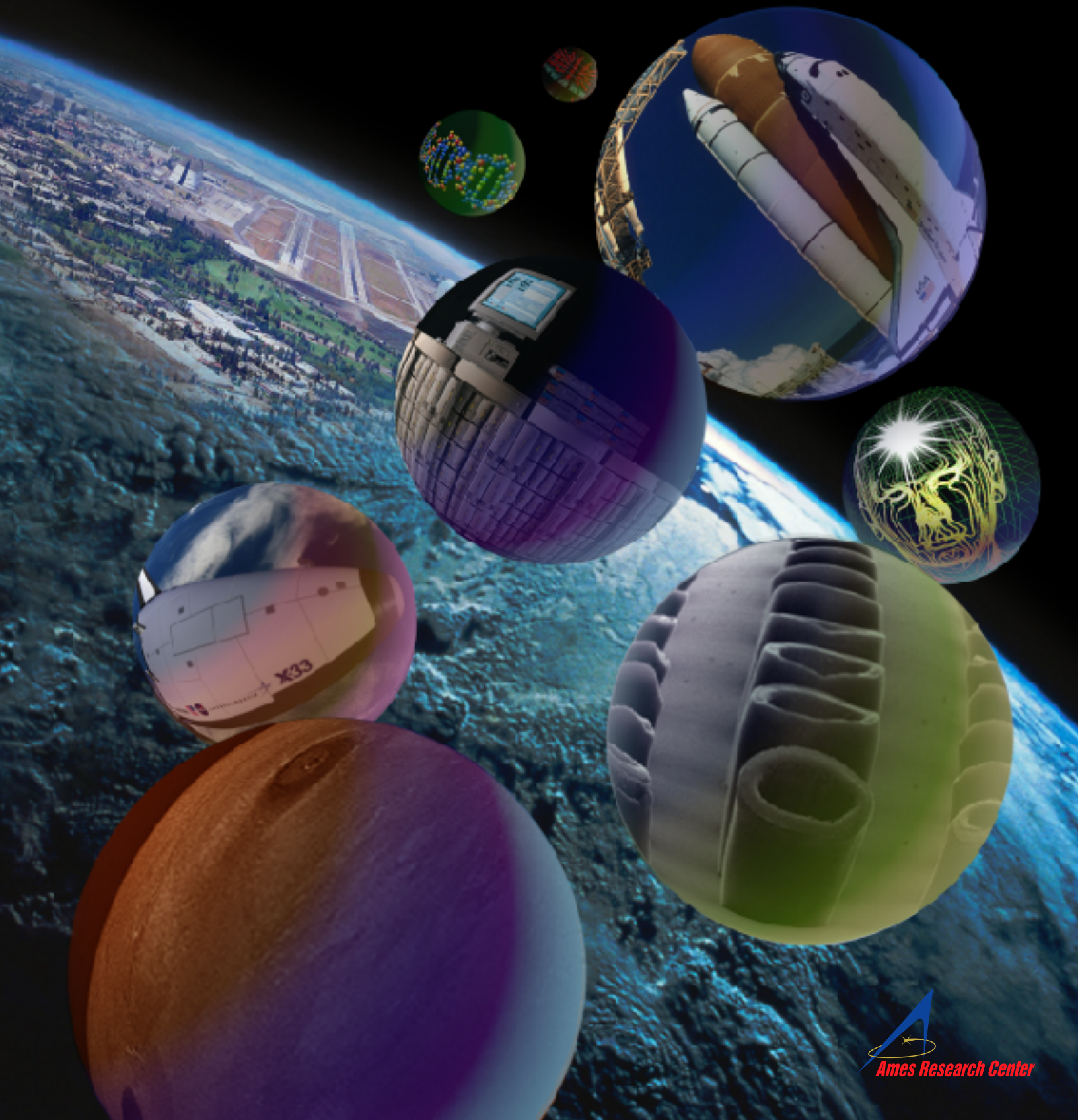
Ames Research Center FY01 Implementation Plan

Stepping Up to the Challenge

Delivering Science and Technology to Advance Aerospace Systems & Missions



Ames Research Center


NANOTECHNOLOGY
BIOTECHNOLOGY
NASA
INFORMATION TECHNOLOGY

Ames Research Center FY01 Implementation Plan

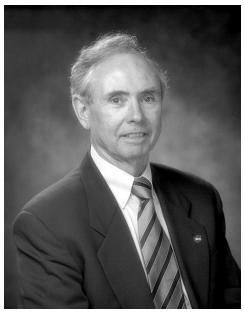
Stepping Up to the Challenge

Delivering Science and Technology to Advance Aerospace Systems & Missions

Implementing NASA's Strategic Plan
with respect to
Center of Excellence,
Center Missions, and
Lead Center Programs and Responsibilities

A Roadmap for Ames' Customers and Employees

January 2001
Ames Research Center
Moffett Field, CA 94035



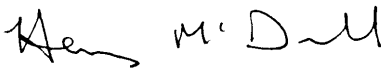
A Message from the Ames Center Director

The grand challenge of NASA's mission to explore space and study the origin and role of life in the Universe is driving the agency's focus on the technology triad in Information Technology, Biotechnology, and Nanotechnology.

These technologies are widely accepted as the most likely sources of breakthrough technologies in the next decade within the agency. Ames Research Center uniquely provides the integrated research environment required to exploit the crossover potential as well as the individual field breakthroughs of the technology triad to meet NASA's mission.

The hard work that we put into searching for and discovering the technological achievements today will shape the future of science and technology. It is imperative that the work we do fits with the nation's goals and the roadmap established for the entire Agency. The Agency states its broad goals, objectives, and values within the NASA Strategic Plan. The Ames Research Center FY 2001 Implementation Plan articulates how the Agency's strategic vision translates into the functions and duties and values of the employees at Ames. Due to the timing of the establishment of the Biology and Physical Research Enterprise, this change is not reflected in this plan.

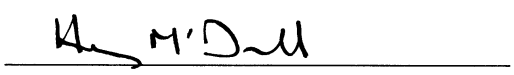
All Ames employees contribute to the success of this Center. I ask each Ames employee to read this Plan and to know what is expected of them and of Ames. This Plan will help ensure that Ames is at the forefront of aerospace technology development, scientific research, and space exploration.



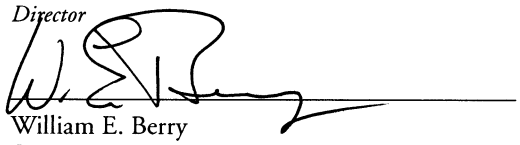
Henry McDonald
Center Director
Ames Research Center

Ames Management Team Concurrence

We the senior management team at Ames, are committed to working with the men and women of the Center and with all our stakeholders, partners, and customers to implement this plan.

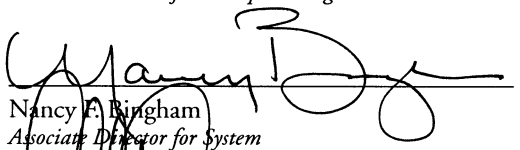


Henry McDonald
Director

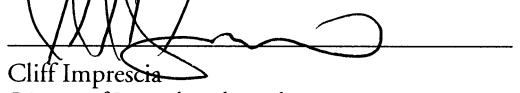


William E. Berry
Deputy Director

Robert Rosen
Associate Director for Aerospace Programs

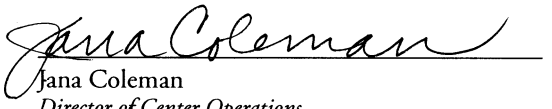


Nancy F. Bingham
Associate Director for System Management and Planning



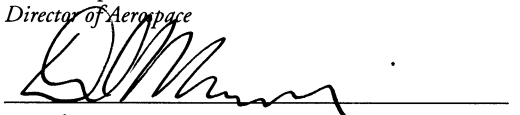
Cliff Impreścia
Director of Research and Development Services

Steve F. Zornetzer
Director of Information Sciences and Technology

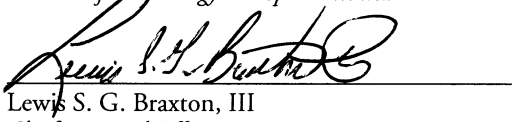


Jana Coleman
Director of Center Operations

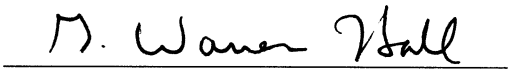
L.S. "Skip" Fletcher
Director of Aerospace



David Morrison
Director of Astrobiology and Space Research

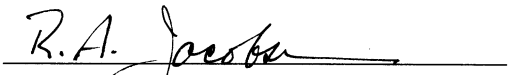


Lewis S. G. Braxton, III
Chief Financial Officer



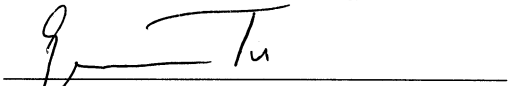
G Warren Hall
Director of the Safety, Environmental and Mission Assurance Office

Lawrence Caroff
Program Manager, SOFIA

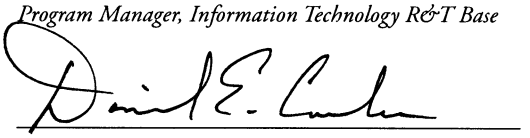


Robert A. Jacobsen
Director, Aerospace Operations Systems
Program Manager, Aviation Systems Capacity Program

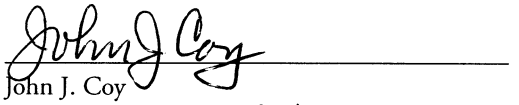
Maurice M. Averner
Program Manager, Fundamental Biology Research



Eugene L. Tu
Program Manager, High Performance Computing and Communications
Program Manager, Information Technology R&T Base



Dan Cooke
Program Manager, Intelligent Systems



John J. Coy
Program Manager, Rotorcraft R&T Base

Robert J. Shiner
Director, Consolidated Supercomputing Management Office
Director, Simulation Facility Group

Table of Contents

Introduction

This document presents the implementation plan for Ames Research Center (ARC) within the overall framework of the NASA Strategic Plan. It describes how ARC intends to implement its Center of Excellence responsibilities, Agency assigned missions, Agency and Enterprise lead programs, and other roles in support of NASA's vision and mission.

All Federal agencies are required by the 1993 Government Performance and Results Act to implement a long-term strategic planning process that includes measurable outcomes and strict accountability. At NASA, this planning process is shaped by the Space Act of 1958, by annual appropriations, and by other external mandates, as well as by customer requirements. The resulting Strategic Plan sets the overall architecture for what we do, identifies who our customers are, and directs where we are going and why. The Strategic Plan is the basis on which decisions regarding program implementation and resource deployment are made.

Whereas the strategic planning process examines the long-term direction of the organization and identifies a specific set of goals, the implementation planning process examines the detailed performance of the organization and allocates resources toward meeting those goals. It is the purpose of this implementation document to provide the connection between the NASA Strategic Plan and the specific programs and support functions that ARC employees perform. This connection flows from the NASA Strategic Plan, through the various Strategic Enterprise plans to the ARC Center of Excellence, primary missions, Lead Center programs, program support responsibilities, and, ultimately, to the role of the individual ARC employee.

Vision, Mission, Goals, and Values

NASA VISION AND MISSION

Vision

NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth.

Mission

- *To advance and communicate scientific knowledge and understanding of Earth, the Solar System, and the Universe*
- *To advance the human exploration, use, and development of space*
- *To research, develop, verify, and transfer advanced aeronautics, space, and related technologies*

NASA uses a variety of means to organize and focus the efforts of the Centers to achieve Agency missions. The primary organizations and initiatives are Strategic Enterprises, Centers of Excellence, Center Missions, and Lead Centers for technical programs.

Strategic Enterprises

NASA has established the four Strategic Enterprises to function as primary business areas for implementing NASA's mission and for serving customers. Each Enterprise has a unique set of strategic goals, objectives, and implementation strategies that address the requirements of the Agency's primary customers. NASA's Centers define how Enterprise programs and central services will be developed and delivered to external and internal customers. *The four NASA Strategic Enterprises are:*

- Aerospace Technology
- Space Science
- Human Exploration and Development of Space
- Earth Science

Centers of Excellence

Centers of Excellence are focused, Agency-wide leadership responsibilities in a specific area of technology or knowledge. They must strategically maintain or increase the Agency's preeminent position in the assigned area of excellence in line with the program requirements of the Strategic Enterprises and the long-term strategic interests of the Agency. A Center designated as a Center of Excellence is charged with being preeminent within the Agency, if not worldwide, with respect to the human resources, facilities, and other critical capabilities associated with a particular area of excellence.

Ames is the Center of Excellence for Information Technology.

Center Missions

Center missions identify the primary concentration of capabilities to support the accomplishment of Strategic Enterprise goals. Each Center has designated areas of mission responsibility, which provide a basis for building human resources capabilities and physical infrastructure in direct support of Enterprise requirements.

The Ames missions are Astrobiology and Aerospace Operations.

Lead and Principal Center Programs

Each NASA program is assigned to a Lead Center for implementation. Lead Center directors have full program management responsibility and authority and, thus, full accountability for assigned missions or programs, ensuring that they are being managed to agreed-on schedule milestones, budget guidelines, technical requirements, and all safety and reliability standards.

The ARC Lead Center Responsibilities in support of Agency Programs are:

- *Intelligent Systems (IS)*
- *High-Performance Computing and Communications (HPCC)*
- *Design For Safety (DFS)*
- *Nanotechnology*

The ARC Principal Center Responsibilities in support of other Agency Assignments are:

- *Consolidated Supercomputing Management Office (CoSMO)*
- *Information Technology Security (ITS)*
- *Center Directives Management System*
- *Extranet for Security Professionals*

The ARC Lead Center Responsibilities in support of the Enterprises are:

- *Information Technology R&T (Research and Technology) Base Program*
- *Rotorcraft R&T Base Program*
- *Aerospace Operations Systems R&T Base Program*
- *Aviation System Capacity Program*
- *Simulation Facility Group Director*
- *Stratospheric Observatory for Infrared Astronomy (SOFIA) Program*
- *Fundamental Biology Program*
- *Biomolecular System Research Program (Under Formulation)*

Center Core Competencies

Ames Research Center's assigned roles and responsibilities are based on its core competencies. Founded in the Center's work-force capabilities and physical assets, these competencies are enhanced by a broad range of collaborations with other government agencies, industry, and academia. Ames Research Center has the following core competencies:
Ames management and supervisors recognize that people are the organization's most important asset.

