall be made in such form and manner, and with such content and other submissions, as the Administrator shall by regulation prescribe. Any grant made, or contract entered into, under this section shall be subject to the limitations and provisions set forth in section 2486d(d)(2) and (4) of this title and to such other terms, conditions, and requirements as the Administrator considers necessary or appropriate.

Sec. 208. (a) (1) The Administrator may designate—

(A) any institution of higher education as a space grant college; and

(B) any association or other alliance of two or more persons, other than individuals, as a space grant regional consortium.

(2) No institution of higher education may be designated as a space grant college, unless the Administrator finds that such institution—

(A) is maintaining a balanced program of research, education, training, and advisory services in fields related to space;

(B) will act in accordance with such guidelines as are prescribed under subsection (b)(2) of this section; and

(C) meets such other qualifications as the Administrator considers necessary or appropriate.

(3) No association or other alliance of two or more persons may be designated as a space grant regional consortium, unless the Administrator finds that such association or alliance—

(A) is established for the purpose of sharing expertise, research, educational facilities or training facilities, and other capabilities in order to facilitate research, education, training, and advisory services, in any field related to space;

(B) will encourage and follow a regional approach to solving problems or meeting needs relating to space, in cooperation with appropriate space grant colleges, space grant programs, and other persons in the region;

(C) will act in accordance with such guidelines as are prescribed under subsection (b)(2) of this section; and

(D) meets such other qualifications as the Administrator considers necessary or appropriate.

(b) The Administrator shall by regulation prescribe—

(1) the qualifications required to be met under subsection (a)(2)(C) and (3)(D) of this section; and

(2) guidelines relating to the activities and responsibilities of space grant colleges and space grant regional consortia.

(c) The Administrator may, for cause and after an opportunity for hearing, suspend or terminate any designation under subsection (a) of this section.

Sec. 209. (a) The Administrator shall support a space grant fellowship program to provide educational and training assistance to qualified individuals at the graduate level of education in fields related to space. Such fellowships shall be awarded pursuant to guidelines established by the Administrator. Space grant fellowships shall be awarded to individuals at space grant colleges, space grant regional consortia, other colleges and institutions of higher education, professional associations, and institutes in such a manner as to assure wide geographic and institutional diversity in the pursuit of research under the fellowship program.

(b) The total amount which may be provided for grants under the space grant fellowship program during any fiscal year shall not exceed an amount equal to 50 percent of the total funds appropriated for such year pursuant to this chapter.

(c) Nothing in this section shall be construed to prohibit the Administrator from sponsoring any research fellowship program, including any special emphasis program, which is established under an authority other than this chapter.

Sec. 210. (a) The Administrator shall establish an independent committee known as the space grant review panel, which shall not be subject to the provis[i]ons of the Federal Advisory Committee Act (5 U.S.C. App.; Public Law 92-463).

(b) The panel shall take such steps as may be necessary to review, and shall advise the Administrator with respect to—

(1) applications or proposals for, and performance under, grants and contracts awarded pursuant to sections 2486d and 2486e of this title;

(2) the space grant fellowship program;

(3) the designation and operation of space grant colleges and space grant regional consortia, and the operation of space grant and fellowship programs;

(4) the formulation and application of the planning guidelines and priorities pursuant to section 2486c(a) and (b)(1) of this title; and

(5) such other matters as the Administrator refers to the panel for review and advice.

(c) The Administrator shall make available to the panel any information, personnel and administrative services and assistance which is reasonable to carry out the duties of the panel.

(d) (1) The Administrator shall appoint the voting members of the panel. A majority of the voting members shall be individuals who, by reason of knowledge, experience, or training, are especially qualified in one or more of the disciplines and fields related to space. The other voting members shall be individuals who, by reason of knowledge, experience or training, are especially qualified in, or representative of, education, extension services, State government, industry, economics, planning, or any other activity related to efforts to enhance the understanding, assessment, development, or utilization of space resources. The Administrator shall consider the potential conflict of interest of any individual in making appointments to the panel.

(2) The Administrator shall select one voting member to serve as the Chairman and another voting member to serve as the Vice Chairman. The Vice Chairman shall act as Chairman in the absence or incapacity of the Chairman.

(3) Voting members of the panel who are not Federal employees shall be reimbursed for actual and reasonable expenses incurred in the performance of such duties.

(4) The panel shall meet on a biannual basis and, at any other time, at the call of the Chairman or upon the request of a majority of the voting members or of the Administrator.

(5) The panel may exercise such powers as are reasonably necessary in order to carry out the duties enumerated in subsection (b) of this section.

Sec. 211. Each department, agency or other instrumentality of the Federal Government which is engaged in or concerned with, or which has authority over, matters relating to space—

(1) may, upon a written request from the Administrator, make available, on a reimbursable basis or otherwise, any personnel (with their consent and without prejudice to their position and rating), service, or facility which the Administrator considers necessary to carry out any provision of this chapter;

(2) may, upon a written request from the Administrator, furnish any available data or other information which the Administrator considers necessary to carry out any provision of this chapter; and

(3) may cooperate with the Administration.

