STRATEGIC PLAN 1985

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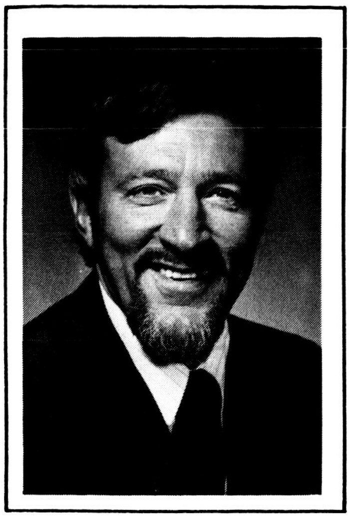
NASA
Lewis Research Center

Foreword



The NASA Lewis Research Center formalized its strategic planning activities in 1982 during a very thorough analysis of its strengths, weaknesses, research thrusts, and business operations. The value of comprehensive planning was proven by the successes of the resultant reorganized staff and research activities. In each year since its inception the planning activity has been oriented to the Center's needs and adapted to the current internal and external environment.

During the strategic planning activity in 1983 the groundwork was laid for the Center's entry into NASA's Space Station Program, the Advanced Turboprop Program, the Altitude Wind Tunnel Project, and the Advanced Communications Technology Satellite Project. Many of the objectives in the 1983 plan were established to prepare the Center for the emergence of these new research opportunities.

The objectives for this year's strategic planning activity were to reexamine the Center's research programs and discipline organizations in the light of these new research and development opportunities. Emphasis was given to formulating key research disciplines as basic building blocks in support of the Center's major research projects. A new organization was formed to provide optimum support to the Center's total effort. This brochure presents the results of this planning activity.

It is perhaps of even greater importance to our effectiveness that we increase our efforts to foster and institutionalize the participative management style at the Center. Clearly, for the Center to succeed, all managers must embrace and practice these concepts of people involvement and consensus decision making as a way of increasing organizational effectiveness and productivity.

We will continue to support this effort through education for all managers by using the LEP-MEP-SEP integrated developmental strategy. This will be supplemented by developing new programs aimed at middle managers to ensure their understanding and commitment to this process. We will also continue our efforts to involve nonsupervisory employees by expanding the number of active quality circles at the Center and by developing new or expanded educational programs. These programs will be designed to increase awareness, understanding, and commitment to participative management practices on the part of all employees.

The focus of this effort will be to create a management environment based on openness and involvement.

I consider the strategic planning process a necessary, evolutionary, and useful function that will be continued at Lewis. Through this process we clearly define the Center's missions, determine the resources required to carry them out, and ensure efficient use of those resources. By involving the Center's entire staff through the participative management process, this strategic plan becomes a reality. Together, we are taking action to chart the Center's course.

Andrew J. Stofan
Director

Our Mission

The NASA Lewis Research Center defines and develops advanced technology for high-priority national needs. The activities of the Center are directed toward new propulsion, power, and communications technologies for application to aeronautics and space, to help ensure U.S. leadership in these areas.

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Strategic Planning Objectives

During this year's planning activity special emphasis was given to two overall objectives:

- To structure the Center's organization to efficiently and competently perform our missions, taking into account recent decisions on major programs and initiatives from the previous year's strategic plan
- To update the Center's strategic plan on the basis of the new organization and missions

Planning Process

The strategic planning process consisted of the following steps:

- Reorganizing the Center to meet several new thrusts and realignments resulting from prior years' planning, and to meet the need/desire to restructure the aeronautics program
- Establishing goals and objectives consistent with those of NASA and the Headquarters program offices
- Establishing a work breakdown structure
- Developing planning options based on the current environment
- Formulating a strategic plan that integrates the selected planning options
- Implementing the plan, including allocating personnel and other resources

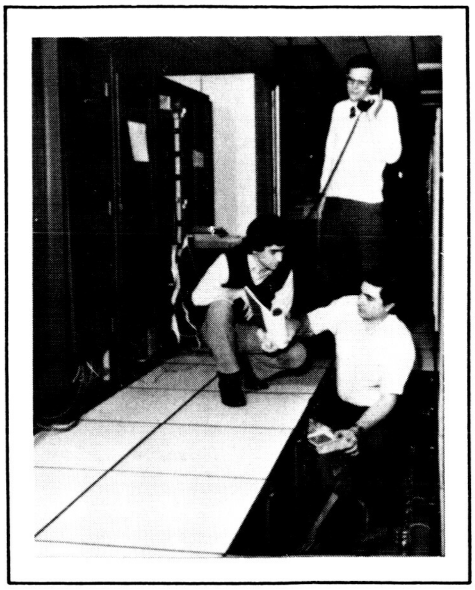
The following sections describe the Lewis goals and objectives, the overall work breakdown structure, and the individual directorate plans, including their goals and objectives, missions, work breakdown structures, and significant actions and accomplishments. The last section summarizes key plans and accomplishments of a Centerwide nature.

Goals and Objectives

The goals and objectives for Lewis were derived from the NASA and Headquarters program office goals and objectives. In like manner, goals and objectives from the Agency and the Center were used by the various directorates and their subordinate organizations in formulating their own goals and objectives. These are described in the individual directorate plans that follow. Similarly, these goals and objectives were cascaded down to the working levels to involve the individual employee in NASA's overall plans. All years are fiscal years.

Lewis Goals and Objectives

The Lewis Environment



Goals

To provide a creative environment and the best of facilities, support services, and management support for our work force so that it can perform with excellence the Center's research, development, mission, and operational responsibilities. To aid employee development so as to enhance and sustain an integrated work force of highest quality.

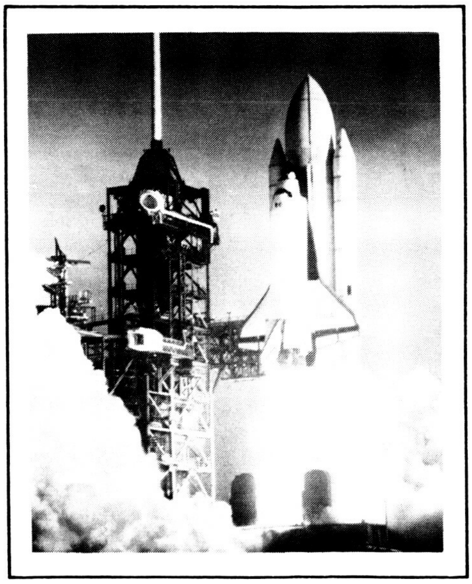
Objectives

- To strengthen the creative environment by eliminating some of the primary deterrents to accomplishing timely, high-quality research
- To hire 125 highly qualified new employees and provide advanced training during 1985 in order to adjust skill-mix problems while meeting or exceeding all equal opportunity goals
- To significantly increase new construction, rehabilitation, maintenance, and repair by increases in the construction-of-facilities budget
- To modestly increase support service contracting in appropriate areas
- To conduct the business of the Center in an efficient, professional manner so as to better support all aspects of the Center's activities
- To upgrade the Class VI computational capability