Technology Core Competencies
- *Information Technology*
- *Biotechnology*
- *Nanotechnology*
- *Aerospace Operations Systems*

Science Core Competencies
- *Astrobiology*
- *Space Biology*
- *Computer Science*

Unique Expertise Areas
- *Rotorcraft*
- *Thermal Protection Systems*

Institutional Support

In addition to these organizations, ARC has many institutional systems that support the Center of Excellence, missions, Lead Center programs, and other research and technology development activities. These systems are essential for ARC to meet its programmatic commitments and for operation of the Center.

VALUES

To ensure a work environment that accurately reflects that belief, ARC encourages and promotes adherence to the following core values:

Safety
We will ensure a safe and secure working environment for our staff.

Respect
We have respect for the individual and for diversities in culture, background, and experience. We maintain the highest principles of fairness and equitable treatment of all employees.

Communication
We recognize that only through open and honest communication will our goals be achieved.

Teamwork
We believe in cooperative interaction among others and ourselves. By working together with respect, trust, and mutual support, we achieve common goals.

Creativity
We foster creativity, ingenuity, and innovation in our endeavors.

Integrity
We maintain the highest principles of integrity, honesty, and accountability.

Excellence
We continually strive to improve. We demand professionalism in our conduct and excellence in our products.

Customer Focus
We are responsive to our customers and satisfy their requirements.

Responsibility
We are responsible stewards of the public interest, public resources, and the public trust.

Relevance
We ensure that all our endeavors are aligned with national needs and with the Agency vision and purpose.

Discovery
We are bold, but prudent, as we expand the boundaries of scientific understanding and technical knowledge in air and space.

Implementing Agency-Level Responsibilities

NASA's Center of Excellence for Information Technology (COE-IT)

As the NASA Center of Excellence for Information Technology (COE-IT), Ames is leading the development of advanced computer science and numerical technologies. NASA scientists and engineers are working to enable significantly lower-cost systems with higher performance and reliability. Technologies will be developed and demonstrated at several levels, including the subsystems and systems levels, in both ground tests and flight tests, where appropriate.

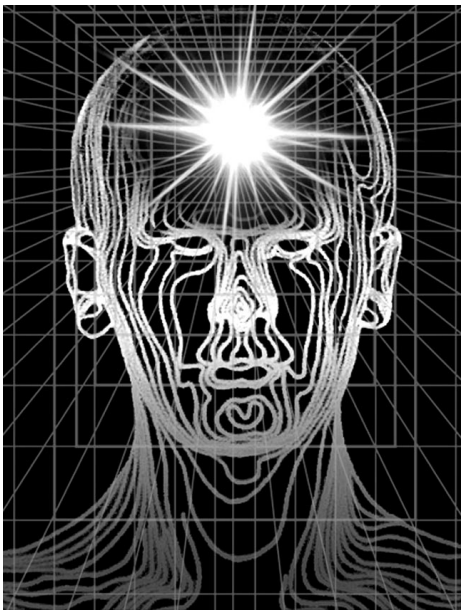
Ames provides information technology research for all Enterprises and provides critical leadership for efforts among NASA field Centers, industry, academia, and other Government agencies. The world-class capability of skilled personnel, processes, and facilities will be maintained and enhanced to develop new and innovative information technologies, to report these technology advances in a timely manner, and to assist in their transfer to commercial ventures that augment America's industrial growth and benefit the quality of life on Earth. Toward this end, Ames is continually assessing relevant research in industry, government, and academia to identify potential areas of collaboration. Thus far, ARC has over 130 IT-related research partners in industry and government. Additionally, ARC is increasing its university-based research and is building particularly strong relationships with key university partners, including Carnegie-Mellon University, the Massachusetts Institute of Technology, and Pennsylvania State University, where some of the most advanced computer science expertise resides. In addition, the new Intelligent Systems (IS) program will be a central focus of the long-term research into advanced computer science that will be necessary in order to develop the technologies for NASA mission requirements.

COE-IT Focus Areas

The focus of Ames' research in computer science and information technology is in three areas critical to the success of future NASA missions:
(1) Automated Reasoning for Autonomous Systems,
(2) Human-Centered Computing, and
(3) High-Performance Computing and Networking.

Automated Reasoning for Autonomous Systems

NASA's mission of space exploration coupled with the administrator's challenge to do it "faster, better, and cheaper" has provided the requirement for one of the most stressing applications facing the computer science research community—that of



designing, building, and operating progressively more capable autonomous spacecraft and rovers. Research on automated reasoning for autonomous systems will enable a new generation of spacecraft to do more exploration at a much lower cost than that of traditional approaches. An impressive early example of this technology (Remote Agent Autonomy Architecture) has demonstrated its usefulness on the Deep Space One (DS-1) mission.

Human-Centered Computing

The emerging concept of human-centered computing constitutes a significant shift in thinking about information technology in general, and about intelligent machines in particular. It embodies a "systems view," in which the interplay between human thought and action and technological systems is understood as inextricably linked and as an equally important aspect of analysis, design, and evaluation. Within this framework, NASA researchers are inventing and deploying sophisticated computational aids designed to amplify human cognitive and perceptual abilities.

High-Performance Computing and Networking

NASA has a long history of leadership in high-performance computing for both scientific and engineering applications. Today the field of high-performance computing is changing rapidly: on the high end, new architectures are under development that combine the performance gains of massively parallel computing with the flexibility of shared-memory multiprocessor approaches; on the low end, powerful microprocessor-based systems are now performing computations that

would have required a supercomputer until very recently; and finally, the advent of high-speed connectivity is making the slogan "the network is the computer" true for more and more applications. Toward this end, NASA is playing an important role in the NGI (Next Generation Internet) Program, which is developing advanced networking technologies, developing revolutionary applications that require advanced networking, and demonstrating these capabilities on test beds that are 100 to 1,000 times faster end-to-end than today's Internet.

ARC has identified mission-critical application areas that with the application of advanced IT capabilities and systems, will revolutionize their design, development, and implementation. These include robotic and human exploration of space, science data understanding, aviation operations, and design and manufacturing in the virtual environment. The staff and facilities at Ames will be used to advance the state of the art in each of these areas in order to meet the needs of NASA's missions and programs.

ARC'S MISSION ASSIGNMENTS

Astrobiology

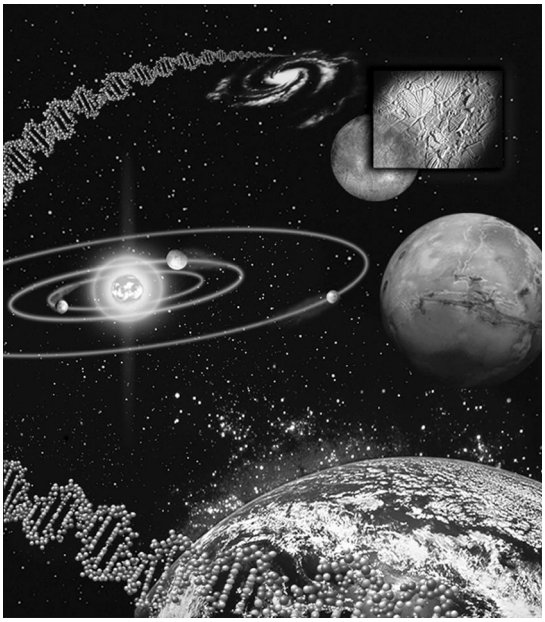
Mission Description

Astrobiology is defined in the NASA Strategic Plan as the study of the living Universe. Astrobiology studies are multidisciplinary and are directed toward the understanding of the origin, evolution, distribution, and destiny of life in the Universe. Recent discoveries about life, the environment, and the potential for life elsewhere, when coupled with the dramatic advances in technological tools and mission capabilities over the past decade, allow us to address long-held questions about the living Universe, and to explore significant new ones. The scientific content of astrobiology is defined in the NASA Astrobiology Roadmap, which was approved in December 1998.

The designation of ARC as the Agency lead in astrobiology recognizes ARC's historical strength in multidisciplinary research in the life, space, and Earth sciences, and ARC's unique involvement in all of NASA's Strategic Enterprises. The Space Science, Earth Science, and Human Exploration and Development of Space Enterprise Offices have also designated ARC as the lead for astrobiology. This designation requires that the Center exercise scientific and technological leadership in this field for the benefit of the entire scientific community. ARC hosts and manages the NASA Astrobiology Institute (NAI).

Implementation Approach

ARC led in the development of a NASA Astrobiology Roadmap, and will continue to bring together the science and technology communities to identify additional research priorities and to translate them into appropriate NASA programs, technology challenges, and flight missions. ARC will continue to lead the effort to identify astrobiological opportunities on NASA's current missions, ascertain and develop the key technologies for future ground and flight research in astrobiology, and develop advanced mission concepts to meet astrobiology's far-ranging science goals.



ARC scientists carry out basic research, participate in flight missions, and facilitate participation of the national science community in astrobiology. To implement the Agency's Center Mission effectively, ARC will continue to develop its research staff and facilities in order to maintain technical excellence and leadership across the range of disciplines encompassed by astrobiology. ARC will define, develop, and operate major research facilities for the benefit of the scientific community. These include flight operations for life science payloads on the space shuttle, spacehub, and International Space Station; operation of a suite of acceleration facilities at the Center for Gravitational Biology; development of the SOFIA airborne observatory and the Space Station Biological Research Facility, for future use by the science community; and the development and operation of other unique facilities to support astrobiological research.

NASA Astrobiology Institute

The NASA Astrobiology Institute (NAI), managed by ARC, carries out world-class, multidisciplinary research on a wide range of fundamental science questions in the field of astrobiology. The NAI is a virtual institute, composed of 11 lead member institutions from around the country that use state-of-the-art communications technologies and tools to collaborate across geographical and institutional boundaries. In FY2001, the scope of the NAI will be increased to include several additional lead institutions, and to extend international collaborations. The NAI mission is to coordinate and catalyze astrobiology across a range of disciplines and organizations; to develop and demonstrate modern communications technologies in support of multidisciplinary research; to provide advice to and technologies for NASA missions; to train students; and to provide outreach to the general public. The NAI director, a distinguished Nobel laureate, and the NAI management staff are located at ARC. NAI operation is guided by an Executive Council formed from representatives of each lead institution.

The NAI has an active Education and Outreach program, which presents the field of astrobiology in the context of research, focused NAI activities, space missions, and technology development. NAI education and outreach priorities include forming partnerships with each lead member team, coordinating lead members' projects to enhance their impact, and leading and assisting in the creation of institute-wide efforts. The NAI takes a comprehensive interest in the generation and use of both traditional communications (print, electronic, "live" exhibits, etc.) and experimental learning innovations (web-casts, remote instrument manipulation, interactive forums). The NAI undertakes uniquely focused activities to reach specific audience communities, such as K-14 educators and students, college-level and postgraduate faculty and students, Internet users, science and technology centers, media outlets, professional colleagues, and traditionally underrepresented communities.

Aerospace Operations

Mission Description

Aerospace Operations is the mission assigned to ARC by the Agency in recognition of ARC's history of contributions in the fields of optimized sequencing, scheduling and control, and human factors for both spacecraft and aircraft. The complexity of and demands on aerospace operational environments is increasing significantly. The national response to this rise in requirements is the increased application of automation and autonomous reasoning methods. This is true in both Earth-based systems, such as the National Airspace System, and in space-based systems, such as the deep space exploration missions. To provide NASA leadership in the development of scientific foundations, ARC is pioneering concepts and technology solutions to enable safer and more effective aerospace operation systems that meet the expanding demands of the Agency and the nation.

Implementation Approach

Ames Research Center has the responsibility to lead the Agency's research and development Mission in Aerospace Operations Systems. Aerospace Operations studies encompass:

- *Automated operations management systems, interfaces, and procedures*
- *Relevant cockpit systems, interfaces, and procedures*
- *Operational human factors, their impact on aerospace operations, and error mitigation*
- *Hazardous environment characterization, detection, and avoidance systems*

ARC'S LEAD CENTER ROLES FOR AGENCY-WIDE PROGRAMS

Intelligent Systems

An essential element in the success of NASA's COE-IT is the strategic investment area called Intelligent Systems. The Intelligent Systems (IS) Initiative is designed to begin a national strategic research program that will fulfill or exceed the NASA administrator's vision for next-generation information technology capabilities. The Initiative will achieve this vision by developing state-of-the-art and revolutionary IS technologies, by leveraging government and university research, and by feeding maturing technologies to ongoing NASA missions and activities, to industry, and to other government agencies.

The IS program will emphasize the research, development, and technology transfer of revolutionary methods, technologies, and processes that apply across NASA's and the nation's engineering and science infrastructure. IS contains four Technology Elements: automated reasoning, intelligent data use, human-centered computing, and revolutionary computing. In combination, these elements provide a comprehensive strategy that integrates high-risk research, concept and prototype development, and the transfer of mature technologies to all IS mission customers throughout NASA.

FY01 Objectives

- *Open agent architectures with reusable autonomy components*
- *Next-generation hardware and software computing methods*
- *Cooperative adaptive intelligent agents for scientific discovery and design*
- *Techniques for remote collaboration with distributed environments*
- *Coordinated planning and execution for fleets*
- *Mature model-based programming processes and tools*
- *Limited utility knowledge discovery and data mining techniques*
- *Experimental demonstration of scalable quantum logic operations*

Approach

Achieving the capabilities described above will require coordinated investment in both in-house and extramural research with partners in universities, industry, and other NASA Centers. Ames Research Center is well positioned to assume technical

leadership and take management responsibility for this strategic investment area. In particular, ARC has internationally recognized leadership in the areas of artificial intelligence, advanced software engineering, and robotic systems. ARC is building upon these essential core capabilities. Accordingly, ARC is integrating with these core capabilities new and rapidly evolving programs in biomimetics (e.g., neural networks and neurotechnology) and other nontraditional computational schemes to establish revolutionary new approaches to computing for the next century.

High-Performance Computing and Communications Program

The NASA High-Performance Computing and Communications (HPCC) Program is a key element of the Federal HPCC Program, which seeks to extend U.S. leadership in the areas of high-performance computing and computing communications. As this is accomplished, these technologies are widely disseminated in order to accelerate the pace of innovation and improve national economic competitiveness, national security, education, health care, and the global environment.