Sec. 212. (a) The Administrator shall submit to the Congress and the President, not later than January 1, 1989, and not later than February 15 of every odd-numbered year thereafter, a report on the activities of the national space grant and fellowship program.

(b) The Director of the Office of Management and Budget and the Director of the Office of Science and Technology Policy in the Executive Office of the President shall have the opportunity to review each report prepared pursuant to subsection (a) of this section. Such Directors may submit, for inclusion in such report, comments and recommendations and an independent evaluation of the national space grant college and fellowship program. Such comments and recommendations shall be submitted to the Administrator not later than 90 days before such a report is submitted pursuant to subsection (a) of this section and the Administrator shall include such comments and recommendations as a separate section in such report.

Sec. 213. The Administrator shall not under this chapter designate any space grant college or space grant regional consortium or award any fellowship, grant, or contract unless such designation or award is made in accordance with the competitive, merit-based review process employed by the Administration on the date of enactment of this Act.

Sec. 214. (a) There are authorized to be appropriated for the purposes of carrying out the provisions of this chapter sums not to exceed—

(1) $10,000,000 for each of fiscal years 1988 and 1989; and

(2) $15,000,000 for each of fiscal years 1990 and 1991.

(b) Such sums as may be appropriated under this section shall remain available until expended.

Document III-27

Document title: NASA Commercial Space Policy, October 1984.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

The Reagan administration placed a high value on privatizing many government services and activities. This perspective extended to space and was coupled with the optimistic viewpoint that space commerce held the potential of growing into a multibillion dollar annual enterprise. In 1984, the administration released a National Commercial Space Policy, which outlined its views in this area. NASA responded soon after with its own commercial space policy, which attempted to redefine the agency's role, including being a partner with U.S. industry in exploring various areas of space commercialization.

[ii]

NASA Commercial Space Policy

Encouraging Private Enterprise in Space

The purpose of this Policy is to prepare NASA for expanding its mission in a new direction—the fostering of commercial enterprises in space.

This Policy, and accompanying Implementation Plan were drawn up by representatives from NASA headquarters and field centers. These representatives looked at the commercial possibilities in space and how NASA can encourage more private industrial ventures in orbit.

To supplement their perspective, the NASA representatives sought and received advice from experts in industry and universities as well as other outside specialists.

[iii] *The United States Government will provide a climate conducive to expanded private sector investment and involvement in civil space activities. . . .*

President Ronald Reagan
in his National Space Policy, July 4, 1982

[iv] *We should establish a policy which would encourage commercialization of space technology to the maximum extent feasible.*

Committee on Science and Technology,
U.S. House of Representatives,
Report, April 15, 1983

* * * * *

The Committee is fully supportive of efforts by the private sector to invest and seek commercial opportunities in space.

Committee on Commerce, Science and
Transportation, U.S. Senate,
Report, May 15, 1983

* * * * *

The extent to which past investment in space technology contributes to our future economic well-being and national growth will depend in large measure on policies and actions taken in a spirit of collaboration by the Federal Government and industry.

Unless the public and private sector join to develop the opportunities presented by new space technologies and unless entrepreneurial forces are engaged more fully, the United States will fall behind in the contest for leadership in space and the economic rewards associated with that position.

May 1983 Report,
National Academy of Public Administration

[v]

Preamble

The new chapter in the U. S. space program that opened early in this decade with the first flights of the Shuttle is now reaching a new phase: space technology is ripe for its transition from exploration to major exploitation, from experimentation to expanded profitable commercial uses.

To examine the opportunities for and impediments to expanded commercial activities in space, NASA formed a Task Force in mid-1983.

The Task Force's conclusions are straightforward:

- Commercial activities in space by private enterprise should be expanded now if our nation is to retain and improve its leadership in science and technology, its high living standards, and its advantage in international trade.
- Natural and bureaucratic barriers inhibiting the commercialization of space need to be and can be lessened or removed through joint actions by the Government and private enterprises.
- With firm resolve and the commitment of reasonable resources over a number of years, Government and private enterprise working together can turn space into a realm of immense benefit for our nation.
- A positive NASA Commercial Space Policy should be implemented to expedite the expansion of self-sustaining, profit-earning, tax-paying, jobs-providing commercial space activities.

[vi] The *NASA Commercial Space Policy* supports commercial space activities through:

- Reducing the risks of doing business in space to levels competitive with conventional investments.
  - To reduce technical risks, NASA will conduct and stimulate additional research relevant to commercial developments in space.
  - To reduce financial risks, NASA will provide easy and inexpensive access to orbit as well as to experimental ground facilities.

  - To reduce institutional risks, NASA will help remove procedural impediments, offer organizational support, and maintain consistent policies regarding its relationship with commercial space ventures.
- Reaching out and establishing new links with the private sector to stimulate the development of private businesses in space.
  - NASA will expand its traditional links with the aerospace industry and academia to also embrace other industries such as new high-technology entrepreneurial ventures and the financial and non-aerospace industrial and academic communities.
  - NASA will expand and target dissemination of scientific information to stimulate domestic space commerce projects.
  - NASA will use public announcements, interviews, speeches, press releases, and articles in technical and business journals to provide information about commercialization opportunities and its commercialization activities to industry, academia, and the American public. . . .