Space Shuttle-Centaur

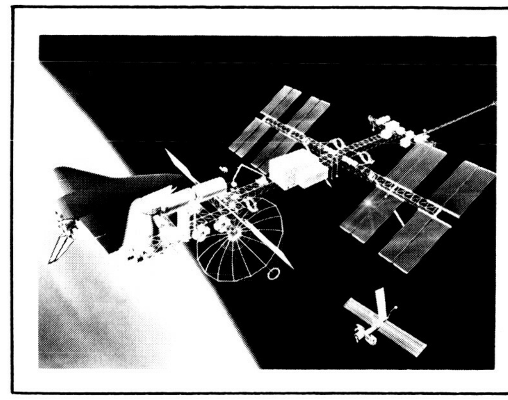
Goal

To extend the operational capability of NASA's Space Transportation System by adapting Centaur for use as a cost-effective, high-energy upper stage for the space shuttle and by improving the shuttle's propulsion system



Objectives

- To develop a Centaur upper stage compatible with the space shuttle in order to provide cost-effective transportation to higher energy orbits by the second quarter of 1986
- To transition additional U.S. Air Force and NASA payloads to Centaur from 1988 to 2000
- To define shuttle-Centaur evolutionary design requirements
- To apply advanced technologies to improving the space shuttle main engine
- To define the technology for improving the RL-10 engine's performance and broadening its operating limits



Space Station

Goal

To support the establishment of a permanent human presence in space by developing the power system and providing the technology for the propulsion systems for a space station

Objectives

- To conduct, as the lead development center in power systems for the initial-operating-capability (IOC) space station, a program that will result in the definition and preliminary design of the power system for the station by early 1986
- To conduct during 1985 and 1986 advanced development and technology programs in space power and propulsion to ensure the readiness of key technology options for developing the IOC space station as well as the evolutionary station
- To conduct during 1985 and 1986 the systems engineering and integration (SE&I) needed to properly support the Johnson Space Center in its role as lead center for overall space station SE&I
- To study and analyze space station utilization requirements for science, technology, and applications areas of traditional Lewis expertise

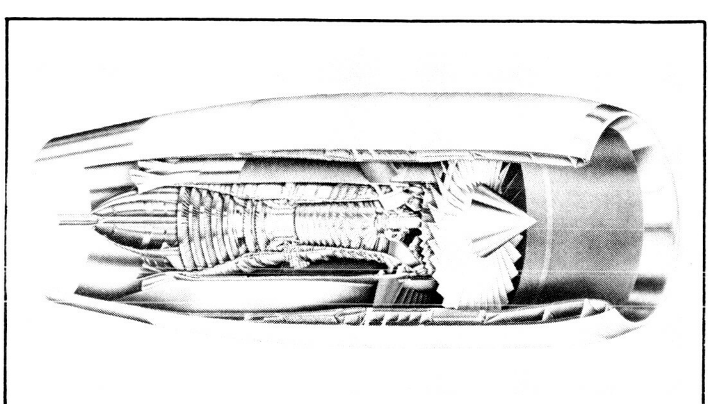
Aeropropulsion Research and Technology

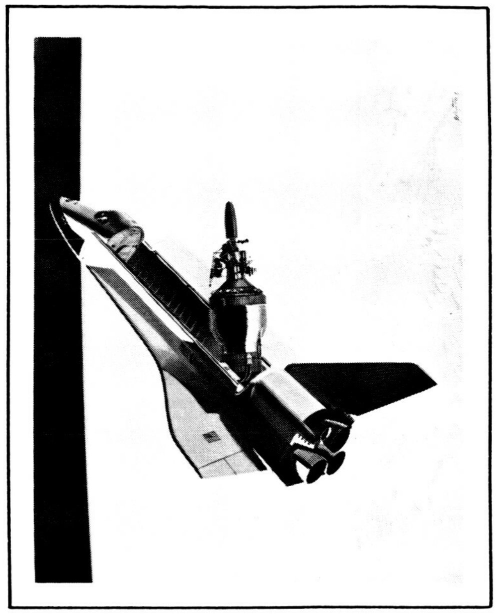
Goal

To conduct an effective and productive aeropropulsion research and technology program that contributes materially to the enduring preeminence of U.S. civil and military aviation

Objectives

- To establish the technology readiness of advanced turboprop by 1989, including a flight test by 1987
- To complete rehabilitation and begin test operation of the Altitude Wind Tunnel by 1991
- To achieve national recognition for Lewis' centers of excellence in internal computational fluid mechanics and engine structural analysis by 1988. To continue to maintain centers of excellence in aeropropulsion materials and instrumentation
- To strengthen Lewis' support of aeropropulsion technology for the small-engine industry and for military aircraft by 1987
- To improve the effectiveness and utilization of the major aeropropulsion facilities at Lewis by 1986
- To refocus the Lewis aeropropulsion program on applications for a broadened range of vehicle classes during 1985





Space Science

Goal

To support effective and productive expansion of human knowledge of the solar system by providing high-energy orbital transfer capability for the Space Transportation System

Objectives

- To complete the adaptation of the Centaur stage to the space shuttle in time to support launch of the Galileo spacecraft in the second quarter of 1986
- To support the shuttle-Centaur launch of the International Solar Polar mission in 1986
- To support the shuttle-Centaur launch of the Venus Radar Mapper Mission in 1988
- To support integration of future space science missions with shuttle-Centaur

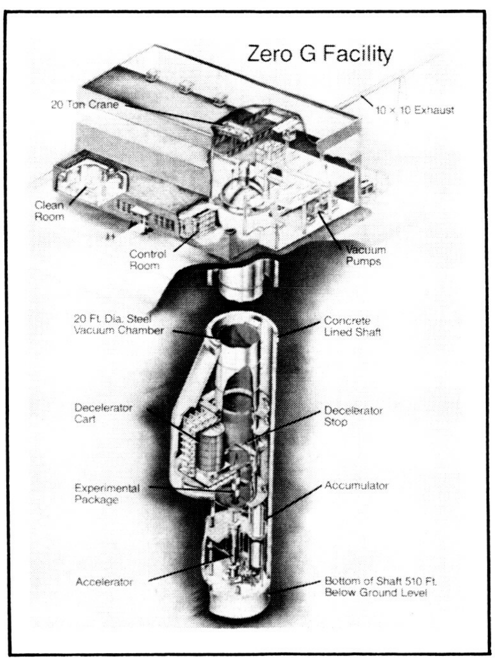
Space Applications and Technology

Goal

To conduct effective and productive space applications and technology programs that will contribute materially to U.S. leadership and security

Objectives

- To develop the high-risk advanced communications technology usable in multiple-frequency bands in order to support a wide range of future communications systems for NASA, other Government agencies, and industry and to ensure continued U.S. preeminence in satellite communications
- To develop the Advanced Communications Technology Satellite system for validation of the proof-of-concept multiple-beam communications technologies
- To support NASA's space technology goals by continuing to maintain Lewis as the center of excellence in space power, space communications, and space propulsion and by maintaining vital support in materials, structural analysis, instrumentation, and computational methods
- To successfully advocate Lewis becoming a center of excellence for microgravity science by 1986 in support of NASA's applications and space station programs, including maintaining and evolving a microgravity materials science laboratory
- To implement and expand Lewis' role in science and technology experiments in space in support of NASA's applications, technology, and space station programs