The HPCC Program is in its second phase (FY00-FY06), and is increasing its focus on the generalization, refinement, and insertion of technologies into the processes that are of most relevance to HPCC's shareholders. To enable this customer-impact objective, the HPCC Program has specific technical objectives in improving the performance, interoperability, portability, reliability, resource management, and usability of high-performance computing and computing communications technologies.

FY01 Objectives

- *Demonstrate benchmarking tools to measure applications performance on high-performance computing test beds*
- *Demonstrate automated parallelization tools to reduce parallelization time and enhance applications performance on high-performance computing test beds*
- *Demonstrate integrated learning technology products in relevant formal and informal educational environments*

Approach

The specific goals of the HPCC program are (1) *to accelerate the development, application, and transfer of high-performance computing and computer communications technologies in order to meet the engineering and science needs of the U.S. aerospace, Earth and space science, spaceborne research, and education communities; and* (2) *to accelerate the distribution of these technologies to the American public. In partnership with the industrial sector, NASA is progressively pursuing larger single-system image parallel computers and new programming methods (SGI 1024).*

In support of this goal, the NASA HPCC Program develops, demonstrates, and develops prototypes for advanced technology concepts and methods, provides validated tools and techniques, and responds quickly to critical national issues. As technologies mature, the NASA HPCC Program facilitates the infusion of key technologies into NASA missions activities, and the national engineering, science, and education communities, and makes these technologies available to the American public. Machines are transferred to CoSMO as capital assets at the conclusion of the research phase. The program is conducted in cooperation with other U.S. Government programs, U.S. industry, and the academic community.

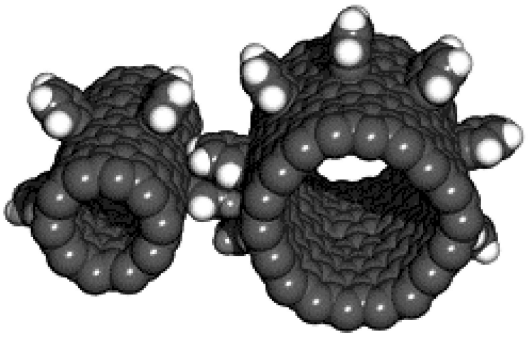
The HPCC Program is coordinated through the Aerospace Technology Enterprise and is managed by Ames Research Center. As a crosscutting multi-enterprise activity, the HPCC Program receives funds from the Aerospace Technology (AT), Space Science (SS), and Earth Science (ES) Enterprises, and from the Office of Human Resources and Education. The Program has supporting work at nine NASA field Centers and at the Jet Propulsion Laboratory (JPL).

Nanotechnology Initiative

Nanotechnology is the science of creating functional materials, devices, and systems through control of matter on the nanometer (atomic) scale and the exploitation of novel phenomena and properties (physical, chemical, and biological) at that scale. Control of organization at the atomic level provides the opportunity to create function-specific materials at the micro- and macroscales. It is important to emphasize that nanotechnology is not simply another step toward "top-down" miniaturization. It constitutes a fundamental change in approach—particularly in self-assembly and other "bottom-up" approaches—that exploits new behaviors dominated by quantum mechanics, material confinement, and large interfaces.

Nanotechnology is a discipline which serves as a NASA Mission enabler—reducing the size of components and vehicles, thereby reducing weight and launch costs. Nanoelectronics combined with component and system nanosensors provide the basis for improved automated reasoning systems and intelligent data understanding. Biological and molecular nanosensors combined with nano-electronics provide an opportunity to identify both fossilized and active life under diverse conditions on other planets as well as spectroscopic detection of species within intergalactic space.

Within the next decade or two, nanotechnology is expected to have a profound effect on all the NASA Enterprises by enabling revolutionary, lighter, smaller spacecraft (microspacecraft and nanospacecraft); powerful, small, low-power-consuming computers; radiation-hardened electronics; nanoelectronics; biosensors for astrobiology and astronaut health monitoring; biomedical sensors and in vivo medical devices; artificial neural systems; robotics; novel nanoelectromechanical systems (NEMS); and advanced materials for solar sails, satellite tethers, and space launch vehicle structures. NASA's nanotechnology initiative will focus the research and development effort on aspects of the Agency's interests by developing an in-house infrastructure, by leveraging government and university research, and by transferring maturing technologies to NASA missions as well as to industry and other government agencies.



Approach

Realizing the potential described above will require coordinated investment across the agency to develop both NASA in-house and extramural research with partners in universities and industry. Ames Research Center is well positioned to assume technical leadership and take management responsibility for this strategic investment area. ARC has internationally recognized leadership in the area of nanotechnology.

Under ARC management, the nanotechnology program will be targeted at fulfilling Agency-wide, mission-driven mid- and far-term requirements. Overall nanotechnology program objectives, and hence the planned products, will be determined by NASA's long-term requirements, driven by the needs of future Agency missions in the 5–25-year time frame. The near-term objectives are to foster nanotechnology infrastructure with an emphasis on sensors (chemical, mechanical, and biological), nanoelectronics and computing, and structural materials. The nanotechnology program plan proposes an initial 2-year transition program, to be followed by a series of renewable, 3-year program phases. A Non-Advocate Review (NAR), leading to approval by the Program Management Council (PMC) and administrator, will precede each nanotechnology program phase except for the initial phase. Periodic reviews are proposed during the 3-year interval between NARs, allowing a long-term technology development view while preserving the accountability and advantages of time-limited and focused programs.

Design for Safety Initiative

The recent problems in some NASA missions, along with similar or related problems in aerospace and general aviation, are symptomatic of the difficulty in synthesizing operational and design parameters. Safety is a system property, encompassing components, subsystems, software, organizations, and human behavior, and their interactions. Yet, typically system design and analysis is decoupled, addressing only components and subsystems until integration occurs. The Design for Safety (DFS) vision is to achieve ultrahigh levels of safety and mission success through the infusion of advanced information technologies.

Approach

Technologies developed by the DFS initiative will be tailored, matured, and infused into all NASA Enterprise missions. Currently, four research areas are planned: System Reasoning for Risk Management, Knowledge Engineering for Safe Systems, Resilient Systems and Operations, and Regenerative Materials and Sensing Technologies.

System Reasoning for Risk Management addresses the need for system-wide life cycle modeling and reasoning to identify risks. This element explicitly includes risk in the design and operations trade space; characterizes human and organizational risk factors emphasizing predictive rather than forensic methods; and performs research and development for safe and reliable software and probabilistic system characterization.

Knowledge Engineering for Safe Systems to ensure that knowledge is captured, integrated, and utilized continuously (during design and operations) to improve safety. The technologies in this element will discover knowledge from raw data, link diverse and heterogeneous information, and provide non-intrusive and relevant expert interaction with system users.

Resilient Systems and Operations will provide intelligent response to both known and unanticipated hazards. These hazards will be addressed by using goal-directed adaptive control and reasoning systems, by performing risk-directed system testing, and through system servicing along with concurrent (rather than sporadic) risk assessment.

Robust Sensing and Components will develop reliable and self-repairing materials and components. This program element will provide advanced sensing methods which will be required for automated non-intrusive condition assessment. Self-healing materials and re-configurable systems will then facilitate safe system operation when unavoidable hazards do surface.

Consolidated Supercomputing Management Office

The Consolidated Supercomputing Management Office (CoSMO) is a NASA Chief Information Officer (CIO)-sponsored functional initiative. The primary goal of CoSMO is to meet the High-Performance Computing requirements for all Enterprises, while realizing an optimal return on investment through effective and efficient management of NASA's high-performance computing assets. It is responsible for the acquisition, maintenance, operation, management, upgrade, and cost-center budgeting for NASA's supercomputer resources, regardless of location. Operations and maintenance support are provided to NASA research and development programs and to secure-computing programs.

Information Technology Security

The Principal Center for Information Technology Security (PC-ITS) provides a unified approach and Agency focus to the problem of information security. It is committed to developing and maintaining a secure, state-of-the-art computing infrastructure that can support NASA programs and projects, as well as NASA researchers throughout the world. This commitment requires a strategy that prevents information from being disclosed to unauthorized persons; that prevents information from being maliciously corrupted, modified, or forged; and that prevents access from being denied because of burdensome procedures or malicious attacks.

Center Directives Management System

The Center Directives Management System (CDMS) was developed with headquarters funding to implement a method of reviewing draft directives and collecting comments and approvals before the directives are released. This is a web-based system with several levels of access and user authentication. Directives managers post draft directives, and reviewers are assigned who can view the directives and make comments. The system has been in continuous operation since 1997 and is currently in active use by Ames Research Center, Glenn Research Center, and Langley Research Center. Regular enhancements are made to the system under the direction of the participating Centers.

Extranet for Security Professionals

ARC was selected in 1998 to be Lead Center for NASA's portion of the development and management of the Extranet for Security Professionals (ESP). The ESP is a secure web-site, developed and established by security professionals funded by Carnegie-Mellon University. ESP's purpose is to provide a secure environment in which security professionals from any government agency can communicate in a private setting and in which each agency can establish agency-only "private" web sites to conduct agency business. ARC developed, activated, and now manages the NASA private web site.

Implementing Enterprise-Level Responsibilities

ARC'S ROLES IN THE AEROSPACE TECHNOLOGY ENTERPRISE

Information Technology R&T Base Program

The Information Technology (IT) Research and Technology (R&T) Base program pioneers the identification, development, verification, transfer, and application of high-payoff aerospace technologies. The program fits within the NASA strategic vision that "NASA is an investment in America's future. As explorers, pioneers, and innovators, we boldly expand frontiers in air and space to inspire and serve America and to benefit the quality of life on Earth."

Program FY01 Objectives

- *Demonstrate a rapid integration and test environment that includes remote connectivity and access to flight simulation data, computational simulation data, and archival databases*
- *Demonstrate integrated propulsion and flight-control systems that are capable of adapting to the absence or loss of any and all control surfaces resulting from failures or malfunctions*
- *Demonstrate a prototype data communications architecture with multipriority capability in a secure high-integrity environment for the National Airspace System*
- *Integrate a large-scale computing node into a distributed computing environment*
- *Demonstrate remote connectivity to high data-rate instruments and distributed real-time access to instrument data*
- *Perform leading-edge research in advanced computing systems and user environments, in revolutionary software technologies, and in pathfinding applications that enable the achievement of NASA's missions in Aerospace Technology*
- *Actively integrate research products with other programs, such as DFS, AvSTAR, and Nanotechnology*

Program Approach

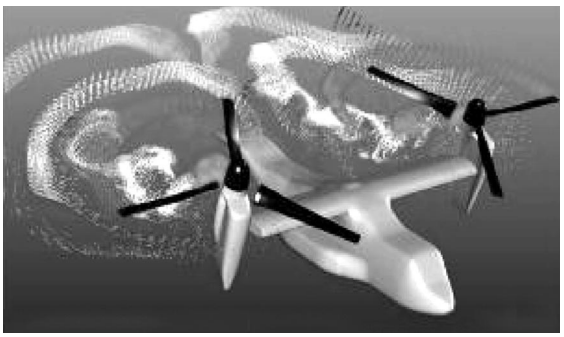
The IT Base Program aims to provide fundamental advances in advanced computing systems and user environments, in revolutionary software technologies, and in pathfinding applications. The IT program comprises three investment areas: Integrated Design Technology, Software Technology, and Advanced Computing.

Integrated Design Technology investment focuses on developing prototype tools and integrated systems to improve the design cycle for aerospace vehicle development. Integrated Design Technology research primarily supports the objective for innovative next-generation design tools, with a specific application to aerospace vehicles. Software Technology investment focuses on performing world-class research in revolutionary software technologies such as the automated generation of flight-critical software, ways to ensure data integrity and security, and development and management of complex flight and aviation operations systems. The primary focus of the Software Technology Investment Area is on reducing the aircraft accident rate. Software Technology also provides strong support to next-generation design tools, as well as Integrated Vehicle Health Management (IVHM) needs for next-generation aerospace vehicles.

The Advanced Computing Technology investment focuses on creating unique user environments for high-performance computing systems. The Advanced Computing Technology investment area is the most crosscutting technology research area. This investment area provides new approaches to providing high-performance computing resources for the Enterprise, and also supports long-term computational research in nanotechnology and quantum computing.

Rotorcraft R&T Base Program

The Rotorcraft R&T Base Program meets the public need for convenient and safe vertical-flight capability for transportation needs, as well as for safety and utility services. The program also provides assistance for the U.S. Department of Defense to insure the continued military supremacy of U.S.-produced rotorcraft.



Program FY01 Objectives

- *Improve the capability to assess the life of complex composite rotorcraft structures*
- *Publish an industry standard design guide for ultra-safe gears for rotorcraft*
- *Complete the flight validation of baseline control laws and modes for CONDUIT (Control Designer's Unified Interfaces)*
- *Publish a HUMS (Health and Usage Monitoring System) Certification Protocol*
- *Improve safety and survivability of rotorcraft in hard landings onto water, soft soil, and rigid surfaces*
- *Provide documentation for composite structures analysis and certification for inclusion in the MIL-HDBK-17 design handbook*
- *Enable rapid prototyping with "express-tool" fabrication*

Program Approach

Rotorcraft's research projects, RAPID, SAFOR, and SILNT directly address the Office of Aerospace Technology (OAT) enterprise goals for increased air mobility, improved safety, and reduced noise. The projects apply revolutionary approaches and high-payoff technologies to the long-term national needs of the future. The goals of the rotorcraft program are strongly coupled with the goals of industry and academia through the aeronautics strategic planning process and direct customer interaction. Project FRIAR directly and uniquely addresses shorter-term technology development and takes advantage of opportunities to transfer technology quickly to industry.

Aerospace Operations Systems R&T Base Program

The Aerospace Operations Systems (AOS) Program is responsible for pioneering the development and validation of advanced technology concepts, methods, and procedures, and for transferring them to the user and regulatory communities to enable major increases in the safety of aircraft operations in the national and international airspace.