[1]

NASA Commercial Space Policy

Introduction

NASA's thrust into the future is taking a new turn: NASA is encouraging free enterprise to participate in space by inviting industries and other private entities to finance and conduct business in space.

Private investment in space is called "space commercialization." Commercial projects would aim at developing profitable products and services in space for sale to consumers on Earth and for other space activities.

The NASA Policy to stimulate the commercialization of space will give new impetus and importance to traditional space efforts. At the same time, the Policy will give private enterprises the extra push they need to get started with permanent self-sustaining, tax revenue-producing establishments that will generate unique goods, well-paying jobs, and new outlets for innovation and ingenuity in space and on the Earth. The rewards can be immense for our nation.

The Policy calls for new ways of thinking about space. It requires revision and innovation in the traditional approaches and outlook. It calls for new roles by and alterations in relationships between NASA and private enterprises.

NASA has accumulated a long and proud history of working closely and productively with private enterprises. NASA-space programs have been based on participation and contributions by a trio of segments in our society—Government, industry, and academic institutions.

Since its earliest days, NASA has employed industries and universities as contractors. Since 1962, NASA has provided launch services for privately-owned commercial communications satellites. Beginning in 1972, NASA has entered into "partnership" arrangements with private firms for the commercial use of space. Now, the nature and character of NASA's relationship with private enterprise is changing still more. To persuade private investors to become involved in new space endeavors, NASA must be responsive to the needs and wants of these investors.

NASA must assure these investors of reliable and dependable roundtrip transportation for their projects between Earth and orbit. NASA must also help assure the availability of suitable work places for industries in orbit.

NASA will need to expand its basic research—with the advice of these customers and partners—to make sure it is relevant and helpful to private space ventures.

NASA must share its experience and know-how, including research information and NASA patents. NASA will need to establish space commercialization offices [2] at its headquarters and field centers to coordinate the new relationships with private investors. There may be opportunity for specialized companies to serve as, intermediaries—bridges—between NASA and private investors in space endeavors.

These and other approaches are outlined in the new NASA Commercial Space Policy on the following pages.

Space commercialization can have profound impact on the future of our Nation. We already know from our experiences with highly profitable, privately-owned communications satellites that free enterprise in space can work well. New leaps in technology which are likely to emerge from private initiatives in space could have major implications for the national economy, individual living standards and life styles, industrial activities and jobs and international trade.

The NASA Commercial Space Policy is designed to provide a foundation and framework for facilitating the realization of these opportunities.

[3]

NASA Commercial Space Policy

Executive Summary

Introduction

President Reagan, in his National Space Policy of July 4, 1982, made the expansion of private investment and involvement in space, a major objective of the United States Government. Committee reports from both Houses of Congress strongly endorsed this thrust in 1983. Supporting statements also have come from studies by non-government groups.

Opportunities for benefiting the nation are significant. Commercial space endeavors offer the potential for new industries, new jobs, lower product costs and an improved balance of trade. Technological advances from commercial use of space could help conquer diseases, produce computers faster and smarter than presently exist, develop metals lighter and stronger than any presently known, increase communications and information availability around the world and enhance our understanding of our environment and its resources.

NASA's Commercial Space Policy is designed to encourage private involvement in commercial endeavors in space to help take advantage of these opportunities. The Policy introduces approaches and incentives to reduce the risks inherent in commercial space ventures to levels competitive with conventional investments.

This "Executive Summary" presents an overview of the goals and principles of the NASA Commercial Space Policy, as well as a summary of major new initiatives NASA will implement to stimulate private investment in commercial space ventures.

Goals and Principles

The primary goal of NASA's Commercial Space Policy is to encourage and stimulate free enterprise in space.

Private investments in space, in turn, are expected to (a) yield important economic advantages; (b) advance science and technology; (c) help maintain in U.S. space leadership; and (d) enhance the nation's competitive position in international trade, thereby improving the in[-]U.S. balance of payments.

Implementation of the NASA Commercial Space Policy is to be guided by these five principles:

1. *The Government should reach out to and establish new links with the private sector.*
NASA will broaden its traditional links with the aerospace industry and the science community to include relationships with major non-aerospace [4] firms, new entrepreneurial ventures, as well as the financial and academic communities.

2. *Regardless of the Government's view of a project's feasibility, it should not impede private efforts to undertake commercial space ventures.*
If the private sector is willing to make the necessary investment, the project's feasibility should allowed to be determined by the marketplace and the creativity of the entrepreneur rather than the Government's opinion of its viability.

3. *If the private sector can operate a space venture more efficiently than the Government, then such commercialization should be encouraged.*
When developing new public space programs, the Government should actively consider the view of, and the potential effect on, private ventures.