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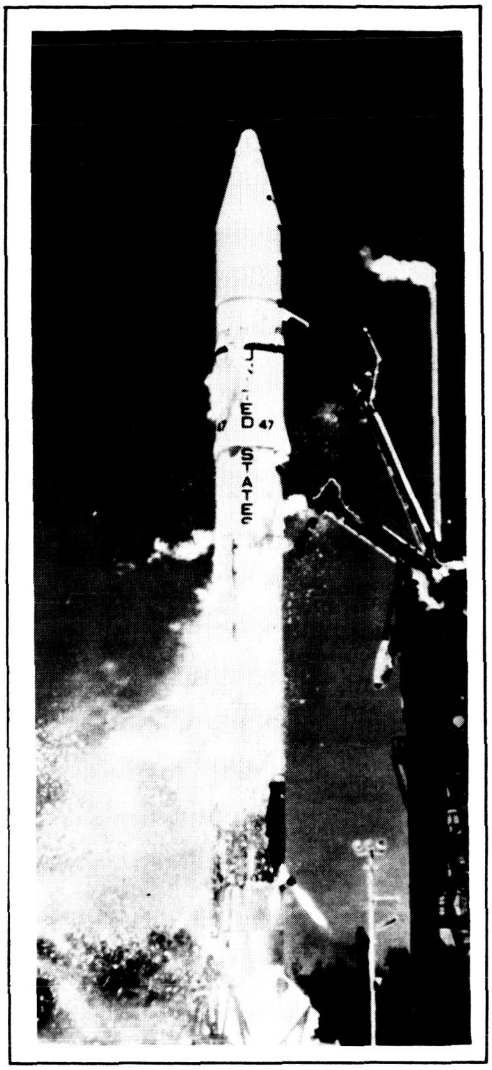

Commercialization of Space

Goal

To promote expansion of opportunities for private sector investment and involvement in aerospace technology and in systems for terrestrial and space-related applications

Objectives

- To support the private sector in using aerospace technologies for terrestrial applications while completing all current terrestrial energy program commitments during 1985–87
- To develop and execute, in cooperation with industry, new programs and projects for technology transfer
- To support NASA Headquarters' policy and contractor efforts to commercialize the Atlas-Centaur launch vehicle while assuring that current NASA and customer schedules and funds are not jeopardized
- To establish Lewis as a major participant in NASA's space commercialization effort

Management

Goal

To establish Lewis as a leader in the development and application of advanced management information system technology and management practices that will significantly increase productivity for Lewis and NASA

Objectives

- To begin implementing the office automation plan by operating administrative automatic data-processing equipment
- To broaden the scope and increase the number of quality circles
- To provide an integrated training program for management and supervisors that will continue to develop awareness, understanding, and use of participative management and consensus decision making at all levels
- To provide opportunities for nonsupervisors to develop participative management skills
- To use the ACTS project as a model for generating and adopting measures to enhance productivity

Directorate Planning

During 1984 the Lewis Research Center was restructured to enhance our ability to fulfill major new programs in aeropropulsion technology, advanced communications, and space station power systems development. The following directorate plans were generated by the members of the new directorate organizations.

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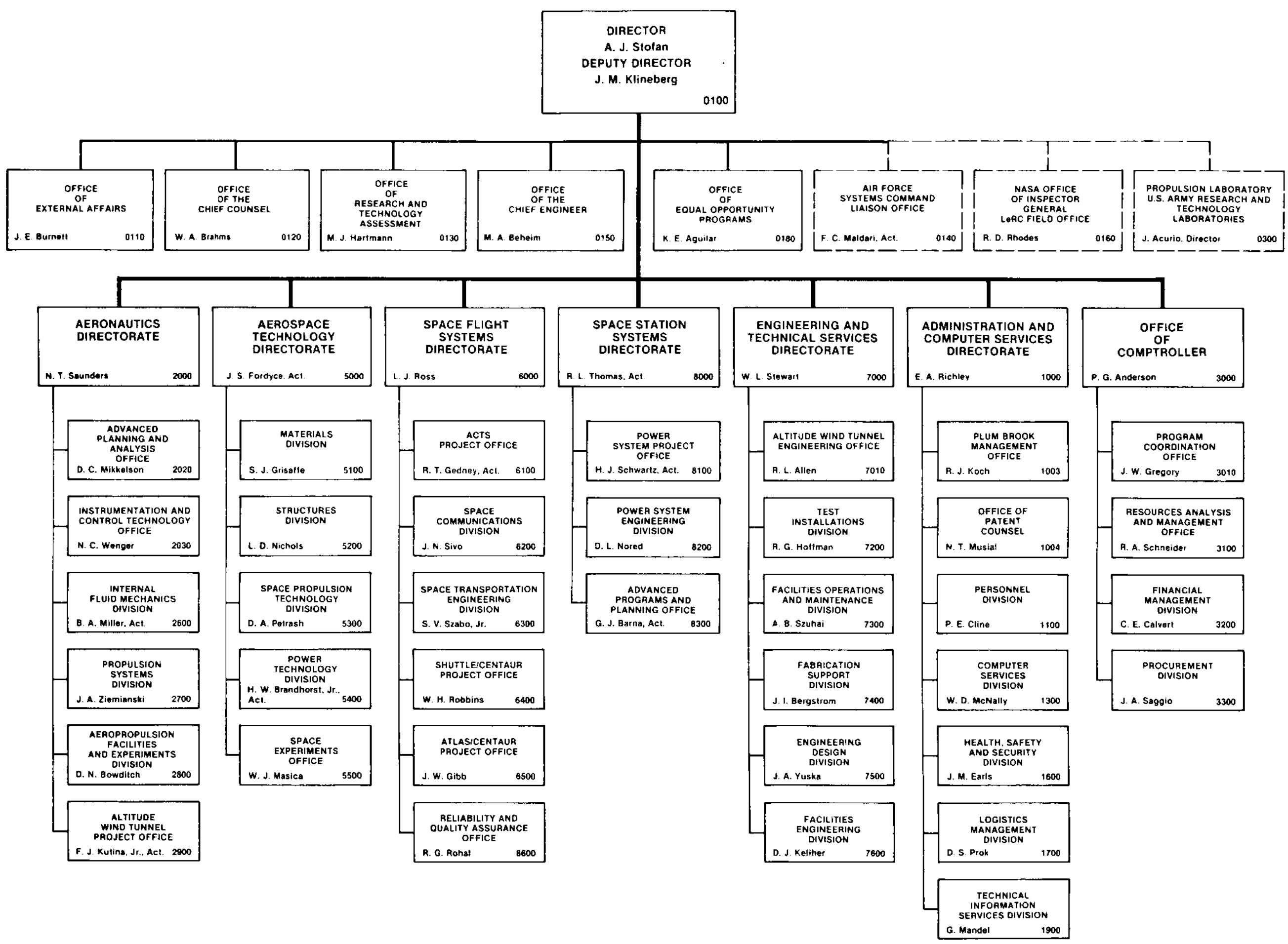


The Lewis Research Center organization

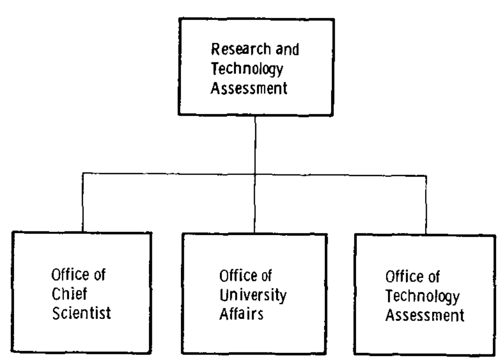
Work Breakdown Structure

The work breakdown structure (WBS), a hierarchical arrangement of planning elements, provides the general framework for the strategic planning activity. At the uppermost tier of the hierarchy the WBS was divided along current directorate organizational lines. Each directorate then prepared a WBS, which for the research directorates followed program lines and for the support directorates followed organizational lines. These WBS's followed a format consistent with the present resources-accounting system to facilitate tabulation of personnel and funding. In the individual directorate strategic plans that follow, at least the first two tiers of the WBS are described.