Program FY01 Objectives

- *Determine how the demands of managing multiple concurrent tasks contribute to crew errors in aviation incidents and accidents; identify and evaluate crew strategies to reduce errors in managing concurrent tasks*
- *Based on pilot simulation study, define effects of in-flight activity breaks as crew fatigue countermeasures*
- *Complete guidelines for perceptually and cognitively matched displays and methods of analysis for optimizing human performance*
- *Down-select of ground-based remote-sensing technologies for a prototype ground-based system to sense icing conditions*

Program Approach

The AOS Program is focused in three investment areas:

The first investment area is human/systems design, assessment, and reliability. Validated tools and prototyped test beds are developed for the design and analysis of innovative human-automation systems in air, ground, and integrated aerospace operations. The purpose of this research is to reduce or mitigate the effects of human error in interpreting automated systems.

The second is human factors. Knowledge bases and models of fundamental human information processing are used to develop operational procedures and technologies to reduce the potential for error in aerospace operations and to enable human operators to respond quickly and appropriately to flight-critical situations.

The third is weather factors prediction and mitigation. Databases, knowledge bases, models, and predictive technologies are developed to assess critical weather influences on both the safety and efficiency of aerospace operations. Advanced concepts and procedures for identifying environmental hazards are developed to avoid or mitigate their effects.

A critical activity of the AOS Program is the administration and operation of the Aviation Safety Reporting System. This activity is funded primarily by the Federal Aviation Administration and is used by the broader aviation community. Its purpose is to lessen the likelihood of aviation accidents by collecting, analyzing, and responding to voluntarily submitted aviation safety incident reports.

Aviation System Capacity Program

The Aviation System Capacity (ASC) Program is responsible for enabling safe increases in the capacity of major national and international airports through both modernization and improvements in the air-traffic management system and the introduction of new vehicle classes that can reduce airport congestion.

Program FY01 Objectives

- *Develop and demonstrate transition airspace decision support tools for air-traffic controller (ATC) airline operations center and ATC/cockpit information exchange and for conflict resolution*
- *Comprehensive mission simulation database for integrated cockpit and operating procedures for complex, low-noise flightpaths*
- *Large-scale database for validation of rotor noise reduction and validated design-for-noise capability*

Program Approach
The ASC Program has two major development areas that as an integrated effort, provide a focused technology foundation.

The first area is the development of advanced air transportation technologies. These technologies will enable substantial increases in the efficiency and capacity of aircraft operations within both the national and international air transportation systems. The approach is to maximize "free flight" to allow the users to lower direct operating costs by trading off time and routing, and to improve the effectiveness of high-density operations in regions where free flight will not be possible. The technologies will also allow smooth and efficient transitions across the boundaries of free-flight regions and nonfree-flight regions; provide system improvements that are easily deployable anywhere in the world; and improve the ability to model and simulate advanced capabilities in the airspace system.

The second area of development involves the enablement of a new vehicle class to reduce airport congestion. The civil tilt-rotor aircraft is a vehicle capable of flying like a conventional turboprop aircraft with the added capability of vertical takeoffs and landings like a helicopter. It can operate in a heliport-type environment at an airport, freeing up runways for traditional aircraft. Critical technologies are needed to overcome the inhibitors of operating tilt-rotor aircraft within the air transportation system. These technologies include development of an efficient, low-noise proprotor; an integrated cockpit for minimum pilot workload during low-noise approaches and departures near congested terminal areas; and a safe and cost-effective one-engine-inoperative emergency contingency power capability.

Aviation System Technology Advanced Research (AvSTAR) Initiative

NASA, working with the Federal Aviation Administration and industry, is pursuing a major research program to develop air traffic management technologies that have the ultimate goal of doubling capacity while increasing safety and efficiency. The air traffic management systems currently being developed by the FAA, Free Flight Phase 1 and 2, are being enabled and supported by NASA developments in Information Technology. Numerous authorities believe this system, even with the improvements expected from Free Flight Phase 1 and 2, will not permit the growth in air traffic that is widely anticipated. A new architecture will be required. While NASA will continue to support Free Flight Phase 1 and 2 under the NASA AATT program, it is believed that a new program termed AvSTAR, will be required.

Approach
The AvSTAR initiative is divided into three major elements: Core Component Technologies, Virtual Airspace Simulation Technology, and System Level Concept Development and Evaluation. The first two program elements will run more or less concurrently and will develop the necessary intelligent systems technologies that would permit the implementation of candidate new airspace system management architectures. In addition, the program will develop the tools necessary to enable various proposed new architectures to be evaluated by simulating the entire air traffic management system. This would allow various authorities, such as the FAA, to thoroughly evaluate proposed solutions prior to field trials and proceed to field trials with only the most promising of proposed architectures. Such evaluations will comprise the third element of the AvSTAR Program. The entire program will be planned in close collaboration with the FAA.

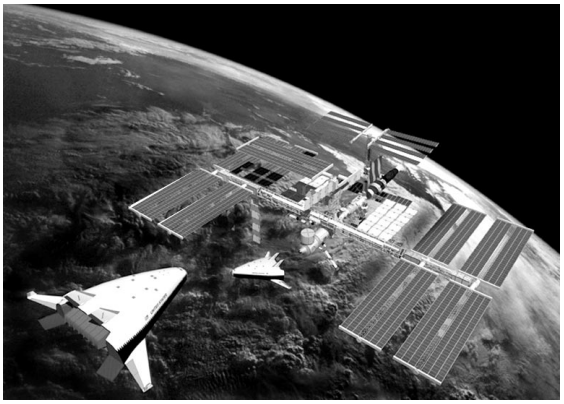
Simulation Facility Group Director

Aerospace Technology (AT) Enterprise leaders determined that central management of major aeronautical facilities was in the nation's best interest and established several facility groups. ARC is responsible for the management of one of those groups: the Simulation Facility Group (SFG). This group is the single mechanism utilized by the Enterprise for strategic management and integrated activity planning in the areas of facility investment, operations policy, business management, and test technology for designated simulation facilities. The SFG considers a U.S. national perspective that includes not only the military and commercial aerospace interests of the government, but those of industry as well.

Within the purview of SFG are the Crew Vehicle Systems Research, Vertical Motion Simulator, and Future Flight Central Facilities at Ames Research Center; and the Visual Motion Simulator, Differential Maneuvering Simulator, and Cockpit Motion Facilities at Langley Research Center.

Space Transportation Technology

ARC leads the Enterprise core competencies in integrated vehicle health management (IVHM) and thermal protection systems (TPS), and supports Agency systems studies relating to Space Transportation.



Program FY01 Objectives

- *Analysis of SHARP-B2 postflight data for application of ultra-high temperature ceramics for sharp leading edges on hypersonic vehicles*
- *Complete supporting work on the TPS and integrated vehicle health management designs, technologies, test data, and hardware for the second generation of reusable launch vehicles (RLV) and support industry in their development*
- *Support third generation RLV efforts by reporting on the potential of improved capability materials for use in adaptive intelligent TPS (aiTPS)*
- *Initiate superthermal insulation material (protects against both reentry heating and cryogenic cooling) development and characterization (Third Generation RLV)*
- *Conduct systems studies as they relate to Space Transportation in support of Lead Center Programs*
- *Continue to support advanced space transportation planning needs and technology development for Zero Boil-Off of the In-Space Transportation Program led by Marshall Space Flight Center (MSFC)*

Program Approach

Important elements of the work performed in support of the Space Transportation Technology programs are (1) new TPS materials/systems; rapid design tools for TPS sizing, including operation and development of improved flow diagnostics of unique, large-scale, high-temperature, arc-jet ground-test facilities; and general support of industry-led teams developing next-generation vehicles; and (2) IVHM systems that can diagnose in-flight/postflight vehicle health. The utility of IVHM will be the capability to take corrective action to mitigate in-flight anomalies and to dramatically reduce the time for recycling vehicles between flights by prescribing only the ground maintenance that is required. ARC will also develop advanced tools for vehicle design, embodying them into Intelligent Synthesis Environments for new space transportation systems. ARC will continue to support systems studies of advanced space transportation systems as a part of Agency teams. ARC will lead the way in developing the first "smart systems" for "intelligent" vehicles under the aegis of the Generation 3 activity built upon its strengths in Information Technology.

Vehicle Systems Base Program

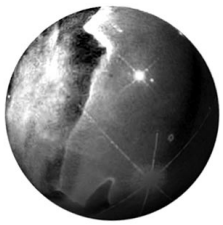
ARC performs a variety of tasks to support the Aerospace Vehicle Systems Base Technology Program led by Langley Research Center. This program draws upon many of ARC's core competencies, including Information Technology and critical facilities, to achieve its goals.

Aviation Safety Program

ARC performs a variety of tasks to support the Aviation Safety Program led by Langley Research Center. This program draws upon many of ARC's core competencies, including Information Technology, Aerospace Operations, and Rotorcraft, to achieve its goals.

Intelligent Synthesis Environment Program

ARC performs a variety of tasks to support the Intelligent Synthesis Environment (ISE) Program led by Langley Research Center. Three of the main Program Elements—the Life Cycle Simulation, the Environments, and the Product Integration Elements, require capabilities that leverage many of ARC's core competencies, including Information Technology.



ARC'S ROLE IN THE SPACE SCIENCE ENTERPRISE

Space Science Research

Research at ARC implements the Space Science Enterprise Goals through three elements dealing with astrophysics, planetary systems, and exobiology. Since the unifying theme for these three elements is the origin and evolution of stars, planets, and life, the total research effort is a major thrust in the Enterprise's Astrobiology program. Astrophysics research addresses Enterprise goals and objectives that deal with understanding how the structure in the Universe emerged, the dynamical evolution of galaxies and stars, and the exchange of matter and energy among stars and the interstellar medium. Planetary Systems research addresses Enterprise goals and objectives that deal with understanding star formation, the evolution and distribution of volatile and organic material, the origin and distribution of planetary systems, rings, and primitive bodies, and planetary atmosphere evolution. Exobiology research addresses Enterprise goals and objectives that deal with understanding the origin, evolution, and distribution of life by conducting research on the cosmic history of biogenic compounds, prebiotic evolution, the early evolution of life, computational astrobiology, and extreme environments in which living organisms can exist.

Program FY01 Objectives

FY01 objectives are represented by some 130 separate research tasks. Most of these tasks relate directly to the goals that are relevant to astrobiology. Illustrative examples are listed below:

- *Search the European space agency astrometric mission satellite and database (HIPPARCOS) mission data archive for extrasolar planetary transit occurrences*
- *Investigate the stellar astrophysics of low-mass protostars by analyzing their temperatures and luminosities*
- *Compare asteroid thermal infrared spectra to Mars Global Surveyor Thermal Emission Spectrometer (TES)*
- *Observe galactic dust, extragalactic dust, and primitive Solar System objects to trace incorporation of interstellar organics into primitive Solar System objects*
- *Examine microbial assemblages found in hot springs with regard to composition and distribution of microbiota along environmental gradients*
- *Plan a facility for analysis of returned, quarantined samples from Mars*
- *Participate in system-integration tests of the SIRTF Infrared Array Camera (IRAC), to validate performance of Channels III and IV silicon:arsenic (Si:As) detector arrays*
- *Investigate the role of a paleo-Martian atmosphere containing reduced gases (methane and ammonia) in brine evolution*
- *Examine structural changes of analog astrophysical ices as a function of temperature, time, and composition*
- *Develop a massively parallel computer code for molecular dynamic simulations that will allow for extending timescales of molecular simulations by two orders of magnitude*

Stratospheric Observatory for Infrared Astronomy Program

The Stratospheric Observatory for Infrared Astronomy (SOFIA), a key element of NASA's new Origins program, is a large-aperture infrared/submillimeter observatory being developed cooperatively by NASA and the Deutsches Zentrum für Luft- und Raumfahrt e.V. (DLR) in Germany. SOFIA will operate in the stratosphere, above 99 percent of the water vapor that obscures infrared wavelengths from all ground-based observatories. The SOFIA System includes the observatory—a 2.5-meter-aperture telescope mounted in an open-port cavity in a Boeing 747 aircraft—plus a science and mission operations center located at Ames Research Center. Across most of the infrared spectral region, SOFIA will have the highest broadband imaging and spectroscopic resolution of any observatory currently approved for development, and will also be deployable worldwide to observe transient events such as occultations and supernovae.

Program FY01 Objectives

- *For the German-provided telescope, to successfully complete fabrication of the subsystem elements so that major subsystems can be assembled and tested*
- *For the U.S. systems, to complete the final design review of the onboard mission control system software, to complete the aircraft modification and the science and mission operations center, and to begin flight test, before delivering the modified aircraft to Germany for installation and test of the telescope*

Program Approach

The observatory is optimized for studying far-infrared wavelengths between 30 and 300 micrometers; however, science data will be obtained across the broad wavelength range of 0.3 to 1,600 micrometers through the use of numerous focal plane instruments brought to the observatory by the international science community. The ability to upgrade instruments regularly will enable the observatory to employ the very latest focal plane and other instrument technologies, including large-format infrared (IR) and submillimeter detector arrays, which will be transferable to other missions over SOFIA's 20-year operating lifetime.

The SOFIA System is under development by contractor teams in the United States and Germany. The U.S. team, led by the Universities Space Research Association (USRA), is developing the Boeing 747 modification, including the large cavity cutout, rerouting of the airframe structure around the cutout, rerouting of the aircraft systems through the telescope cavity, and developing the new systems installations such as the cavity door and environmental control system. The USRA's team is also providing the onboard mission control system and the science and mission operations center. Several of these items are being developed in conjunction with ARC, which is providing some of the designs, hardware, and facilities. In Germany, a consortium of companies led by MAN Technology is developing the airborne telescope assembly, including its 2.7-meter-diameter primary mirror, and its optics, structure, vibration isolation, and pointing control systems. The telescope will be ready in late FY 2001 for installation into the modified aircraft; it is scheduled to be done in Germany. This will be followed by the return of the observatory system to the United States for a planned series of tests and certification flights. Science operations will start about a year after the telescope is installed.

Other Space Science Elements

Additional research areas at ARC play major roles in implementing the Space Science goals. One area is the Center for Mars Exploration (CMEX), a joint activity of the Astrobiology and Space Research and the Information Systems Directorates, which deals with goals and objectives for integrated human and robotic Mars exploration. A second area, Space Projects, addresses Enterprise goals and objectives that deal with advanced technology and advanced mission concepts for Solar System exploration missions and projects. The third area is Space Technology, which addresses Enterprise goals and objectives that deal with the development of advanced technologies to enable future astrophysics missions, as well as robotic and human Solar System exploration missions.