4. *The Government should invest in high-leverage research, and space facilities which encourage private investment. However, the Government should not expend tax dollars for endeavors the private sector is willing to underwrite.*
This will provide at least two benefits. First it will enable NASA to concentrate a greater percentage of its resources on advancing the technological state-of-the-art in areas where the investment is too great for the private sector. Second, it will engage the private sector's applications and marketing skills for getting space benefits to the people.

5. *When a significant Government contribution to a commercial endeavor is requested, two requirements must be met. First, the private sector must have significant capital at risk, and second, there must be significant potential benefits for the nation.*
In appraising the potential benefits from and determining appropriate Government contributions to commercial space proposals, NASA will use an equitable, consistent review process.

A possible exception to these principles would be a commercial venture intended to replace a service or displace a NASA R&D program and/or technology development program of paramount public importance now provided by the Government. In that case, the Government might require additional prerequisites before commercialization.

Implementation

In implementing this Policy, NASA will take an active role in supporting commercial space ventures in the following categories, listed in order of importance:

- New commercial high-technology ventures.
- New commercial applications of existing space technology.
- [5] Commercial ventures resulting from the transfer of existing space programs to the private sector.

NASA will implement initiatives to reduce the technical, financial and institutional risks associated with doing business in space.

To reduce *technical risks*, NASA will:
Support research aimed at commercial applications; ease access to NASA experimental facilities; establish scheduled flight opportunities for commercial payloads; expand the availability of space technology information of commercial interest; and support the development of facilities necessary for commercial uses of space.

To reduce *financial risks*, NASA will:

Continue to offer reduced-rate space transportation for high-technology space endeavors; assist in integrating commercial equipment with the Shuttle; provide seed-funding to stimulate commercial space ventures; and, under certain circumstances, purchase commercial space products and services and offer some exclusivity.

To reduce *institutional risks*, NASA will:

Speed integration of commercial payloads into the Orbiter; shorten proposal evaluation time for NASA/private sector Joint Endeavor proposals; establish procedures to encourage development of space hardware and services with private capital instead of Government funds; and introduce new institutional approaches for strengthening NASA's support of private investment in space.

A high-level Commercial Space Office will be formed within NASA as a focal point for commercial space matters. This Office will be responsible for implementing the NASA Policy to stimulate space commerce. It will have sufficient authority and resources to fully carry out this assignment.

Document III-28

Document title: Office of the Press Secretary, "The President's Space Policy and Commercial Space Initiative to Begin the Next Century," February 11, 1988.

Source: Ronald Reagan Presidential Files, NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

During the second Reagan administration, an alternative space policy making body concentrating on commercial spaceflight emerged to complement the National Security Council's Senior Interagency Group (Space), known as SIG (Space). Chaired by the Commerce Department, the Space Working Group of the White House Economic Policy Council worked on a new set of commercial space initiatives during 1987, at the same time that SIG (Space) was examining overall national space policy. SIG (Space) finished its review first, and its directive on national space policy was approved by President Reagan on January 5, 1988 (published in 1995 as Document III-42 in Volume I of Exploring the Unknown: Selected Documents in the History of the U.S. Civil Space Program*). However, its release was delayed until the space commerce review was completed. Both reviews were made public on February 11, 1988.*

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[1]

The President's Space Policy and Commercial Space Initiative to Begin the Next Century

Fact Sheet

The President today announced a comprehensive "Space Policy and Commercial Space Initiative to Begin the Next Century" intended to ensure United States space leadership.

The President's program has three major components:

- Establishing a long-range goal to expand human presence and activity beyond Earth orbit into the Solar System;
- Creating opportunities for U.S. commerce in space; and
- Continuing our national commitment to a permanently manned Space Station.

The new policy and programs are contained in a National Security Decision Directive (NSDD) signed by the President January 5, 1988, the FY 1989 Budget the President will submit shortly to Congress, and a fifteen point Commercial Space Initiative.

I. Expanding Human Presence Beyond Earth Orbit

In the recent NSDD, the President committed to a goal of expanding human presence and activity in the Solar System. To lay the foundation for this goal, the President will be requesting $100 million in his FY 1989 Budget for a major new technology development program "Project Pathfinder" that will enable a broad range of manned or unmanned missions beyond the Earth's orbit.

Project Pathfinder will be organized around four major focuses:

- Exploration technology;
- Operations technology;
- Humans-in-space technology; and
- Transfer vehicle technology.

This research effort will give the United States know-how in critical areas, such as human in space environment, closed loop life support, aero braking, orbital transfer and maneuvering, cryogenic storage and handling, and large scale space operations, and provide a base for wise decisions on long term goals and missions.

Additional highlight[s] of the NSDD are outlined in Section IV of this fact sheet.

[2] **II. Creating Opportunities for U.S. Commerce in Space**

The President is announcing a fifteen point commercial space initiative to seize the opportunities for a vigorous U.S. commercial presence in Earth orbit and beyond—in research and manufacturing. This initiative has three goals:

- Promoting a strong U.S. commercial presence in space;
- Assuring a highway to space; and
- Building a solid technology and talent base.