Office of Research and Technology Assessment

Mission

The Office of Research and Technology Assessment will strengthen basic research at Lewis and ensure that our aeronautics and space programs receive the maximum benefit from basic research activities here, at universities, and within industrial organizations. The Office will assist in evaluating, and selecting directions for, future focused research and technology programs. The Office is organized into three groups that are responsible for monitoring in-house research, for coordinating university programs, and for evaluating Lewis and industry efforts in aeronautics and space. The development of visionary programs with high payoff is the ultimate goal.



Office of Research and Technology Assessment work breakdown structure

Strategic Objectives and Actions Planned

Office of the Chief Scientist

The Office of the Chief Scientist has been performing certain critical duties very effectively for some years and plans to continue these efforts in 1985. These duties include managing and coordinating the basic research carried out under the Fund for Independent Research, as well as that supported by the Director's Discretionary Fund. Both have been quite successful in supporting selected new research projects, with the Director's fund particularly aimed at the development of innovative ideas. Efforts selected by the Lewis Research Advisory Board will be supported until the idea has been proven and support becomes available from regular sources. Overall responsibility for the senior management research reviews also resides in this Office. To help evaluate in-house Lewis discipline efforts, peer reviews are planned and managed by the Chief Scientist. These reviews will result in the same rigorous standards that are currently applied to university and contract programs. The first peer review, of combustion fundamentals in September 1984, appears to have been quite successful. Structural dynamics will be reviewed in March 1985 and electrochemistry fundamentals later in the year. Results from these peer reviews will be factored into next year's strategic planning activity.

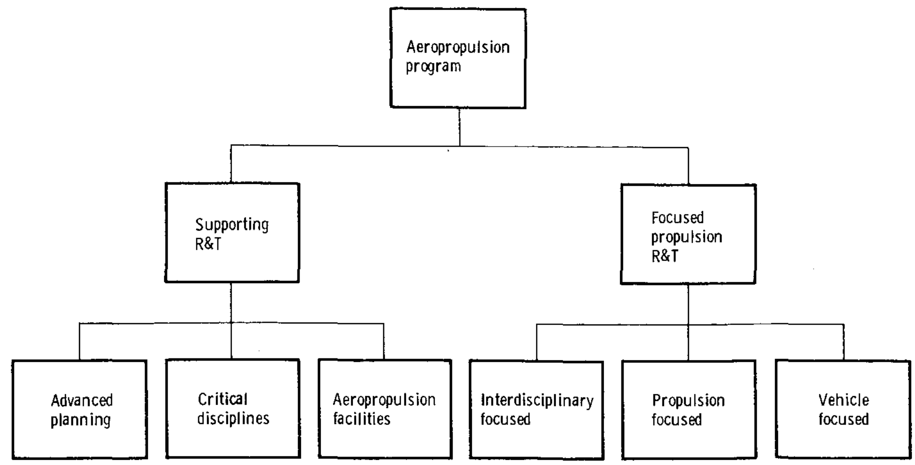
Attached to this Office is a group of outstanding individual researchers whose efforts at present are totally analytical. Plans are being formulated for the creation of a coordinated network of outstanding experimental researchers who will perform some critical experimental work. Experimental work often leads into new areas and may also provide critical data to help the analyst in explaining an existing problem. The members of these groups will be available for consultation with other Lewis organizations and will lend their expertise to the technology assessment process as required.

Office of University Affairs

The Office of University Affairs is new. Its plans include consolidating and centralizing the coordination of Lewis-university interactions. University relations will be managed from this Office in such a way as to improve bi-directional communications between the various university segments and Lewis management, research, and project staff. Any manner in which university administrations, departments, faculties, and students can help Lewis in its programs will be investigated and supported, as appropriate. The most important action the Office will undertake is the establishment and nurturing of contacts between university faculty researchers and Lewis researchers. Additionally, specific measures will be taken to cultivate the graduate student population working on research grants both to enhance the recruitment pool and to develop an improved network among these young researchers. A university programs management information system will be developed for use Centerwide and to structure liaison activities with procurement, recruitment, and training. In all relations with the university community, consideration will be given to enhancing their sense of partnership, which, in turn, will promote a strong community of advocacy for the continuation and growth of Lewis programs.

Office of Technology Assessment

The Office of Technology Assessment is newly created, but for some time many have felt its need in Lewis management's technical and policy decision making. The Office will coordinate inputs from Lewis technical staff (including our own "fellows"), university experts and industrial researchers, and any organization whose information would affect assessment of the subject area. Outside experts will be brought to Lewis when required. A procedure is being formulated for selecting the areas to be assessed, and several assessments are planned for 1985. This Office will also assist in identifying discipline experts at Lewis and will channel visitors and inquiries on technical matters to the appropriate Lewis expert. It will sponsor research and technology briefings and special presentations to inform the staff of Lewis accomplishments. An enlarged response to various aerospace industrial research and development programs will be implemented in 1985 in cooperation with NASA Headquarters Office of Aeronautics and Space Technology and the Department of Defense.



Aeronautics Directorate work breakdown structure

Aeronautics Directorate

Mission

The Aeronautics Directorate, as restructured and redirected, consolidates and strengthens the key disciplinary "building blocks" for future advances in aeropropulsion; provides a focus for discipline, component, and system research; strengthens the roles and responsibilities for major facilities and experiments; and emphasizes both program planning and mission analysis as catalysts for generating ideas and identifying directions.

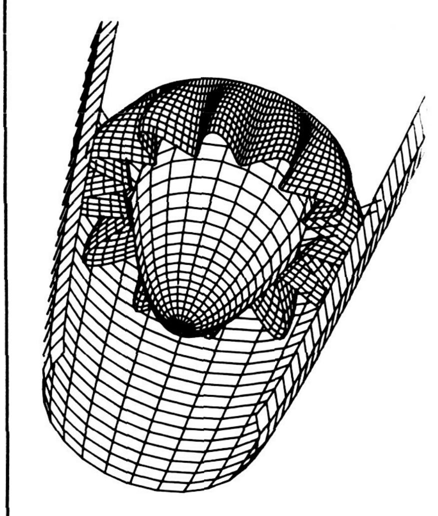
The mission of the Aeronautics Directorate is to establish aeropropulsion technology that contributes significantly to the continuing preeminence of the U.S. civil and military aircraft industry. The Directorate is responsible (1) for significantly advancing research in internal computational fluid mechanics and instrumentation and controls; (2) for achieving major propulsion technology advances in interdisciplinary-, propulsion-, and vehicle-focused programs; (3) for enhancing the capabilities of existing aeropropulsion experimental facilities and developing new facilities; and (4) for identifying and evaluating innovative propulsion concepts. The Directorate also supports other Lewis directorates, other centers, and other agencies in applying aeropropulsion-related technology and ensuring effective and timely transfer of this technology to appropriate elements of U.S. industry.

Strategic Objectives and Actions Planned

Directorate Level

The Aeronautics Directorate, before establishing its strategic objectives for the next 5 years, established guidelines for strategic planning. These guidelines assume a constant level of civil service staffing, moderate funding growth in institutional support, significant (at least 50 percent) funding growth in the total aeronautics budget, which includes the significant out-year funding increases required by the Advanced Turboprop Project and the Altitude Wind Tunnel, and major involvement of both staff and facilities in all future programs.