FY01 Objectives

- *Fabricate IR detectors and test under the conditions expected to prevail at the Next-Generation Space Telescope (NGST) and SOFIA focal planes*
- *Implement the initial stage of improving the fringe-tracking algorithm for the Infrared Optical Telescope Array (IOTA) interferometer*
- *Develop a prototype germanium:antimony (Ge:Sb) detector array for the Airborne Infrared Echelle Spectrograph (AIRES) facility science instrument for SOFIA*
- *Fabricate and test deep cryogenic multiplexing readouts to be used in infrared detectors for missions such as the Next Generation Space Telescope, Explorers, and SOFIA*
- *Provide project support of the Mars 2003 entry vehicles and advanced TPS development required for the Mars 2005 Lander Program in collaboration with JPL*
- *Continue to support advanced space transportation planning needs of the Mars Exploration Program led by the Johnson Space Center (JSC) and the Jet Propulsion Laboratory (JPL)*

ARC'S ROLES IN THE HUMAN EXPLORATION AND DEVELOPMENT OF SPACE ENTERPRISE

Fundamental Biology Program

The NASA Fundamental Biology (FB) Lead Center Program Office leads the Agency's efforts in fundamental biological research and relevant technology development, and supports activities conducted on the ground and in space.

Program FY01 Objectives

- *Develop control parameters for International Space Station (ISS) research through appropriate ground-based hypergravity and microgravity simulation studies; make these data available through an extension of the Ames Life Sciences Data Archive (Bioengineering Database/Database Manager)*
- *Complete archive of prior ARC major missions (SL-3, SLS-2, SL-J, IML-1, 2) and current missions*
- *Issue Life Sciences NASA research announcement (NRA) for new research in fundamental biology*
- *Conduct research on the effects of microgravity on the development of the avian skeleton and vestibular system on UF-1*
- *Provide information on the effects of gravity on super-dwarf wheat photosynthesis and respiration on UF-1*
- *Investigate the effects of gravity on the growth and physiology of flax seeds and moss on STS-107*
- *Provide information on the effects of the space environment on bacterial virulence through research conducted on STS-107*
- *Conduct DNA microarray analysis of two different cell types flown in space to collect data on the effects of the space environment on gene expression*
- *Develop and integrate biological technologies to support Fundamental Biology Research objectives for biological species ranging from cells to simple organisms*
- *Apply technologies in Information Technology, Biotechnology, and Nanotechnology to missions*
- *Develop methods for observing (visual, optical) changes induced by actual or simulated spaceflight conditions*
- *Analyze biological data for quantitative changes induced by actual or simulated spaceflight conditions*
- *Develop usable genomic detection and characterization systems*
- *Seek and implement innovative and collaborative leveraging opportunities (intramural and extramural) for maximizing the scientific and technological return of FB technology development activities*

Program Approach

The approaches of the Fundamental Biology Program are to thoroughly investigate relevant biological characteristics on the ground before conducting research in space; to effectively use the characteristics of the space environment, especially microgravity and increased radiation; and to enhance our understanding of fundamental biological processes. Additionally, the program will utilize state-of-the-art technology to

- *Measure and evaluate biological phenomena*
- *Develop the scientific and technical foundations for a safe, productive human presence in space for extended periods and in preparation for exploration*
- *Apply this knowledge and technology to improve the nation's competitiveness and education, and the quality of life on Earth*
- *Inform, educate, and provide opportunities for students and the public to participate in life science research, which uses the unique laboratory of space to understand fundamental biology, physiology, evolution, and development of living systems*
- *Utilize the Life Sciences Data Archive to help with this approach*

Space Station Biological Research Project

The Space Station Biological Research Project (SSBRP) supports Fundamental Biology Research goals by enabling long-term space science research in relevant science disciplines. The research program will initially emphasize microbiology and cell-culture research using equipment developed for use in the International Space Station. The initial suite of instruments and facilities under development include the incubator, the insect habitat, the cell culture unit (CCU), the habitat holding rack (HHR), the life sciences glove box (LSG), compound and dissecting microscopes, and a passive dosimeter (PDS).

Later, research capability will be augmented by a second HHR, a 2.5-m-diameter variable-g centrifuge, and habitats for plants, rodents, and aquatic organisms, and an incubator for avian and reptilian eggs. Laboratory support equipment will also be developed, including small- and micromass measurement devices. In addition, risk-reduction flight testing of habitat development units and subsystems will start to be flown as early as 2001 (plant and egg are the first two).

Project FY01 Objectives

- *Complete and fly (flight 5A.1) Passive Dosimeter System (PDS)*
- *Complete implementation of the validation and science experiments on flight 5A.1*
- *Complete and fly (UF-1) the Biomass Production System (BPS), the risk-reduction development unit designed to test the technology required for the Plant Habitat and the Avian Development Facility (ADF), the risk-reduction development unit designed to test the technology required for the egg incubator habitat*
- *Complete implementation of the validation flight UF-1*
- *Complete the critical design review (CDR) for the incubator habitat, compound and dissecting microscope developments, and cell culture unit habitat*
- *Complete the preliminary design review (PDR) for the life sciences glove box (LSG) habitat attachment mechanism*
- *Complete the procurement process and start work on the second phase of the Plant Research Unit Habitat (PRU) development*
- *Complete the preliminary design review (PDR) for the small-mass measuring device (SMMD) and the micromass measuring device (MMMD) developments and the centrifuge, NASDA-provided hardware*
- *Complete the Ames Life Sciences Data Archive web site that will make appropriate ARC project and PI data available to PIs and management as the data are generated during a mission*

Project Approach

The Project is responsible for the design, development, test, verification, and on-orbit validation of the flight hardware and software. The flight hardware and software constitutes a suite of highly integrated, state-of-the-art equipment that includes two habitat holding racks, one life sciences glove box, one 2.5-m centrifuge, and 27 flight habitats of seven different types (not including spares). SSBRP is also responsible for developing the required ground-operations capabilities including training, ground controls, operations, and ground communication facilities that interact with the Space Station, other NASA Centers, and PIs in their laboratories. SSBRP will also develop common-use Space Station laboratory support equipment such as a small-mass measurement device (SMMD), a micromass measurement device (MMMD), compound and dissecting microscopes, and radiation dosimeters. Partners in the hardware development include the National Aerospace Development Agency of Japan (NASDA), the Canadian Space Agency (CSA), the Hungarian Space Office (HSO), and six business enterprises.

Center for Health Applications of Aerospace-Related Technologies

The Center for Health Applications of Aerospace-Related Technologies (CHAART) supports surveillance of epidemiological elements to insure human health on the ground and in space.

FY01 Objectives

- *Develop training courses in the application of aerospace technologies to issues of human health in collaboration with the World Bank, U.S.-Japan Cooperative Medical Sciences Program, United Nations Staff College, the Centers for Disease Control and Prevention, and the World Health Organization*
- *Support ongoing research collaborations with the National Oceanic and Atmospheric Administration and Environmental Protection Agency on climate change and human health*
- *Support ongoing research collaborations with Yale University and the University of Illinois on the spatial patterns of Lyme disease risks in New England and the upper Midwest*
- *Support ongoing research collaborations on cholera with the Center for Marine Biotechnology and International Centre for Diarrhoeal Disease Research, Bangladesh*
- *Organize a workshop to develop plans for a global infectious disease risk-assessment program integrating elements of biology, epidemiology, modeling, information systems, and technology development*

Approach

The approach of the CHAART Program is to interact with various national and international programs and with elements in academia to stage workshops to address world health problems and develop methods to ensure that adequate training programs are provided to circumvent the problems.

Life Sciences Research

The goal of Life Sciences Research at ARC is to understand the role and influence of gravity on living systems, from cells in culture to physiological studies in animals and humans. Through a better understanding of fundamental biology will come knowledge useful for the development of countermeasures to the deleterious effects of weightlessness and for the maintenance of human health on Earth.

FY01 Objectives

- *Develop and fly gravitational biology experiments in research (R) missions R1 and R2 aboard STS 107 and STS 111, respectively*
- *Deliver new research hardware to the International Space Station (ISS) and conduct experiments on flights 5A.1, and UF-1, and UF-3*
- *Support JSC's human countermeasure studies through the development of a wireless mobile physiological monitor (MPM) for observing physiological health and performance*
- *Support JPL's development of a wireless augmented reality prototype (WARP) to provide a heads-up display in a space habitat*
- *Analyze and publish results from the Hyper-g Project which will provide baseline data (to ISS flight experiments) on the effects of altered gravity on biological systems*
- *Sponsor joint ARC/JSC collaborative workshop to define, plan, and initiate a series of countermeasure studies over the next 5 years using Ames' unique research facilities including the Human Powered Centrifuge, the 20G, the Linear Accelerator, the 52-foot Chronic Live Aboard Centrifuge, and the Human Bed Rest Facility*
- *Apply ARC three-dimensional (3-D) imaging technologies to facilitate Fundamental Biology PI flight experiment design and resultant crew training particularly in modeling the ISS glove box, dissection tools, and rodents along with haptic feedback*
- *Operate the acceleration facilities to support a cadre of 30 intra- and extramural PI experiments that will further our understanding of the role of gravity in living systems including human exposure up to 2 g; exposures of rodents, fish, and insects for prolonged periods at 2 g, primate exposures at variable g, and human response to linear acceleration and use of the human-powered centrifuge*
- *Initiate new research in nanotechnology for biomedical applications.*

Approach

The approach of the Life Sciences Research team at Ames is to develop the technology and flight equipment required to support NASA's Life Sciences research on the ground and in space, and to facilitate the use of the space shuttle, Space Hab and the International Space Station and other potential NASA microgravity platforms in reaching the experiment objectives of NASA's life sciences community. The research team will conduct extensive ground-based studies utilizing a suite of unique gravitational research facilities and advanced 3-D imagery technologies. Additionally the team will (1) provide education and training to domestic and foreign investigators in the application of aerospace technologies to disease surveillance and risk assessment, and (2) transfer technology and promote education for the improvement of the quality of life on Earth.

Other HEDS Research

Additional research elements at ARC play major roles in the implementation of the HEDS Enterprise. The goal of the Advanced Life Support (ALS) research effort at ARC is to develop advanced technologies that provide the foundation for long duration missions by significantly reducing life-cycle costs, improving operational performance, promoting self-sufficiency, and increasing safety, as well as providing commercial opportunities for public benefit.

FY01 Objectives

- *Development of a fully regenerative water recycling system for long duration exploration missions which reduces the current state-of-the-art system mass equivalent metric by a factor of five*
- *Development and testing of a prototype carbon dioxide compressor which could be incorporated into an evolutionary International Space Station (ISS) to close the air loop for the first time*
- *Support ongoing research collaborations with the University of Arizona in the development of In-Situ Resource Utilization (ISRU) technologies for human and robotic Mars exploration missions*
- *Support ongoing research collaborations with Utah State University, Rutgers University, and industry in the development of solid waste processing technologies for human planetary missions*

Earth Science Research

Earth Science Research at ARC supports the goals and objectives of the Enterprise described in the Earth Science Strategic Plan of 2000 and the Office of Earth Science (OES) Science Plan of 2000. ARC performs basic research in atmospheric chemistry and dynamics, atmospheric physics, and ecosystem science and technology, and leads major airborne science to provide new information about both atmospheric and ecosystem processes.

FY01 Objectives

- *Maintain readiness of airborne sensor instrumentation for land science (MODIS/ASTER Airborne Simulator [MASTER], Digital Array Scanned Interferometer [DASI], multispectral cameras, thermal infrared [TIR], and polarization imagers) in support of Earth Observing System (EOS) and airborne science*
- *Conduct research in conjunction with Life and Space Sciences on the questions in astrobiology that relate to the future of life on Earth and beyond Earth, using environmental and climate simulation, modeling, microbial and plant sciences including retrospective studies and sensing of biosignatures; publish the book Evolution and the Physical Environment as a result of the Linnean Society workshop of the same name*
- *Develop means to address large-scale computing challenges associated with climate modeling, including parallel computing, utilization of computational grids, and the efficient porting of legacy codes onto advanced architectures*
- *Conduct computer simulation models of large eddy simulation/microphysical modeling of marine boundary layer, cirrus clouds of tropical upper troposphere water vapor concentration, and Aerosol Physical Chemistry Model (APCM)*
- *Manage the Fourth Convection and Moisture Experiment (CAMEX 4), a multi-agency, airborne and surface field campaign and ensure that experiment data to fulfill missions objectives are delivered*
- *Analyze data from SAFARI and SOLVE to understand effects of dust and fire aerosols on the radiative properties of clouds, and to sort out competing theories on polar stratospheric clouds and ozone depletion effects*

Approach

Global and regional atmospheric and ecosystem studies are primary areas of investigation at ARC. To carry out these astrobiology-related investigations, scientists, technologists, and mission personnel at ARC work in collaboration with leading scientists and ministries around the world (1) to design, formulate, and perform experimental measurements, remote sensing, in situ data analyses, and computer simulations of atmospheric and ecosystem processes, and to study the exchanges between the biosphere and the atmosphere, using both airborne and satellite sensor data; (2) to conceive and develop advanced instrumentation to satisfy the measurement requirements of the Earth Science Enterprise and related enterprises, emphasizing both airborne and selected spacecraft sensors; (3) to provide the scientific understanding and the methods needed to apply remote sensing and geographic data analyses to the study of infectious diseases, and the associated models for risk analysis of disease transmission in the various human populations; (4) to transfer scientific knowledge and technology to U.S. commercial and private interests, national and international governmental agencies and ministries, other disciplines, and educational institutions; and (5) to provide science mission management and science leadership for major science programs of NASA and other agencies. Ames Research Center will sign a memorandum of understanding with the Earth Science Enterprise (Goddard Space Flight Center) to pursue and advance high-performance computing.

Implementing Center-Level Responsibilities Initiatives

INITIATIVES

Safety

In FY01, the Center will pursue the Occupational Safety and Health Authority Voluntary Protection Program (VPP) certification. This effort will be accomplished in addition to implementing the Ames Safety Accountability Program (ASAP). The integrated effort of these objectives will reduce the number of hazards on the job and significantly improve safety at Ames.The VPP and the Ames Safety Accountability Programs are based on programs that have proved effective throughout industry. The new initiative includes the following key elements:

- *Management Leadership and Employee Involvement*
- *Work-Site Analysis*
- *Hazard Prevention and Control*
- *Safety and Health Training*

All elements are integrated into a single management plan that is designed to change behavior and improve accessibility to management. The complete integration includes a new management culture shift to accountability, combined with metrics, pay for performance, and real-time feedback to management by means of automation.