Promoting a Strong U.S. Commercial Presence in Space

1. *Private Sector Space Facility:* The President is announcing an intent for the Federal Government to lease space as an "anchor Tenant" in an orbiting space facility satiable for research and commercial manufacturing that is financed, constructed, and operated by the private sector. The Administration will solicit proposals from the U.S. private sector for such a facility. Space in this facility will be used and/or subleased by various Federal agencies with interest in microgravity research.

   The Administration's intent is to award a contract during mid-summer of this year for such space and related services to be available to the Government no later than the end of FY 1993.
2. *Spacehab:* The Administration is committing to make best efforts to launch within the Shuttle payload bay, in the early 1990s, the commercially developed, owned and managed Shuttle middeck module: Spacehab. Manifesting requirements will depend on customer demand.

   Spacehab is a pressurized metal cylinder that fits in the Shuttle payload by and connect to the crew compartment through the orbiter airlock. Spacehab takes up approximately one-quarter of the payload bay and increases the pressurized living and working space of the orbiter by approximately 1,000 cubic feet or 400 percent in usable research volume. The facility is intended to be ready for commercial use in mid-1991.
3. *Microgravity Research Board:* The President will establish, through Executive Order, a National Microgravity Research Board to assure and coordinate a broader range of opportunities for research in microgravity conditions.

NASA will chair this board, which will include senior-level representatives from Departments of Commerce, Transportation, Energy, and Defense, NIH [National Institutes of Health], and NSF [National Science Foundation]; and will consult with the university and commercial sectors. The board will have the following responsibilities:

- To stimulate research in microgravity environments and its applications to commercial uses by advising Federal agencies, including NASA, on microgravity priorities, and consulting with private industry and academia on microgravity research opportunities;
- To develop policy recommendations to the Federal Government on matters relating to microgravity research, including tapes of research, government/industry/and academic cooperation, and access to space, including a potential launch voucher program;

[3] • To coordinate the microgravity programs of Federal agencies by:
  - reviewing agency plans for microgravity research and recommending priorities for the use of Federally-owned or leased space on microgravity facilities; and
  - ensuring that agencies established merit review processes for evaluating microgravity research proposals; and
- To promote transfer of Federally funded microgravity research to the commercial sector in furtherance of Executive Order 12591.

NASA will continue to be responsible for making adjustments on the safety of experiments and for making manifesting decisions for manned space flight systems.

4. *External Tanks:* The Administration is making available for five years the expended external tanks of the Shuttle fleet at no cost to all feasible U.S. commercial nonprofit endeavors, for use such as research, storage, or manufacturing in space.
   NASA will provide any necessary technical other assistance to these endeavors on a direct cost basis. If private sector demand exceeds supply, NASA may auction the external tanks.
5. *Privatizing Space Station:* NASA, in coordination with the Office of Management and Budget, will revise its guide lines [sic] on commercialization of the U.S. Space Station to clarify and strengthen the Federal commitment to private sector investment in this program.
6. *Future Privatization:* NASA will seek to rely to the greatest extent feasible on private sector design, financing, construction, and operation of future Space Station requirements, including those currently under study.
7. *Remote Sensing:* The Administration is encouraging the development of commercial remote sensing systems. As part of this effort, the Department of Commerce, in consultation with other agencies, is examining potential opportunities for future Federal procurement of remote sensing data from the U.S. commercial sector.

Assuring a Highway to Space

8. *Reliance on Private Launch Services:* Federal agencies will be required to purchase expendable launch services directly from the private sector to the fullest extent feasible.
9. *Insurance Relief for Launch Providers:* The Administration will take administrative steps to address the insurance concerns of the U.S. commercial launch industry, which currently uses Federal launch ranges. These steps include:
   - *Limits on Third Party Liability:* Consistent with the Administration's tort policy, the Administration will propose to Congress a $200,000 cap on noneconomic damage awards to individual third parties resulting from commercial launch accidents;

[4] • *Limits on Property Damage Liability:* The liability of commercial launch operators for damage to Government property resulting from a commercial launch accident will be administratively limited to the level of insurance required by the Department of Transportation.

If losses to the Government exceed this level, the Government will waive its right to recover for damages. If losses are less than this level, the Government will waive its right to recover for those damages caused by Government willful misconduct or reckless disregard.

10. *Private Launch Ranges:* The Administration will consult with the private sector on the potential construction of commercial launch range facilities separate from Federal facilities and the use of such facilities by the Federal Government.
11. *Vouchers for Research Payloads:* NASA and the Department of Transportation will explore providing to research payload owners manifested on the Shuttle a one time launch voucher that can be used to purchase an alternative U.S. commercial launch service.

Building a Solid Technology and Talent Base

12. *Space Technology Spin-Offs:* The President is directing that the new Pathfinder program, the Civil Space Technology Initiative [CSTI], and other technology programs be conducted in accordance with the following policies:
    - Federally funded contractors, universities, and Federal laboratories will retain the rights to any patents and technical data, including copyright, th[at] result from these programs. The Federal Government will have the authority to use this intellectual property royalty free;
    - Proposed technologies and patents available for licensing will be housed in a Pathfinder/CSTI library within NASA; and
    - When contracting for commercial development of Pathfinder, CSTI and other technology work products, NASA will specify its requirements in a manner that provides contractors with maximum flexibility to pursue innovative and creative approaches.
13. *Federal Expertise on Loan to American Schools:* The President is encouraging Federal Scientists, engineers, and technicians in aerospace and space related careers to take a sabbatical year to teach in any level of education in the United States.
14. *Education Opportunities:* The President is requesting in his FY 1989 Budget expanding five-fold opportunities for U.S. Teachers to visit NASA field centers and related aerospace and university facilities.