The Directorate program, shown in the work breakdown structure, emphasizes the development of interdisciplinary-, propulsion-, and vehicle-focused research and technology and, to that end, requires advanced planning, the support of certain critical disciplines, and aeropropulsion facilities.


Twelve-lobe mixer nozzle

Advanced Planning

The Advanced Planning and Analysis Office will assess the performance potentials of advanced and unconventional propulsion and aircraft systems. It will also identify and analyze new propulsion concepts and their integration, which could enable new vehicle systems. The Office will be key to developing the new ideas, concepts, and systems that will set the direction for aeropropulsion programs. It is planned, for example, to evaluate the turbine bypass engine in a variety of aircraft applications and to assess the benefits and technology needs of non-heat-propulsion systems such as microwave-beam-powered engines.

Critical Disciplines

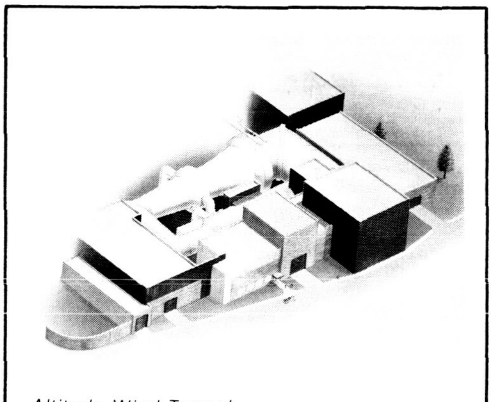
The Instrumentation and Controls Technology Office combines and focuses key elements of ongoing programs and expands into related new areas. The Office will continue to develop and apply advanced instrumentation. With the restructuring of the aeropropulsion program the Office's efforts are being expanded into instrument applications, high-temperature electronics research and development, advanced control sensor technology, and the development of advanced control strategies. The focus of the controls effort is to develop the technologies for "smart" engines of the future. Examples of planned actions are the demonstration of fiber optic sensors for use in propulsion control systems and the development of minimally intrusive sensors for measuring temperature, strain, and heat flux on propulsion system components.

The Internal Fluid Mechanics Division consolidates all activities at Lewis related to internal computational fluid mechanics. The division develops computational methods, performs modeling, and develops and verifies codes. Key research in computational methods includes numerics, mesh construction, and algorithm development. The modeling area will be supported by fundamental research in fluid mechanics, combustion, kinetics, and heat transfer. The Division plans, for example, to establish archival benchmark data for modeling fundamental fluid dynamics, heat transfer, and combustion specific to aeropropulsion. It will use these benchmark data to verify three-dimensional internal flow codes over the range of aeropropulsion components and systems.

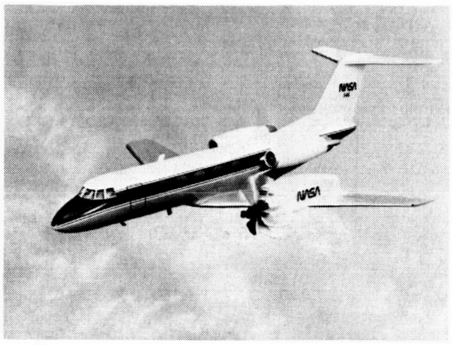
Aeropropulsion Facilities

The Altitude Wind Tunnel (AWT) Project Office is responsible for program advocacy and an extensive in-house modeling program as well as the design and construction of this facility. Modeling involves both physical models and simulations.

AWT is essential for the development of future aeropropulsion systems and will provide a unique capability for NASA and the nation. Specifically, the AWT will enable both propulsion-airframe integration studies and adverse-weather research (e.g., icing and heavy rain) that are not now possible because of facility limitations of size, speed, and altitude capability.


Altitude Wind Tunnel

The typical role of research facility operations has been expanded in the new organizational structure. The Aeropropulsion Facilities and Experiments Division will manage not only the major Lewis aeropropulsion facilities but also the experiments conducted in these facilities. Facility managers will be responsible for assembling a team to accomplish all aspects of a test program.



Gulfstream G11 testing propfan

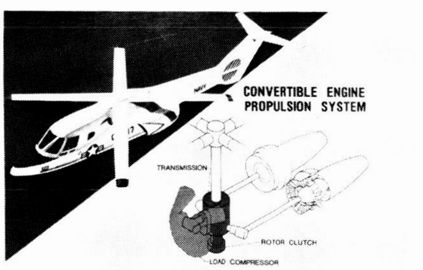
Propulsion-Focused Technology

Included in propulsion-focused technology are small engines and high-thrust-to-weight engines. Small engines include the Department of Energy-funded automotive gas turbine, which is the Directorate's second highest priority, as well as rotary engines and small aircraft gas turbine engines. A new initiative in small-engine technology is being planned and advocated for fiscal 1987. The initial efforts on high-thrust-to-weight engines will involve defining the most appropriate role for Lewis.

Vehicle-Focused Propulsion Technology

Included in vehicle-focused propulsion technology are subsonic transports, advanced rotorcraft, supersonic aircraft, and hypersonic aircraft. In the subsonic transport category is the Advanced Turboprop Project, which has the highest priority in the Directorate. This project involves major in-house and contractual efforts to establish technology readiness for the next generation of fuel-efficient engines for transport use in the 1990's. Current efforts in advanced rotorcraft are in convertible engine technology, integrated controls, and advanced transmissions.

For 1987 and beyond, the Directorate has identified three possible initiatives in vehicle-focused technology: convertible engines, supersonic short-takeoff-and-vertical-landing aircraft (STOVL), and hypersonic propulsion. The convertible engine initiative would include efforts in the X-wing, the folding tilt rotor, and subsonic vertical/short takeoff and landing. The supersonic STOVL initiative, also known as powered lift, would be a joint program with the Ames Research Center and would include cooperation with the United Kingdom on vectored thrust and with Canada on an augmentor/ejector. The hypersonic propulsion initiative would be a joint program with the Langley Research Center.



High-speed rotorcraft

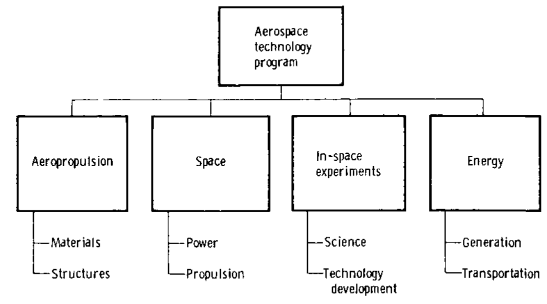
Interdisciplinary-Focused Propulsion Technology

Interdisciplinary-focused propulsion technology includes icing technology, special projects, and hot-section durability. Icing technology, in addition to the icing research program, includes substantial support for the AWT modeling effort. Hot-section durability, an effort in which the Aerospace Technology Directorate has the lead, supplies a high percentage of the net research and development funding for key disciplinary technologies of materials, structures, instrumentation and sensors, and internal computational fluid mechanics. Because funding for the current hot-section technology program, HOST, will expire in 1988, a new initiative will be advocated for future years as a means of continuing funding for these key disciplinary technologies.