Human Resources Initiative

ARC will continue the development and implementation of a Human Resources Initiative to place greater emphasis on the fact that our people are our greatest asset. This initiative requires formal, continuing management education for all supervisors; the creation of Individual Development Plans for all staff members; and an examination and improvement in the workplace environment. It also creates a process for management accountability to carry out these requirements.

Program and Project Management Development

The ARC Program and Project Management (P/PM) Development Program will expand the scope of the Academy West program. Currently serving NASA's Academy of Program/Project Leadership (APPL) and NASA Engineering Training (NET), the Academy West Program will provide services to NASA's Leadership and Management Development Program and Agency-wide Risk Management training initiatives. In addition, The ARC P/PM Development Program will incorporate new initiatives into its existing offerings. New development projects, based on benchmarking of best practices, will include the Lead Center Program Managers Mentoring Project, a Project Management Knowledge Management Team and Open PM Forums facilitated by guest presenters from Silicon Valley industries.

Full-Cost Practices

ARC is moving forward with the implementation of full-cost practices and will continue to improve the cost-effectiveness of mission performance through complete implementation of the Agency's Full-Cost Initiative. This initiative will drive policy and practice improvements in the managing, budgeting, and accounting areas that will support "full disclosure" on activities for more fully informed decision making and better performance measurement. The planned improvements include categorizing costs as direct, service, and general and administrative (G&A).

The Full-Cost Initiative also ensures compliance with recent legal and administrative guidance, including the 1990 Chief Financial Officers Act, 1993 Government Performance and Results Act, 1993 National Performance Review, and the Federal Financial Management Improvement Act of 1996.

Integrated Financial Management System

In addition to operating the Center's legacy systems, ARC is deeply involved with the Agency-wide effort to standardize and improve the financial and business management processes and systems within the Agency. The ARC Integrated Financial Management Program (IFMP) team is actively participating in all aspects of the Agency-wide program, including reengineering business processes, configuring and testing the system, and preparing employees to work in the new environment. The initial system to be replaced is the core accounting system followed by time and attendance, procurement and logistics, budget formulation, human resources, travel, environmental, aircraft management, facilities, and payroll. The IFM System will replace the Agency's existing business management environment, which comprises decentralized, nonintegrated systems that were originally developed to satisfy unique Center requirements. The IFM System will provide the NASA Strategic Enterprises, Lead Centers, Lead Program managers, and Center directors with accurate and timely financial information to support decision making and to enable strategic manage-

ment. In addition, the system will be designed to satisfy the needs of external customers who require financial information from NASA.

Education

As stated in the NASA Strategic Plan, one of NASA's primary goals is to inspire achievement and innovation. In order to accomplish this, NASA uses its unique resources to support educational excellence for all. Ames delivers the NASA Education Program within the framework of the NASA Implementation Plan for Education, 1999-2003. The education function at ARC is strategically dispersed throughout the Directorates, and all major technical endeavors at ARC contain educational outreach components. This scenario has increased the magnitude, diversity, and technical excellence of ARC's education programs. The wide ranges of ARC's education programs are constantly being refined, and new programs are being introduced to better serve the needs of the educational community within the Bay Area, the state of California, and 10 other western states. The following is a brief list of the wide range of educational activities at ARC:

- *The California Air and Space Center (CASC)*
- *The JASON Project*
- *The ARC Aerospace Encounter*
- *National Engineers' week*
- *Science and engineering fairs, and an active speakers' bureau*
- *The NASA Quest program*

New education technology products are produced in conjunction with the significant aeronautics and space programs at the Center. The products usually consist of CD-ROMs and are web based; they fully integrate curriculum based on National Science Standards.

Equal Opportunity/Diversity

ARC strongly supports the principles of equal opportunity and endorses achieving diversity in the workplace. Employees who work at ARC are valued and no one is excluded on the basis of race, color, religion, sex, age, national origin, disability, sexual orientation or any other nonmerit-based factor. The Center fosters and maintains a work environment that respects and values individual differences and is reflective of the entire range of communities that the Center serves. The Center's efforts are focused on workforce representation, recruiting, hiring, retention, training, employee development, promotions, Alternative Dispute Resolution, multicultural employee groups, Diversity Dialogue Groups, and partnerships with historically black colleges and other minority universities.

NASA Research Park Development

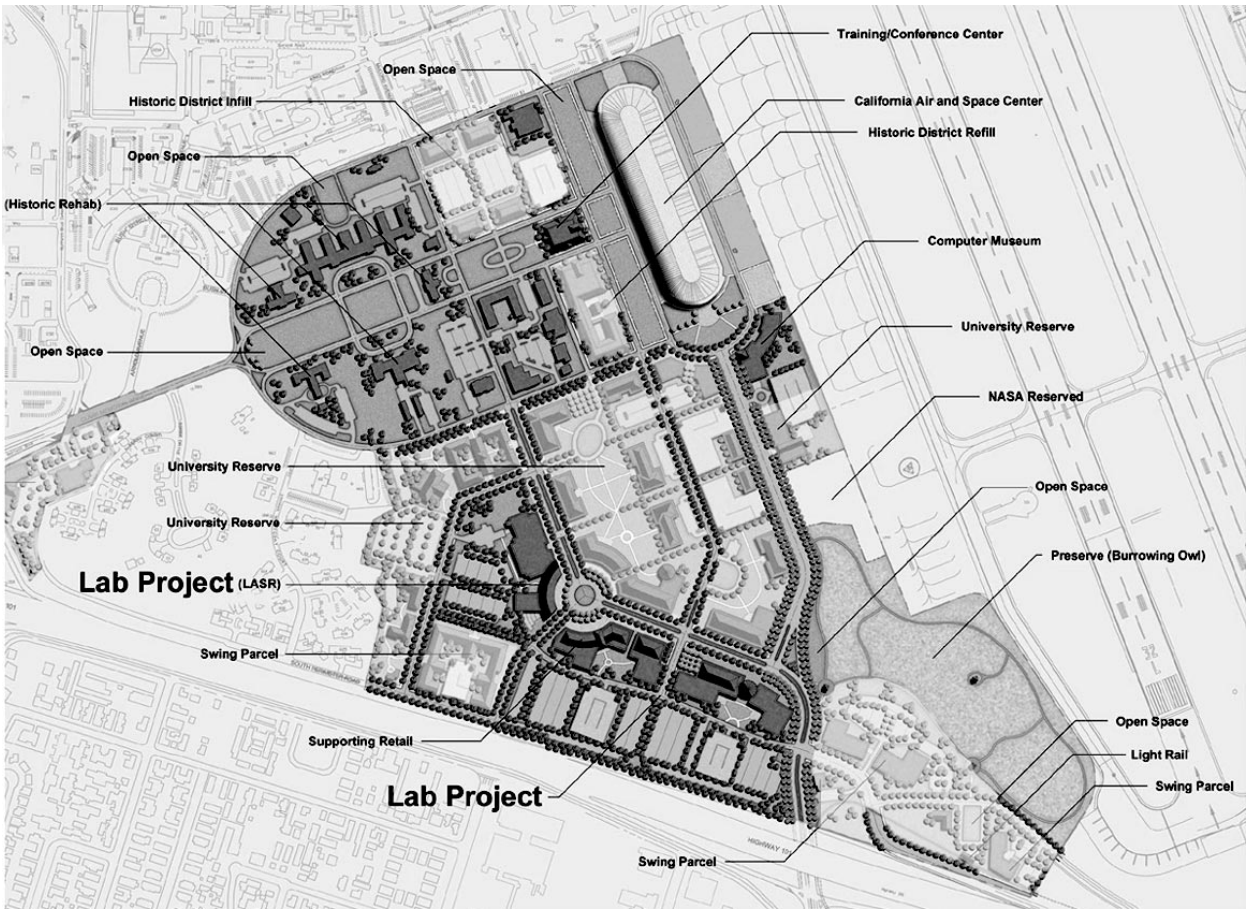
ARC is embarking on a bold new vision to create NASA Research Park (NRP), a collaborative research park which will bring together premiere talent in the areas of astrobiology, information technology, and aerospace technology. The transformation of ARC's unused capacity into a unique environment for enhancement of NASA's programmatic initiatives, as well as the Agency's commercialization, education, and outreach goals, will integrate three key components.

ARC will develop a world-class campus for research and learning that will utilize ARC's unique stock of buildings and partnerships with local government, academia, industry, and nonprofit organizations. With its notable military history, prominent architecture, and availability of land, ARC will be an ideal place where NASA, its collaborative partners, and the public can promote advances in aerospace and aviation technology, understand advances in information technology, and explore the outer limits of the Universe. Public displays, interactive exhibits, school programs for students and teachers, and lecture programs will be featured on the campus.

In partnership with academia and industry, NASA will promote entrepreneurship and innovation at ARC. By taking advantage of its proximity to leading entrepreneurs and heads of innovative organizations, NASA and its partners can support the development of business incubators focused on high technology and biotechnology industries. Linkages can be formed with business education programs to provide forums, seminars, executive lecture series, and other venues to facilitate the exchange of information and experience to solve real-world business problems related to technology innovation, technology commercialization, and technology management.

ARC will create a unique community of research scientists, students, and educators with a shared mission to advance human knowledge of space, Earth, and society. A lively and vibrant community will attract industry. NASA will provide critical public safety services and other services typically furnished by municipal government.

An Integrated Development Plan was issued in the first quarter of FY00. That plan described how portions of ARC will evolve into a shared-use campus with government, academia, industry, and nonprofit organizations. The plan also outlines the steps required to optimally develop federal property and to balance NASA's programmatic goals against the financial requirements and infrastructure constraints. This plan was developed in cooperation with local governments to ensure its sensitivity to



the needs of the surrounding communities and the environment. It is also a sensible and prudent undertaking for the nation.

Support Functions

A full array of institutional systems support the ARC Center of Excellence, missions, Lead Center programs, and other research and technology development activities. These systems encompass a wide range of areas, including the following.

Acquisition/Procurement

Contract and grant specialists award procurements that support research and operations for all NASA Enterprises. Specialists are integrally involved in the planning and implementation of business-related program/project goals. Annually, the Division awards $500 million in new work and concurrently performs over $3 billion in contract management. NASA Ames program and project success is directly linked to acquisition excellence.

Documentation Development

Professional specialists who work under the Scientific and Technical Information (STI) Program acquire, produce, distribute, and archive scientific, technical, and nontechnical information using traditional and advanced technologies. Services provided include printing and reproduction, photo and imaging, audiovisual and video production, graphics and exhibit design, publications, and library support.

Human Resources

Human resource specialists work to attract, enhance, and retain a highly effective workforce, properly balanced and trained to accomplish the Center's various missions. They work closely with ARC supervisors and managers, providing advice and assistance in planning and implementing proactive human resources programs within each organization. They also provide management and staff development programs to fully utilize the capabilities and potential of the Center's workforce.

Facilities Maintenance and Operations, Logistics, and Supplies

Support is provided through two primary functions: (1) institutional facilities, base operations, and maintenance; and (2) supply and logistics services. In addition, as host for the ARC Moffett Complex, the necessary maintenance of infrastructure and buildings is provided to support office space and military housing utilized by resident agencies.

Information Technology Services
Services include the development and maintenance of a secure, state-of-the-art computing infrastructure that can support Ames researchers and partners throughout NASA and the world. This infrastructure consists of networking, desktop computing, and other Information Technology services such as telephones, business data processing, World Wide Web, e-mail, software development, and IT systems engineering.

Protective Services
A wide range of emergency and nonemergency services are provided, including security, law enforcement, fire/crash rescue, export control, special projects, and emergency preparedness, response, and recovery. Support includes coordination of Center access for all employees and visitors, security clearance processing, foreign travel briefings and debriefings for personnel traveling overseas, and physical, technical, and information security throughout the Center.

Research and Development Services
Cost-effective and highly qualified support is provided to the Agency's R&D programs by providing wind-tunnel testing operations, hardware development, systems engineering, and project and facility construction management. Utilizing concurrent engineering, rapid prototyping, advanced analysis tools, and experienced project management expertise, systems engineering serves the Center's programs, as well as external customers in integrated product design and development. The hardware development capability is centered on unique skills made possible by the advanced tools and expertise of its crafts people. Products range from sophisticated spacecraft hardware and biological sensors to highly accurate and detailed wind-tunnel models. Wind-tunnel testing utilizes modernized national-class facilities, leading-edge instrumentation, and expert technical support for high-speed, high-fidelity data acquisition and understanding. Ames is a leader in wind-tunnel testing productivity, capability, and knowledge.

Commercialization and Technology Transfer
The Commercial Technology Office manages the transfer and commercialization of NASA technologies and the infusion of external technologies to enhance NASA programs, the U.S. economy, and the quality of life. Services to accomplish these goals include protection, patenting, and licensing of NASA-developed intellectual property; development of public/private partnerships and strategic alliances; and management of the Small Business Innovative Research/Small Business Technology Transfer (SBIR/STTR) programs and NASA-related small business incubation.

Equal Employment Opportunity
Equal employment opportunity, affirmative employment, and diversity in the workplace are promoted through a variety of mechanisms. Enforcement procedures ensure compliance with existing rules, regulations, statutes, policies, and mandates.

Public Affairs, Outreach, Communication and Education
An extensive array of media services, public affairs activities, and informational, outreach, and educational programs support Center and Agency goals. Many are explained within the foregoing sections.

Financial Systems
Effective, efficient, and economic financial and budgetary systems are developed and maintained to support the Center and Agency customers in line with established goals. High-quality, proactive business services help customers to operate effectively, efficiently, and economically, with varying budgets and program requirements.

Legal Services
Legal Services provides advice and assistance to all ARC management and to all ARC organizations. Legal Services also furnishes timely and accurate legal advice on a wide range of topics; acts as legal representative for and on behalf of ARC in administrative and judicial proceedings; and participates in various management working groups.

Safety, Environmental, and Mission Assurance
A safe workplace, responsible stewardship of the environment, and reliable and quality systems are promoted. Support includes effective advocacy, technical consultation, policy guidance, oversight, training, regulatory interface, and the application of risk-assessment tools.