    In addition, NASA, NSF, and DoD [Department of Defense] will contribute materials and classroom experiments through the Department of Education to U.S. schools developing "tech shop" programs. NASA will encourage corporate participation in this program.
15. *Protecting U.S. Critical Technologies:* The Administration is requesting that Congress extend to NASA the authority it has given the Department of Defense to protect the whole-sale release under the Freedom of Information Act those critical national technologies and systems that are prohibited from export.

[5] **III. Continuing the National Commitment to the Space Station**

In 1984, the President directed NASA to develop a permanently manned Space Station. The President remains committed to achieving this end and this requesting $1 billion in his FY 1989 Budget for continued development and a three year appropriation commitment from Congress for $6.1 billion. The Space Station, planned for development

in cooperation with U.S. friends and allies, is intended to be a multi-purpose facility for the nation's science and applications programs. It will permit such things in space as: research, observation of the solar system, assembly of vehicles for facilities, storage, servicing of satellites, and basing for future space missions and commercial and entrepreneurial endeavors in space.

The help ensure a Space Station that is cost effective, the President is proposing as part of this Commercial Space Initiative actions to encourage private sector investment in the Space Station, including directing NASA to rely to the greatest extent feasible on private sector design, financing, construction, and operation of future Space Station requirements.

IV. Additional Highlights of the January 5, 1988 NSDD

- *U.S. Space Leadership:* Leadership is reiterated as a fundamental national objective in areas of space activity critical to achieving U.S. national security, scientific, economic and foreign policy goals.
- *Defining Federal Roles and Responsibilities:* Government activities are specified in three separate and distinct sectors: civil, national security, and nongovernmental. Agency roles and responsibilities are codified and specific goals are established for the civil space sector; those for other sectors are updated.
- *Encouraging a Commercial Sector:* A separate, nongovernmental or commercial space sector is recognized and encouraged by the policy that Federal Government actions shall not preclude or deter the continuing development of this sector. New Guidelines are established to limit unnecessary Government competition with the private sector and ensure that Federal agencies are reliable customers for commercial space goods and services.
- The President's launch policy prohibiting NASA from maintaining an expendable launch vehicle adjunct to the Shuttle, as well as limiting commercial and foreign payloads on the Shuttle to those that are Shuttle-unique or serve national security for foreign policy purpose, is reaffirmed. In addition, policies endorsing the purchase of commercial launch services by Federal agencies are further strengthened.
- *National Security Space Sector:* An assured compatibility for national security missions is clearly enunciated, and the survivability and endurance of critical national security space functions is [sic] stressed.
- *Assuring Access to Space:* Assured access to space is recognized as a key element of national space policy. U.S. space transportation systems that provide sufficient resiliency to allow continued operation, despite failures in any single system, are emphasized. The mix of space transportation vehicles will be defined to support mission needs in the most cost effective manner.
- *Remote Sensing:* Policies for Federal "remote sensing" or observation of the Earth are established to encourage the development of U.S. commercial systems competitive with or superior to foreign-operated civil or commercial systems.

Document III-29

Document title: Office of the Press Secretary, "Commercial Space Launch Policy," NSPD-2, September 5, 1990.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

During the administration of George Bush, 1989 to 1993, several commercial space policy documents emerged that affected the manner in which NASA conducted its relations. National Space Policy Directive-2 established a "Commercial Space Launch Policy" that reflected the administration's commitment to develop a thriving commercial space sector by establishing "the long-term goal of a free and fair [space launch] market in which the U.S. industry can compete" internationally.

[no pagination]

Statement by the Press Secretary

The President has approved a new National Space Policy Directive providing important guidance which will further encourage the growth of U.S. private sector space activities. This policy, developed by the Vice President and the National Space Council, is completely consistent with, and provided the policy framework for, the President's August 22, 1990, decision regarding participation by a U.S. firm in Australia's Cape York space launch project. The policy supplements the National Space Policy which the President approved on November 2, 1989.

The commercial space launch policy recognizes the many benefits which a commercial space launch industry provides to the United States. It balances launch industry needs with those of other industries and with important national security interests, and establishes the long-term goal of a free and fair market in which U.S. industry can compete. The policy specifies a coordinated set of actions for the next ten years aimed at achieving this goal.

Fact Sheet on Commercial Space Launch Policy

Policy Findings

A commercial space launch industry can provide many benefits to the U.S. including indirect benefits to U.S. national security. The long-term goal of the United States is a free and fair market in which U.S. industry can compete. To achieve this, a set of coordinated actions is needed for dealing with international competition in launch goods and services in a manner that is consistent with our nonproliferation and technology transfer objectives. These actions must address both the short-term (actions which will affect competitiveness over approximately the next ten years) and those which will have their principal effect in the longer term (i.e. after approximately the year 2000).