Aerospace Technology Directorate

Mission

The Aerospace Technology Directorate's mission is (1) to provide the technology for aeropropulsion and space needs in space power, space propulsion, aerospace materials, and aerospace structures, (2) to define, develop, and conduct in-space experiments in basic science, materials, fluids, and space propulsion and power technology development, and (3) to manage synergistic terrestrial energy projects for the Department of Energy (DOE) and the Agency for International Development (AID) in order to fulfill current commitments. In fulfilling its mission the Directorate must work closely with the other program directorates not only as a developer of technology, but also by providing critical support to their programs as required.



Aerospace Technology Directorate work breakdown structure

Strategic Objectives and Actions Planned

Directorate Level

This update of the Lewis strategic plan reaffirms and builds upon previous objectives in the major categories shown in the work breakdown structure. The recent reorganization, which consolidates space power and propulsion technology, space experiments, and the broadly applicable disciplines of materials and structures in this Directorate, grew from the successes achieved to date by the Center in meeting its strategic objectives and from a recognition that in technology a high degree of synergism exists across the major fields of interest to Lewis. The overall Directorate objectives are (1) to maintain and further develop Lewis' research and technology lead as a center of excellence in space power, space propulsion, and aeropropulsion materials and structures and to become a center of excellence for microgravity science; (2) to expand Lewis' role in science and technology experiments in space; (3) to successfully fulfill all commitments to other directorates; and (4) to continue meeting energy program commitments to DOE and AID.

Directorate funding is expected to increase over the next few years. However, to achieve its objectives, the Directorate will have to maintain strong program advocacy, increase its market share of research and development funds, and broaden its constituency beyond the Office of Aeronautics and Space Technology (OAST) to the Office of Space Science and Applications, the Office of Space Flight, and the Department of Defense. The development of joint programs between OAST and others will be vigorously pursued as appropriate. Personnel working on Directorate programs include NASA civil service employees, Army employees, support service contractors, and university consortium staff. The Directorate civil service level will remain essentially constant. Increasing staffing needs for growing areas (e.g., space station propulsion and space experiments) will be satisfied through internal rebalancing, more support service contractors, and university consortium augmentation.

Aeropropulsion

A Directorate goal is to maintain and develop a center of excellence in materials, structures, and life prediction so as to meet future technology needs and to support systems projects in collaboration with the Aeronautics Directorate. In the restructuring of the aeronautics program, it was recognized that these disciplines are as critical to aircraft engines as they are to space propulsion and power systems. A strong program will continue in advanced materials and processes, structural mechanics and dynamics analysis, and life prediction. Augmenting the base research and technology efforts are interdisciplinary programs in turbine engine hot-section technology (HOST) and ceramics for advanced turbine engines. Currently being given midcourse corrections, HOST will form the basis for Lewis achieving a premier posture in computational structural mechanics, reaching into the problems of small engines with steeper thermal gradients and ceramic components. Structural ceramics are of major importance to the competitiveness of the United States' aircraft industry. Raising ceramics funding to the levels needed to achieve technology readiness will be strongly advocated. Another important initiative is composite materials for engines. The Directorate will continue to provide strong support to the Advanced Turboprop and Altitude Wind Tunnel Projects and to other priority aeronautics programs like Small Engine Technology.

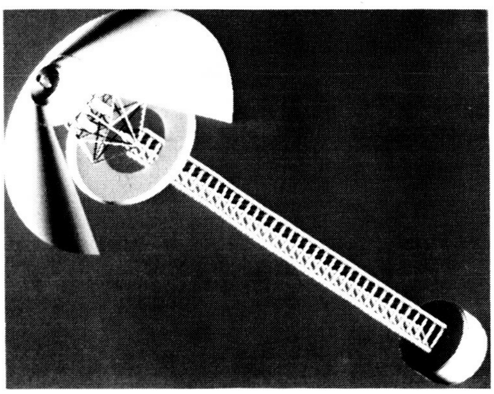
High-temperature fatigue and structures laboratory

Space Power

A Directorate goal is to maintain Lewis' role as lead center and center of excellence for space power research and technology: in photovoltaics, electrochemistry, thermal and power management, power distribution, and nuclear/solar dynamic power systems, including supporting materials, structures, and life prediction disciplines and studies. Lewis' role will continue to grow because power is now recognized as a major technology issue for the space station and its evolution, for geostationary Earth-orbiting spacecraft, and for military systems. The importance of the nuclear dynamic option is growing and Lewis is expecting to play an important role. Initiatives being advocated include advanced solar dynamic systems, free-piston Stirling research and technology, "satellite 2000" bus technology, and electrodynamic tether. Growth is expected in power and electronic materials research.

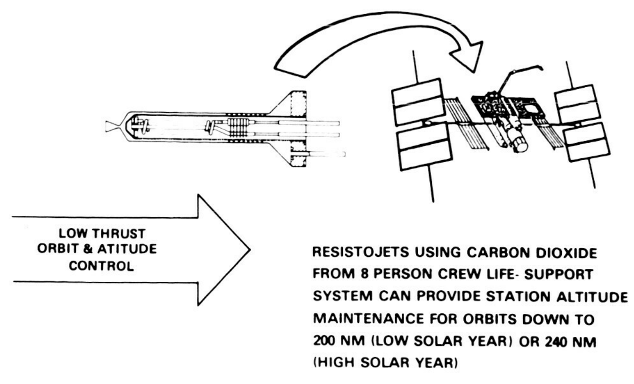
Space Propulsion

A Directorate goal is to maintain Lewis' role as lead center and center of excellence for space propulsion research and technology for Earth-to-orbit, orbit-to-orbit, and auxiliary propulsion systems, including supporting materials, structures, and life prediction disciplines and studies. It is anticipated that Lewis will continue to lead in orbit-transfer-vehicle (OTV) engine technology. A research engine initiative is just beginning.



Reactor Stirling engine space power system

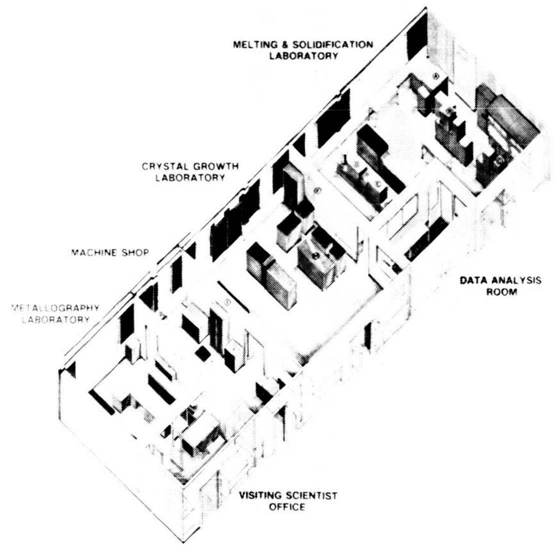
Programs related to the space shuttle main engine will remain of high priority and grow. These programs demand a broad interdisciplinary team from several directorates. Major new efforts in auxiliary propulsion are multiple-fuel resistojet and hydrogen-oxygen (H/O) thruster technology and the propulsion test bed and integrated propulsion system for the space station. The arc jet is receiving more attention, and work continues on inert-gas ion thrusters and storable systems. To support these continuing and expanding activities, an altitude capability has been added to the Rocket Engine Test Facility and modifications are being made to tank 5 in the Electric Propulsion Laboratory. Other modifications are in construction-of-facilities planning.