Systems Management
ARC is committed to improving the quality and consistency of the Center's approach toward systems management, which is the integration of systems engineering, system safety and risk assessment, product development, and cost estimation and analysis. The Systems Management Office evaluates and reports to the Center Director on whether the processes, infrastructure and oversight mechanisms are in place to implement systems management in a disciplined and thorough manner, and to ensure that its effectiveness can be verified independently. The initiatives to be conducted by the Systems Management Office for FY01 include:

- *Independent assessments of the Center's major programs and initiatives*
- *Training and skill development*
- *Tools development and deployment*

GPRA Metrics FY 2001

Space Science Enterprise FY 2001

Performance Plan – CHART 1

Enterprise FY01 Target	00#	FY01 Ames Contribution
Obtain expected scientific data from 80% of operating missions.	1S2	Study atmospheric variability on Uranus and Neptune with HST.
Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in astronomy rocket and balloon flights, and by making satisfactory research progress in related Research and Analysis (R&A) and Data Analysis (DA) programs.	1S3	1. Implement development programs for near-IR focal plane arrays. 2. Improve sensitivity, size of candidates (InSb and HgCdTe). 3. Develop packaging concepts to achieve 4 k x 4 k pixel formats. 4. Make observations of deuteration in star forming cores.
Successfully develop and launch no less than one of two missions within 10% of budget and schedule.	1S4	1. Prepare XRD/XRF instrument concepts for future Mars and outer solar system missions. 2. Generate atmospheric radiation algorithm for Mars GCM for comparison to Mars 01 observations.
Obtain expected scientific data from 80% of operating missions.	1S5	1. Participating Scientist on Mars Global Surveyor. 2. IDS for Cassini.
Perform innovative scientific research and technology development by meeting technology development objectives for major projects, by achieving mission success in space physics rocket and balloon flights, and by making satisfactory research progress in related R&A and DA programs.	1S6	Develop mid-infrared Si:As detectors which meet the requirements of NGST, SOFIA, and future Explorer missions.
Perform innovative scientific research and technology development by meeting interferometry technology development objectives and by making satisfactory research progress in related R&A programs.	1S7	1. Implement the initial stage of improving the fringe-tracking algorithm of the IOTA interferometer. 2. Conduct Project Vulcan to detect extrasolar planets.
Perform innovative scientific research and technology development by meeting technology development objectives and by making satisfactory research progress in the related R&A program, including the Astrobiology program.	1S8	1. Use “biomorphic forms” as biomarkers. Investigate evolving systems in protocells. 2. Study structural functions of peptides in membranes. 3. Analyze lipid biomarkers in natural samples. 4. Simulate greenhouse effect on climate of early Mars.
Continue and expand the integration of education and enhanced public understanding of science with Enterprise research and flight mission programs.	1S9	Participate in Project Astro.
Investigate the composition, evolution, and resources of Mars, the Moon, and small bodies by successfully launching a Mars mission, by obtaining data from operational spacecraft, and by making satisfactory progress in related R&A and DA programs.	1S10	1. Model the surface composition of the asteroid 624 Hektor using 0.3 to 3.6 micron spectra. 2. Simulate Martian climate using a general circulation model.
Plan, develop, and validate new technologies needed to enable future research and flight missions by achieving performance objectives in the space science core technology programs and by making progress as planned in the Flight Validation program.	1S12	Evaluate new neural network architectures and extend networks to flight mission data sets.

Earth Science Enterprise FY 2001

Performance Plan – CHART 2

Enterprise FY01 Target	00#	FY01 Ames Contribution
Explain the dynamics of global carbon cycle by building improved models and prediction capabilities.	1Y4	Improve the spatial resolution and description of land use effects in the CASA model and implement the model on Ames supercomputers for improved throughput. Implement and test these models against boreal and Amazonian ecosystem problems.
Explore the dynamics of global water cycle by developing, analyzing, and documenting multi-year data sets.	1Y5	Manage the Fourth Convection and Moisture Experiment (CAMEX 4), a multi-agency, airborne and surface field campaign and assure that experiment data to fulfill mission objectives are delivered.
Explain the dynamics of global water cycle by building improved models and prediction capabilities.	1Y6	Use the Large Eddy Simulation/microphysical modeling of marine boundary layer clouds to show relationship between sea surface temperature and cloud optical depth.
Explain the dynamics of long term climate variability by building improved models and prediction capabilities.	1Y8	1. Examine the spectral radiative properties of dust and smoke aerosol in Southern Africa and the effects they have on the radiative properties of clouds by analysis and modeling of data acquired during the Southern African Fire/Atmosphere Regional Science initiative. 2. Application of Upper Atmosphere Research Satellite (UARS) humidity data and aircraft emission inventories to generate global persistent contrail frequency maps.
Explain the dynamics of atmospheric chemistry by building improved models and prediction capabilities.	1Y10	1. Use an Aerosol Physical Chemistry Model (APCM) to analyze the Upper Atmosphere Research Satellite (UARS) data to evaluate the potential impact of contrail on the global climate and the role of stratospheric denitrification in the formation of the Antarctic ozone loss. 2. Use an Aerosol Physical Chemistry Model (APCM) to analyze data from Subsonic Aircraft Contrail and Cloud Effects Special Study (SUCCESS) to study the effect of aerosol composition in the nucleation of cirrus clouds in the upper troposphere and their subsequent role in heterogeneous chemistry.
Provide regional decision-makers with scientific and applications products/tools.	1Y14	Develop a combined regional climate and ecosystem model for forecasting the effects of climate change on the crop growing conditions of the vineyards of Napa County, CA.

Enterprise FY01 Target	00#	FY01 Ames Contribution
Support an expanded, productive research community to include 975 investigations by 2001	1H3	1. Conduct DNA microarray analysis of 2 different cell types flown in space to collect data on the effects of the space environment on gene expression. 2. Issue Life Sciences NASA research announcement (NRA) for new research in Fundamental Biology. 3. Develop and fly gravitational biology experiments on Research (R) mission R2 aboard STS 111. 4. Operate the acceleration facilities to support a cadre of 30 intra- and extramural PI experiments that will further our understanding of the role of gravity on living systems. 5. Complete Archive of prior major missions (SL-3, SLS-2, SL-J, IML-1&2) and current missions.
Conduct outstanding peer-reviewed and commercial research on STS 107 to advance knowledge in the fields of medicine, fundamental biology, biotechnology, fluid physics, materials processing and combustion.	1H4	1. Investigate the effects of gravity on the growth and physiology of flax seeds and moss on STS-107. 2. Provide information on the effects of the space environment on bacterial virulence through research conducted on STS-107.
Begin research on the International Space Station.	1H5	1. Complete implementation of the validation and science experiments on flight 5A.1. 2. Conduct research on the effects of microgravity on the development of the avian skeleton and vestibular system on UF-1. 3. Provide information on the effects of gravity on super dwarf wheat photosynthesis and respiration on UF-1. 4. Develop control parameters for ISS research through appropriate ground-based hypergravity and microgravity simulation studies. Make these data available through an extension of the Ames Life Sciences Data Archive (Bioengineering Database/Database Manager). 5. Analyze and publish results from the Hyper-g Project which will provide baseline data (to ISS flight experiments) on the effects of altered gravity on biological systems.
Successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities.	1H13	1. Complete and fly (5A.1) Passive Dosimeter System. 2. Complete and fly (UF-1) the Biomass Production System (BPS). 3. Complete and fly (UF-1) the Avian Development Facility (ADF), the risk reduction development unit designed to test the technology required for the Egg incubator Habitat. 4. Complete implementation of the validation flight UF-1. 5. Complete the Critical Design Review (CDR) for the Incubator Habitat. 6. Complete Critical Design Review (CDR) for compound and dissecting microscope developments. 7. Complete the Critical Design Review for the Cell Culture Unit Habitat. 8. Complete the Life Sciences Glovebox (LSG) habitat attachment mechanism Preliminary Design Review (PDR). 9. Complete the procurement process and start work on the second phase of the Plant Research Unit Habitat (PRU) development.

HEDS Enterprise FY 2001 (cont.)

Performance Plan – CHART 3 (Cont.)

Enterprise FY01 Target	00#	FY01 Ames Contribution
Successfully complete the majority of the planned research activities in support of initiation of on-orbit research opportunities. (cont.)	1H13	10. Complete the Preliminary Design Review (PDR) for the Small Mass Measuring Device (SMMD) and the Micro Mass Measuring Device (MMMD) developments. 11. Complete the Preliminary Design Review (PDR) for the Centrifuge, NASDA provided hardware.
Develop new biomedical and technological capabilities to facilitate living and working in space and the safe return to Earth.	1H17	1. Initiate new research in nanotechnology for biomedical applications. 2. Support JSC's human countermeasure studies through the development of a wireless Mobile Physiological Monitor (MPM) to monitor physiological health and performance. 3. Support JPL's development of a Wireless Augmented Reality Prototype (WARP) to provide a heads-up display in a space habitat. 4. Apply ARC three-dimensional (3-D) imaging technologies to facilitate Fundamental Biology PI flight experiment design and resultant crew training particularly in modeling the ISS glovebox, dissection tools, and rodents along with haptic feedback.
Develop and demonstrate technologies for improved life support systems.	1H18	1. Complete development and full-scale testing of a prototype solid-state CO_2 compressor for ISS air revitalization system application. 2. Complete PDR and CDR of next-generation Water Recovery/Processing System. 3. Conduct In Situ Resource Utilization (ISRU) research and technology development for Mars Exploration mission applications.
Initiate implementation of the Bioastronautics Initiative.	1H31	1. Sponsor joint ARC/JSC collaborative workshop to define, plan, and initiate a series of countermeasure studies over the next 5 years using the Ames unique research facilities. 2. Initiate design of the 52' Chronic Live Aboard Centrifuge as part of long term studies and countermeasures.
Support participation in HEDS research (via educational outreach) program.	1H26	Support NASA's Education Outreach Program through university guest lectures, through participation in the Speaker's Bureau, through lecturing to grade and middle schools, through displays and brochures at scientific meetings, and through use of the Hangar 1 Spacelab for student tours.

Enterprise FY01 Target	00#	FY01 Ames Contribution
NASA's research stresses aviation system monitoring and modeling, accident prevention and accident mitigation. The performance target is to complete 75% of the conceptual designs of systems for preventing and mitigating accidents (programmatic performance indicators in appendix), and to demonstrate tools for accident analysis and risk assessment.	IR1	1. Complete the development and demonstration of digital encryption technology, in collaboration with the FAA and International Aviation community, leading to establishment of an encryption standard to improve the security of the next-generation ATN communications systems. 2. Demonstration of system-wide simulation of National Aviation System development proficiency standards for check airmen. 3. Identification of high-probability human error contexts and development of virtual reality aids for aircraft maintenance and inspection. 4. Demonstrate integrated propulsion and flight control system capable of adapting to absence or loss of any and all control surfaces resulting from failures or malfunctions. 5. Demonstrate prototype data communications architecture with multipriority capability in a secure high-integrity environment for the National Airspace System. 6. Publish an industry standard design guide for ultra-safe gears for rotorcraft. 7. Complete the flight validation of baseline control laws and modes for CONDUIT (Control Designer's Unified Interfaces). 8. Publish a HUMS (Health and Usage Monitoring System) Certification Protocol. 9. Improve safety and survivability of rotorcraft in hard landings onto water, soft soil, and rigid surfaces. 10. Determine how the demands of managing multiple concurrent tasks contribute to crew errors in aviation incidents and accidents. 11. Based upon pilot simulation study, define effects of in-flight activity breaks as fatigue countermeasures. 12. Complete guidelines for perceptually and cognitively matched displays and methods of analysis for optimizing human performance. 13. Down select of ground-based remote sensing technologies for a prototype ground-based system to sense icing conditions.
NASA's research stresses engine technology to reduce the emissions of oxides of nitrogen and carbon dioxide. The performance target is to complete one system-level technology benefit assessment, one component concept selection and one new material system.	IR2	Establish feasibility of adapting ultra high temperature ceramics Thermal Protection Materials for gas turbine applications (collaboration with GRC).
NASA's research has stressed reducing noise in the areas of engines, nacelles, engine/airframe integration, aircraft interiors and flight procedures. The performance target is complete large-scale demonstration of a 2-5-decibel reduction in aircraft noise based on 1997 production technology, and initial assessments of concepts offering an additional 3-decibel reduction.	IR3	Complete large-scale airframe noise reduction wind-tunnel tests in 40- by 80-foot test section of the NFAC.
NASA's research stresses operations systems for safe, efficient air traffic management and new aircraft configurations for high productivity utilization of existing runways. The performance target is to complete the civil tiltrotor project by validating databases for contingency power, flightpaths, and noise reduction, as well as complete at least one demonstration of an airspace management decision support tool.	IR4	1. Develop and demonstrate transition airspace decision support tools for ATC/airline operations center and ATC/cockpit information exchange and for conflict resolution. 2. Comprehensive mission simulation database integrated cockpit and operating procedures for complex, low-noise flightpaths. 3. Large-scale database for validation of rotor noise reduction and validated design-for-noise capability.

Aerospace Technology FY 2001 (cont.)

Performance Plan – CHART 4 (Cont.)