In the near term, this includes trade agreements and enforcement of those agreements to limit unfair competition. It also includes the continued use of U.S.-manufactured launch vehicles for launching U.S. Government satellites.

For the longer term, the United States should take actions to encourage technical improvements to reduce the cost and increase the reliability of U.S. space launch vehicles.

Implementing Actions

U.S. government satellites will be launched on U.S.-manufactured launch vehicles unless specifically exempted by the President.

Consistent with guidelines to be developed by the National Space Council, U.S. Government Agencies will actively consider commercial space launch needs and factor them into their decisions on improvements in launch infrastructure and launch vehicles aimed at reducing cost, and increasing responsiveness and reliability of space launch vehicles.

The U.S. Government will enter into negotiations to achieve agreement with the European Space Agency (ESA), ESA member states, and others as appropriate, which defines principles of free and fair trade.

Nonmarket launch providers of space launch goods and services create a special case because of the absence of market[-]oriented pricing and cost structures. To deal with their entry into the market there needs to be a transition period during which special conditions may be required.

There also must be an effective means of enforcing international agreements related to space launch goods and services.

Statement by the Press Secretary

The United States seeks a free and fair international commercial space launch market to further the use of outer space for the betterment of mankind. At the same time, because space launch technologies have significant military applications, important U.S. national security considerations must be addressed by our commercial space launch policy.

Over the past several weeks, the President has had detailed discussions with the Vice President and other senior advisors on U.S. commercial space launch policy developed by the National Space Council. The President has authorized the Secretary of State to approve a license application for participation by a U.S. firm in Australia's Cape York space launch project, provided certain agreements necessary to ensure U.S. national security interests are reached.

Specifically, the U.S. will seek agreements to ensure that:

(1) The USSR will provide launch services (boosters, equipment, technology, or training) only from Cape York or any other single location;

(2) The USSR and Australia will observe the Missile Technology Control Regime; and

(3) U.S. regulations on technology transfer to the Soviet Union will be observed.

The United States hopes and expects that these agreements can be concluded quickly so that the license can be granted.

To permit continued U.S. participation, the United States in the coming months will also be seeking agreements to ensure free and fair trade in the international commercial space launch market.

Details of the U.S. commercial space launch policy will be announced in the near future.

Document III-30

Document title: Executive Office of the President, "U.S. Commercial Space Policy Guidelines," NSPD-3, February 11, 1991.

Source: NASA Historical Reference Collection, NASA History Office, NASA Headquarters, Washington, D.C.

In 1991, the Bush administration refined its commercial space policy by issuing NSPD-3, which articulated in specific terms a commercial space policy "aimed at expanding private sector investment in space by the market-driven Commercial Space Sector." The intent was to move more of the onus for investment in space technology to the private sector, where it was assumed that market forces would drive down costs.

[1]

U.S. Commercial Space Policy Guidelines

A fundamental objective guiding United States space activities has been space leadership, which requires preeminence in key areas of space activity. In an increasingly competitive international environment, the U.S. Government encourages the commercial use and exploitation of space technologies and systems for national economic benefit. These efforts to encourage commercial activities must be consistent with national security and foreign policy interests, international and domestic legal obligations, including U.S. commitments to stem missile proliferation, and agency mission requirements.

United States space activities are conducted by three separate and distinct sectors: two U.S. Government sectors[—]the civil and national security[—]and a non-governmental commercial space sector. The commercial space sector includes a broad cross section of potential providers and users, including both established and new market participants. There also has been a recent emergence of State government initiatives related to encouraging commercial space activities. The commercial space sector is comprised of at least five market areas, each encompassing both earth and spacebased activities, with varying degrees of market maturity or potential:

[2] *Satellite Communications:* the private development, manufacture, and operation of communications satellites and marketing of satellite telecommunications services, including position location and navigation;

Launch and Vehicle Services: the private development, manufacture, and operation of launch and reentry vehicles, and the marketing of space transportation services;

Remote Sensing: the private development, manufacture, and operation of remote sensing satellites and the processing and marketing of remote sensing data;

Materials Processing: the experimentation with, and production of, organic and inorganic materials and products utilizing the space environment; and

Commercial Infrastructure: the private development and provision of space[-]related support facilities, capabilities and services.

In addition, other market-driven commercial space sector opportunities are emerging.

The U.S. Government encourages private investment in, and broader responsibility for, space-related activities that can result in products and services that meet the needs of government and other customers in a competitive market. As a matter of policy, the U.S. Government pursues its commercial space objectives without the use of direct federal subsidies. A robust commercial space sector has the potential to generate new technologies, products, markets, jobs, and other economic benefits for the nation, as well as indirect benefits for national security.

Commercial space sector activities are characterized by the provision of products and services such that:

- private capital is at risk;
- there are existing, or potential, nongovernmental customers for the activity;
- the commercial market ultimately determines the viability of the activity; and
- primary responsibility and management initiative for the activity resides with the private sector.