Space station resistojet

In-Space Experiments

The maturing operational space shuttle provides a practical way to perform in-space experiments. The planned space station will provide even greater opportunities. The Aerospace Technology Directorate is the focal point for Lewis to take advantage of these new opportunities. There are two Directorate goals. The first is to successfully advocate Lewis becoming a center of excellence for microgravity science (materials, combustion, and fluid physics) by 1986 in support of NASA's applications, commercialization, and space station programs. This would include maintaining and evolving a microgravity materials science laboratory. The second goal is to implement and expand Lewis' role in science and technology experiments in space in support of NASA's applications, technology, and space station programs. Eight experiments are currently funded, with six more on the threshold. In this area growth is limited only by imagination. For full vitality new ways of doing business will have to be developed. A modification to the Lewis Zero-Gravity Facility, the space experiments laboratory, is being actively advocated for the 1987 construction-of-facilities budget.



Microgravity materials science laboratory

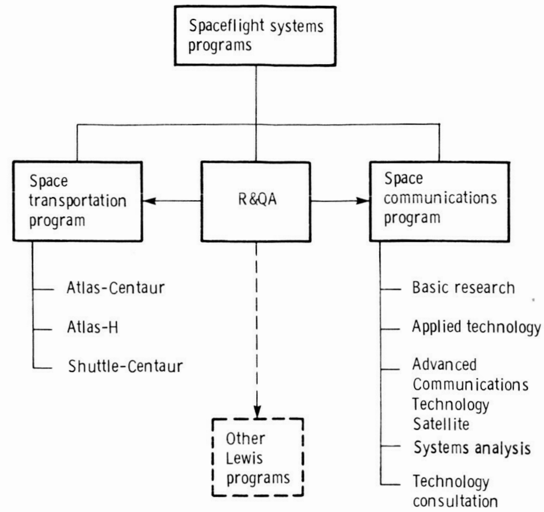
Energy

There are two Directorate goals. The first is to continue to meet all existing program commitments to DOE and AID by more use of support service contractor personnel in the photovoltaic, phosphoric acid fuel cell, wind, and Stirling engine projects and to provide support to the Automotive Gas Turbine Project. The second goal is to begin or expand selected aeronautics and space technology programs from those energy projects that are synergistic to Lewis' interests (e.g., Stirling engine and ceramics).

Space Flight Systems Directorate

Mission

The Space Flight Systems Directorate is responsible for the development and operational activities associated with the Center's spaceflight program assignments. The Directorate is conducting research and development in two major program areas: space transportation and space communications. The Directorate also provides reliability and quality assurance for these programs as well as for other major system development programs at the Center.

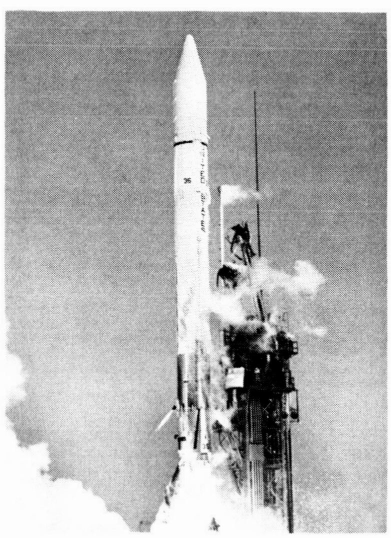


Space Flight Systems Directorate work breakdown structure

Strategic Objectives and Actions Planned

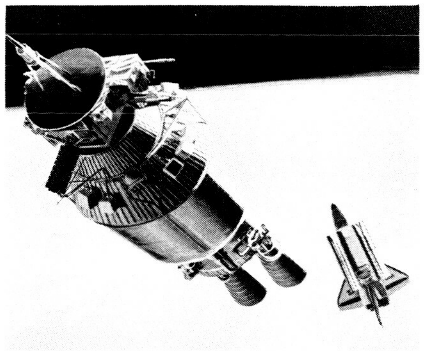
Space Transportation Program

Since 1962, Lewis has been responsible for the development of the Centaur upper stage and has managed 100 launches, including 60 Atlas-Centaurs. Since 1981, the Space Flight Systems Directorate has also provided certain acquisition and technical consultation and management support to the Air Force for five Atlas-H boosters. The Directorate will continue its efforts to provide completely reliable launch vehicles through the duration of these programs. With the advent of the space shuttle and plans to commercialize the Atlas-Centaur, the final Lewis-managed launch of Atlas-Centaur (AC-68) is scheduled for 1987. It is anticipated that Lewis' commitment to the Air Force to procure and manage Atlas-H launch vehicles will end in 1986. Over the next 2 years the Lewis team will ensure the orderly shutdown of production of Atlas-Centaur and Atlas-H launch vehicles and the disposal of Government equipment (tooling, manufacturing equipment, machines, etc).



Launch of AC-35-24

A major new space transportation program, the development of Centaur as an upper stage for the space shuttle, was begun in 1982. During 1983, the base program established at the end of 1982 was expanded to include additional missions. In October 1983, a $253 million contract was awarded to General Dynamics Corporation for the design, development, and production of two Centaur vehicles, modified for use with the shuttle, to support the NASA Galileo (Jupiter) and International Solar Polar missions in 1986.


Artist's concept of shuttle-Centaur

In the near term the Directorate's strategic plan calls for successfully accomplishing the base program plus future augmentations, as appropriate.

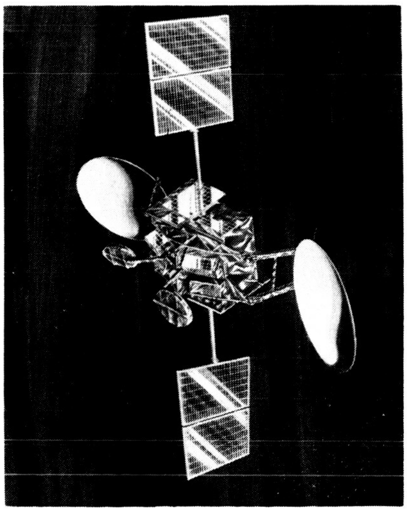
For the long term the Directorate staff and capabilities will be maintained as required. Upon completion of the initial Centaur-in-shuttle development activities in 1986, it is envisioned that there will be a gradual transition from development activities to mission integration and operations.

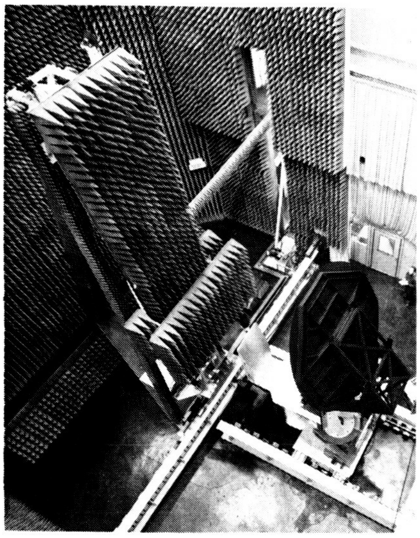
Space Communications Program

In 1979, Lewis was designated the lead center for research and development in space communications. Since then, Lewis has continued to build a broad-based, integrated communications program of studies, basic research, applied high-risk technology (base program), and flight experimentation where required (flight programs).

The base program of the Space Communications Division is developing technology usable in multiple-frequency bands to support a wide range of future communications systems for NASA, other Government agencies, and U.S. industry. In 1984, significant progress was made in all of these areas. As a result the integrated base program is sure to be strengthened. A contract was signed on August 10, 1984, with RCA Astro Electronics, Inc., for the development of the Advanced Communications Technology Satellite (ACTS) system, embodying advanced multiple-beam antennas, onboard switching and processing, and other advanced technologies. A separate ACTS Project Office was established within the Directorate to manage the ACTS system development and operations.