Enterprise FY01 Target	00#	FY01 Ames Contribution
NASA's research stresses high-speed computing, high-capacity networks, and improved physics-based methods. The performance target is to develop at least three new design tools and accomplish at least four demonstrations of advances in computation and communications.	IR8	1. Develop, implement and test capabilities for distributedcollaborative design. Develop methods for analysis of "quality of solution" and uncertainty analysis and propagation to increase design confidence. 2. Demonstrate benchmarking tools to measure applications performance on high-performance computing testbeds. 3. Demonstrate automated parallelization tools to reduce parallelization time and enhance applications performance on high-performance computing testbeds. 4. Demonstrate a rapid integration and test environment that includes remote connectivity and access to flight simulation data, computational simulation data, and archival databases. 5. Integrate a large-scale computing node into a distributed computing environment. 6. Demonstrate remote connectivity to high data-rate instruments and distributed real-time access to instrument data. 7. Improve the capability to assess the life of complex composite rotorcraft structures. 8. Complete the flight validation of baseline control laws and modes for CONDUIT (Control Designer's Unified Interfaces). 9. Provide documentation for composite structures analysis and certification for inclusion in the MIL-HDBK-17 design handbook. 10. Enable rapid prototyping with "express-tool" fabrication.
NASA's research stresses highly reliable, fully reusable configurations, advanced materials and innovative structures. The performance target is to complete assembly of the third X-34 test vehicle, and demonstrate 75% of the technology developments (programmatic performance indicators in appendix) for reusable launch vehicles.	IR10	1. Gen. 2 RLV: Conduct IVHM & TPS in-house R & D and support industry per plans currently under development. 2. Gen. 3: Report on potential of TPS materials that can heal themselves after micrometeorite impact and initiate superthermal insulation materials development and characterization. 3. X-37: Deliver, per schedule and funding availability software & hardware for three flight experiments: IVHM, Flexible TPS and wing leading edge TPS. 4. Continue to advocate and develop SHARP L1 technology demonstrator effort. 5. Demonstrate benchmarking tools to measure applications performance on high-performance computing testbeds. 6. Demonstrate automated parallelization tools to reduce parallelization time and enhance applications performance on high-performance computing testbeds. 7. Integrate a large-scale computing node into a distributed computing environment.
NASA's research stresses technology for reusable, long-life, high-power electric and advanced clean chemical engines for Earth orbital transfer and breakthrough propulsion, precision landing systems and aerocapture systems for planetary exploration. The performance target is to commence X-37 vehicle assembly, and complete one Pathfinder flight.	IR11	1. Complete high spectral resolution, 2-D CFD code for synthetic spectra predictions of radiative heat transfer for high-speed entry. 2. Develop ultrasmall TPS/aerothermal sensors for ground and flight experiments. 3. Support zero boil off cryogen storage demonstration at MSFC.
Continue the solicitation of customer feedback on the services, facilities and expertise provided by the Aerospace Technology Enterprise.	IR12	1. Ames will continue its very effective customer survey program for its systems engineering, hardware development, and research and development testing to validate its customer service effectiveness. 2. Conduct customer surveys on arc jet testing and report result to HQ.

Manage Strategically FY 2001

Performance Plan – CHART 5

Enterprise FY01 Target	00#	FY01 Ames Contribution
NASA will increase the safety of its infrastructure and workforce with facilities safety improvements, reduced environmental hazards, increased physical security, and enhanced safety awareness among its employees.	1MS1	Ames will pursue OSHA VPP Certification by making key improvements in the safety of its infrastructure, enhanced participation in the safety among its employees, engineering of safety into all projects as well as implementation and completion of all Safety Accountability Metrics.
Continue to take advantage of opportunities for improved contract management by maintaining a high proportion of Performance Based Contracts (PBCs), and maintain significant contractor involvement in NASA programs of small businesses, minority institutions, and minority and women owned businesses.	1MS2	1. Continue review of all requirements for possible 8(a) set-aside. Conduct outreach activities targeting SDBs. Based on FY 00 achievements and projections for FY01, the 8% goal will be fully met or exceeded. 2. Complete conversion of all on-site support service contracts to PBC. Ensure all new requirements are considered for PBC.
Renew Agency's management systems, facilities, and human resources through updated use of automated systems, facilities revitalization, and Personnel training.	1MS3	ARC has continually improved the Center's management processes to meet the cost performance metric and has typically achieved accruals in excess of 83%.
Improve IT infrastructure service delivery to provide increased capability and efficiency while maintaining a customer rating of "satisfactory," and enhance IT security through reduction of system vulnerabilities across all NASA centers, emphasizing IT security awareness training for all NASA personnel.	1MS4	1. Complete the deployment of PKI encryption technology throughout the Agency's field centers to enable secure messaging across NASA and with its partners. 2. Complete the implementation of a new Center-wide computer network which will improve the effectiveness of Ames researchers through improved performance and an architecture which reduces the IT security risks to Ames IT assets. 3. IT Security Training Completions by October 1, 2001: General Awareness 90% Civil Servants and contractors, Manager Training 95% Civil Servant managers, Systems Administrator Training, 90% Civil Servant General Awareness 100% UNIX and 80% NT.

Provide Aerospace Products and Capabilities FY 2001

Performance Plan – CHART 6

Enterprise FY01 Target	00#	FY01 Ames Contribution
Establish prototype collaborative engineering environments focused on the representative set of enterprise applications and evaluate performance against non-collaborative benchmarks.	1P2	Develop, enhance, and manage a leading edge IT-based collaboration capability supporting the 16 worldwide members of the NASA Astrobiology Institute.
Dedicate 10 to 20 percent of the Agency's Research & Development budget to commercial partnerships.	1P5	Through the NASA Small Business Innovation Research program, collaboration with commercial partners to develop an instrument to measure aerosol parameters and trace gas in real-time.

Generate Knowledge FY 2001

Performance Plan – CHART 7

Enterprise FY01 Target	00#	FY01 Ames Contribution
The Space Science Enterprise, the Earth Science Enterprise, and OLMSA/HEDS will make science data obtained widely accessible as soon as possible after receipt and will maintain these data in open archives.	1G5	The Ames Earth Science Project Office will make the data from the SAGE III Ozone Loss and Validation Experiment (SOLVE) available to the scientific community and the public by publishing the data on CD-ROM and maintaining open, online archives.
Work with other federal agencies and U.S. industry to complement and support our activities.	1G6	1. Ames will implement Interagency Agreements with NOAA and the DOE for continuing collaborations on atmospheric chemistry, dynamics and physics research. 2. Continue the MOU and Implementation Plan between the country of Brazil and the USFS with NASA (Ames) as first partner for research in fire effects throughout the country, including implementation of new sensing approaches both from aircraft and from satellites.
Pursue mutually beneficial cooperative activities in aeronautics and space with other nations.	1G7	Continue the MOU and Implementation Plan between the country of Brazil and the USFS with NASA (Ames) as first partner for research in fire effects throughout the country, including implementation of new sensing approaches both from aircraft and from satellites.

Communicate Knowledge FY 2001

Performance Plan – CHART 8

Enterprise FY01 Target	00#	FY01 Ames Contribution
Convey information about, and knowledge generated by NASA's programs, to the public	1CK1	Ames continues to provide access to documentation and digital images to the science community and the public through an external web presence.
Assist the public and customers to locate and retrieve information on, or that has been generated by, a NASA program	1CK2	The ARC STI group will work directly with the Dreamtime partners to develop a new public web site. The site will showcase the best images from the photo and video archives.
Facilitate the transfer of NASA generated technology and innovations to private industry	1CK3	Increase access to technology transfer and commercialization opportunities via the Internet based Tech Tracs database and new technology publications.
Support educational excellence and reach out to the undeserved and underrepresented minority community	1CK4	Demonstrate integrated learning technology products in relevant formal and informal educational environments.

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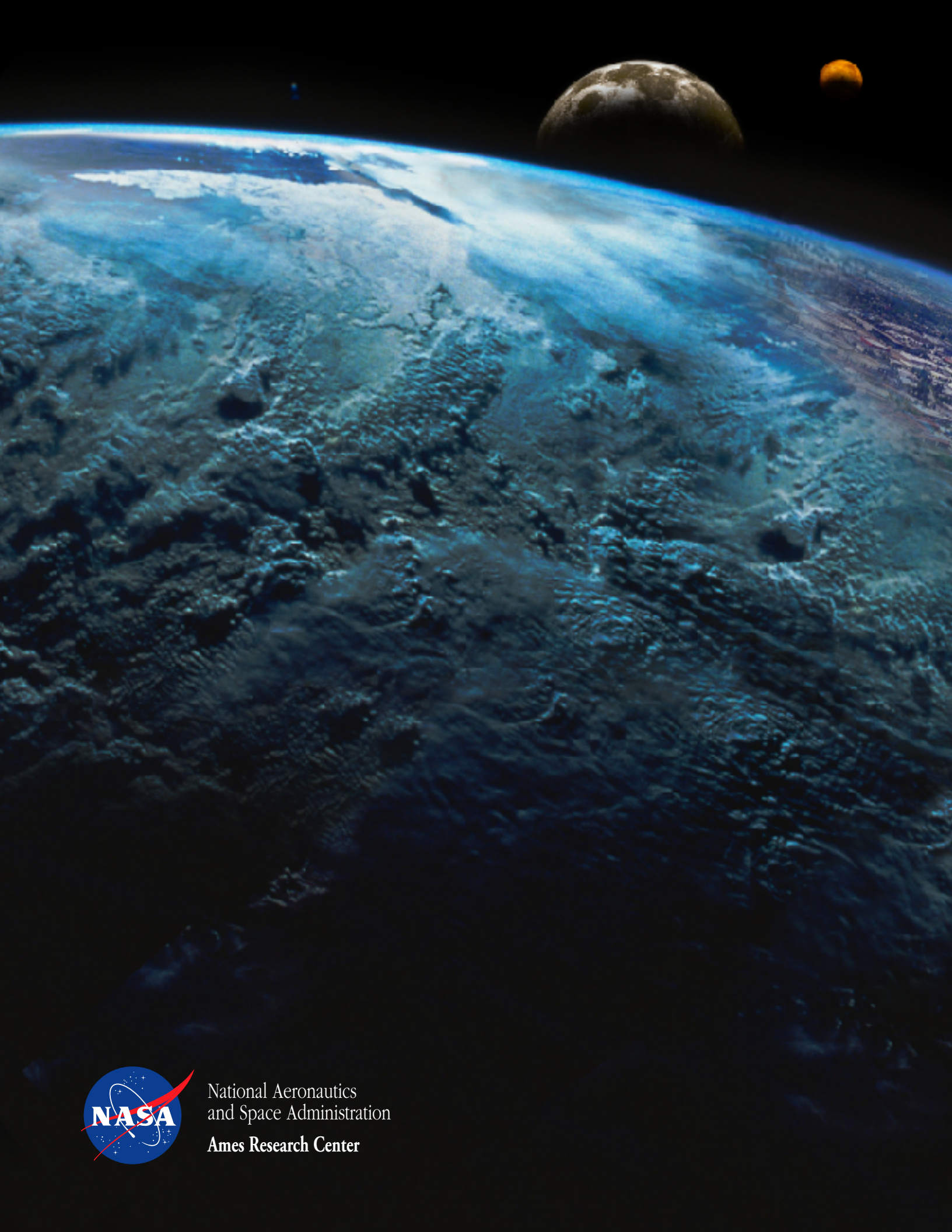
If calling from outside ARC, each phone number is preceded by area code and prefix. (for example, (650) 604-1234).

ACRONYMS

ADF	Avian Development Facility
AIRES	airborne infrared echelle spectrograph
ALS	advanced life support
AOS	Aviation Operations Systems
APCM	aerosol physical chemistry model
APPL	Academy of Program/Project Leadership
ARC	Ames Research Center
ASAP	Ames Safety Accountability Program
ASC	Aviation System Capacity
ASTER	advanced spaceborne thermal emission and reflection radiometer
AT	Aero-Space Technology
ATC	air traffic controller
BPS	Biomass Production System
CAMEX	Convection and Moisture Experiment
CASC	California Air and Space Center
CCU	cell culture unit
CDMS	Center Directives Management System
CDR	critical design review
CHAART	Center for Health Applications of Aerospace-Related Technologies
CIO	chief information officer
CMEX	Center for Mass Exploration
COE-IT	Center of Excellence for Information Technology
CONDUIT	control designer's unified interface
CoSMO	Consolidated Supercomputing Management Office
CSA	Canadian Space Agency
DASI	digital array scanning interferometer
DFS	design for safety
DS	deep space
EOS	Earth Observing System
ES	Earth science
EPS	Extranet for Security Professionals
FB	fundamental biology
FRIAR	Fast-Response Industry Assistance Requests (project)
FY	fiscal year
G&A	general and administrative
HEDS	Human Exploration and Development of Space
HHR	habitat holding rack
HIPPARCOS	European space agency astrometric mission satellite and data base
HPCC	high-performance computing and communications
HSO	Hungarian Space Office
HUMS	Health and Usage Monitoring System
IFMP	Integrated Financial Management Program
IOTA	Infrared Optical Telescope Array
IR	infrared
IRAC	infrared array camera
IS	Intelligent System
ISE	intelligent synthesis environment
ISS	International Space Station
ITS	Information Technology Security
IVHM	integrated vehicle health management

JASON	(scientific educational expedition project-after Jason of the Golden Fleece)
JPL	Jet Propulsion Laboratory
JSC	Johnson Space Center
LSG	life sciences glove box
MASTER	MODIS/ASTER (airborne simulator)
MMMD	micromass measuring device
MODIS	moderate-resolution imaging spectrometer
MPM	mobile physiological monitor
MSFC	Marshall Space Flight Center
NAI	NASA Astrobiology Institute
NAR	non-advocate review
NASA	National Aeronautics and Space Administration
NASDA	National Aerospace Development Agency (Japan)
NEMS	nanoelectromechanical system
NET	NASA Engineering Training
NGI	Next Generation Internet
NGST	next-generation space telescope
NRA	NASA research announcement
NRP	NASA Research Park
OAT	Office of Aero-Space Technology
EOS	Office of Earth Science
PC-ITS	Principal Center for ITS
PDR	preliminary design review
PDS	passive dosimeter
PI	principal investigator
PMC	Program Management Council
P/PM	program and project management
PRU	plant research unit
R&T	research and technology
RLV	reusable launch vehicle
SAFARI	Southern African Fire/Atmosphere Regional [Science] Initiative
SAFOR	Safe All-Weather Flight Operations for Rotorcraft (project)
SAGE	Self-Adhesive Grid Code
SBIR	Small Business Innovative Research
SFG	Simulation Facility Group
SILNT	Selected Integrated Low-Noise Technologies (project)
SIRTF	Space Infrared Telescope Facility
SMMD	small-mass measuring device
SOFIA	Stratospheric Observatory for Infrared Astronomy
SOLVE	SAGE III Ozone Loss and Validation Experiment
SS	Space Science
SSBRP	Space Station Biological Research Project
STI	Scientific and Technical Information (program)
STS	Space Transport System
STTR	small business technology transfer
TES	Thermal Emission Spectrometer
TIR	thermal infrared
TPS	thermal protection system
UF	utilization flight
USRA	Universities Space Research Association
VPP	Voluntary Protection Program
WARP	writers augmented reality prototype



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