[3]

Implementing Guidelines

The following implementing guidelines shall serve to provide the U.S. private sector with a level of stability and predictability in its dealings with agencies of the U.S.

Government. The agencies will work separately but cooperatively, as appropriate, to develop specific measures to implement this strategy. U.S. Government agencies shall, consistent with national security and foreign policy interests, international and domestic legal obligation and agency mission requirements, encourage the growth of the U.S. commercial space sector in accordance with the following guidelines:

- U.S. Government agencies shall utilize commercially available space products and services to the fullest extent feasible. This policy of encouraging U.S. Government agencies to purchase, and the private sector to sell, commercial space products and services has potentially large economic benefits.
  - A space product or service is "commercially available" if it is currently offered commercially, or if it could be supplied commercially in response to a government procurement request.
  - "Feasible" means that products and services meet mission requirements in a cost-effective manner.
  - "Cost-effective" generally means that the commercial product or service costs no more than governmental development or directed procurement where such government costs include applicable government labor and overhead costs, as well as contractor charges and operations costs.
  - However, the acquisition of commercial space products and services shall generally be considered cost-effective if they are procured competitively using performance-based contracting techniques. Such contracting techniques give contractors the freedom and financial incentive to achieve economies of scale by combining their government and commercial work as well as increased productivity through innovation.
  - U.S. Government agencies shall actively consider, at the earliest appropriate time, the feasibility of their using commercially available products and services in agency programs and activities.
  - [4] U.S. Government agencies shall continue to take appropriate measures to protect from disclosure any proprietary data which is shared with the U.S. Government in the acquisition of commercial space products and services.
- U.S. Government agencies shall promote the transfer of U.S. Government-developed technology to the private sector.
  - U.S. Government-developed unclassified space technology will be transferred to the U.S. commercial space sector in as timely a manner as possible and in ways that protect its commercial value.
  - U.S. Government agencies may undertake cooperative research and development activities with the private sector, as well as State and local governments, consistent with policies and funding, in order to fulfill mission requirements in a manner which encourages the creation of commercial opportunities.
  - With respect to technologies generated in the performance of government contracts, U.S. Government agencies shall obtain only those rights necessary to meet government needs and mission requirements, as directed by Executive Order 12591.
- U.S. Government agencies may make unused capacity of space assets, services and infrastructure available for commercial space sector use.
  - Private sector use of U.S. Government agency space assets, services, and infrastructure shall be made available on a reimbursable basis consistent with OMB [Office of Management and Budget] circular A25 or appropriate legislation.
- U.S. Government agencies may make available to the private sector those assets which have been determined to be excess to the requirements of the U.S. Government in accordance with U.S. law and applicable international treaty obligations. Due regard

shall be given to the economic impact such transfer may have on the commercial space sector, promoting competition, and the long-term public interest.

[5] • The U.S. Government shall avoid regulating domestic space activities in a manner that precludes or deters commercial space sector activities, except to the extent necessary to meet international and domestic legal obligations, including those of the Missile Technology Control Regime. Accordingly, agencies shall identify, and propose for revision or elimination, applicable portions of U.S. laws and regulations that unnecessarily impede commercial space sector activities.

- U.S. Government agencies shall work with the commercial space sector to promote the establishment of technical standards for commercial space products and services.
- U.S. Government agencies shall enter into appropriate cooperative agreements to encourage and advance private sector basic research, development, and operations. Agencies may reduce initial private sector risk by agreeing to future use of privately supplied space products and services where appropriate.
  - "Anchor tenancy" is an example of such an arrangement whereby U.S. Government agencies can provide initial support to a venture by contracting for enough of the future product or service to make the venture viable in the short term. Long[-]term viability and growth must come primarily from the sale of the product or service to customers outside the U.S. Government.
  - There must be demonstrable U.S. Government mission or program requirements for the proposed commercial space good or service. In assessing the U.S. Government's mission or program requirements for these purposes, the procuring agency may consider consolidating all anticipated U.S. Government needs for the particular product or service, to the maximum extent feasible.
  - U.S. Government agencies entering into such arrangements may take action, consistent with current policies and funding availability, to provide compensation to commercial space providers for future termination of missions for which the products or services were required.

[6] • The United States will work toward establishment of an international trading environment that encourages market[-]oriented competition by working with its trading partners to:
  - Establish clear principles for international space markets that provide an atmosphere favorable to stimulating greater private investment and market development;
  - Eliminate direct government subsidies and other unfair practices that undermine normal market competition among commercial firms;
  - Eliminate unfair competition by governments for business in space markets consistent with domestic policies that preclude or deter U.S. Government competition with commercial space sector activities.

The U.S. Commercial Space Policy Guidelines are consistent with the National Space Policy and the U.S. Commercial Space Launch Policy which remain fully applicable to activities of the governmental space sectors and the commercial space sector.

Reporting Requirements

U.S. Government agencies affected by these guidelines are directed to report by October 1, 1991, to the National Space Council on their activities related to the implementation of these policy guidelines.

George Bush