Strategic objectives of the Directorate are to promote a stable and viable NASA advanced communications program and to stengthen Lewis' role as the lead center in space communications research and development.


Advanced Communications Technology Satellite


Interim antenna test laboratory

The following specific actions were planned for the next 2 years:

- To assist Headquarters in expanding and detailing the long-term NASA program plan
- To continue to advocate for the resources necessary to enable program growth in selected areas and overall program stability and effectiveness
- To continue to raise the quality of the staff and improve the skill mix through selective hiring
- To continue ACTS design, development, and fabrication
- To define appropriate advanced flight programs as follow-ons to ACTS

For the long term it is planned

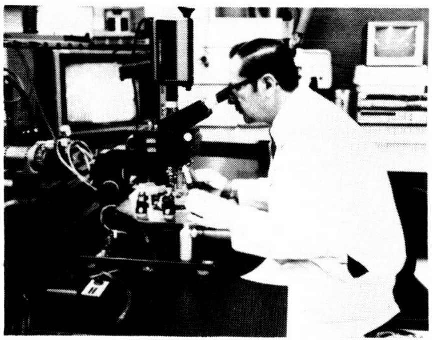
- To continue program advocacy and development in advanced communications elements and systems
- To maintain a broad-based, integrated communications program
- To continue development to the launch of ACTS (1989) and to begin ACTS experiments (through 1991)

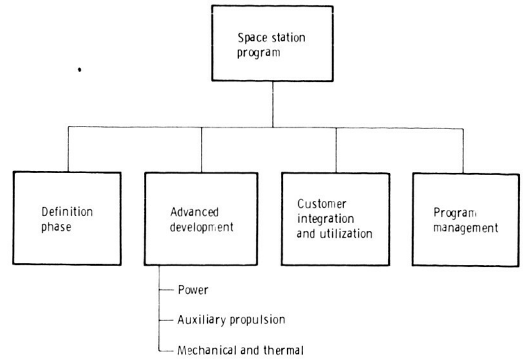
Potential augmentations to the base program may include

- Undertaking selective basic research applicable to a second-generation (or expanded) space station
- Developing a center of excellence in solid-state microelectronics and microwave systems
- Securing additional near-term resources to accelerate the pace of applied technology

Reliability and Quality Assurance

During 1984, the Reliability and Quality Assurance Office (R&QAO) concentrated on supporting the larger, more complex programs at Lewis such as launch vehicles, ACTS, and space station. All personnel assignments within R&QAO have been made to support these programs. Their support has been very demanding on the staff, especially in the areas of electronic parts, materials, electronic packaging, and contractor/vendor surveys. The staff has grown by 20 percent and the new personnel have been trained and are making positive contributions in support of these programs. The key objectives will be to continue to upgrade the staff, both in number and capability, in order to better support the Center's large, complex space programs.


Reliability testing of solid-state devices



Space Station Systems Directorate work breakdown structure

Space Station Systems Directorate

Mission

The mission of the Space Station Systems Directorate is to manage and coordinate all of the work performed at Lewis in support of the Space Station Program. This includes the work performed as lead center for power for the initial-operating-capability (IOC) space station, which involves defining and developing the power system. It also includes supporting roles in auxiliary propulsion and other disciplines and in the use and evolution of the space station.

Strategic Objectives and Actions Planned

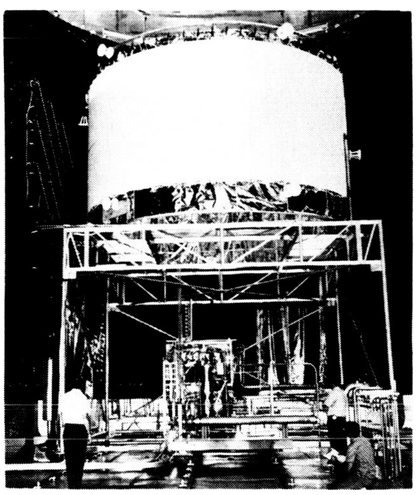
The Space Stations Systems Directorate was organized when Lewis was assigned as lead center for the power system for the IOC space station and as supporting center for auxiliary propulsion and other technology efforts. The Directorate will meet all program and technical requirements associated with these roles in order to ensure our continued major responsibility for space station power, to maintain our leadership in space power, and to enhance our role in propulsion.

It is anticipated that the permanent full-time complement of the Directorate, currently 94, will be 135 by the end of 1985.

Definition Phase

Power

The Directorate will manage two major contracts for tradeoff studies, systems engineering, and preliminary design of the power system for the IOC space station and platforms. The contractors will also establish the interfaces between the power system and other space station systems managed by other NASA centers (JSC, MSFC, and GSFC). They will also perform the work necessary to integrate the power system with the space station. Finally they will focus on other factors such as performance, reliability, maintainability, and cost, which is of great importance. Systems engineering and integration (SE&I) work will be performed by Lewis to augment and guide the contracted effort.



Power system test

The objective is to define the most capable power system for the IOC space station and platforms within cost and other constraints. A successful definition phase is needed to ensure Lewis' continuing role in space station power.

Propulsion

The Directorate will support Marshall Space Flight Center in its lead role in propulsion for the IOC space station. This support will include in-house SE&I effort. Sufficient Lewis participation in the definition phase will be sought to bring about a better recognition and acceptance of Lewis' capabilities and expertise in propulsion and fluid management for space station applications.

The strategic objectives of this support are to ensure that Lewis technologies are adequately assessed for their potential benefits to the Space Station Program and to help focus the advanced development program supported by the Space Station Program Office and the OAST Focused-Technology Program.

Evolution and Growth

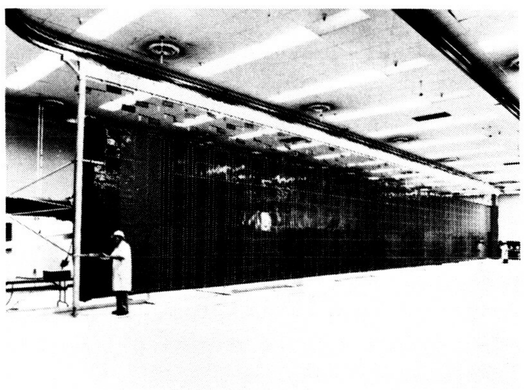
The Directorate will perform studies to define growth paths for power and propulsion systems for the space station, including the orbital transfer vehicle (OTV), and to assess the merits of advanced technology options. This effort will ensure that growth implications are factored into IOC designs.

The strategic objectives of this effort are to maintain Lewis' role as lead center in power for the space station and as a center of excellence in space power as well as to develop Lewis' roles in power and propulsion technology and hardware for the evolutionary space station.

Advanced Development

Power

The Directorate manages a NASA-wide program in advanced power system development. The objective is to bring to technical readiness power system technology options for the IOC space station. This program includes work performed by other NASA centers (MSFC, JSC, and JPL), work related to prototype hardware, and the power system work under the OAST Focused-Technology Program. The technologies covered under advanced development include solar arrays, regenerative fuel cells, solar dynamic systems, power management and distribution, and those mechanical and thermal technologies that support the power system. Results will be incorporated in the contractors' definition phase. An important additional effort is to define new facilities or augmentation of present facilities that may be needed to demonstrate technical readiness and to support the design and development phase.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