National Aeronautics
and Space Administration

Dryden Flight Research Center
2004 Implementation Plan

Dryden Flight Research Center 2004 Implementation Plan

On the cover — A 1997 mural titled “Accepting the Challenge of Flight” by renowned aerospace artist Robert McCall depicts past, present, and future contributions of NASA Dryden and some of its people to the science of flight research. The mural, on display in the foyer of Dryden’s Walter Williams Research Aircraft Integration Facility, portrays some of the Dryden people who represent the multi-talented staff of the Center.

The Dryden Flight Research Center is named for Dr. Hugh L. Dryden, an internationally renowned aeronautical scientist who worked for the National Bureau of Standards from 1918 to 1946, eventually becoming its Associate Director. In 1947, Dryden succeeded George W. Lewis as Director of the National Advisory Committee for Aeronautics (NACA), the nation's top civilian aeronautics research institution. That same year, Dryden made the Muroc Flight Test Unit (predecessor of NASA Dryden) a permanent facility. During the following 11 years, Hugh Dryden guided NACA toward high speed flight, hypersonic flight, and ultimately space flight. With the formation of the National Aeronautics and Space Administration (NASA) in 1958, President Eisenhower appointed Dr. Dryden the agency's first Deputy Administrator, a role in which he had a profound influence over the early American space program. Dryden served in this capacity until his death on December 2, 1965. The Dryden Flight Research Center was named in his honor on March 26, 1976. The following is his explanation of the role of flight research,

> *"...to separate the real from the imagined problems and to make known the overlooked and the unexpected problems..."*

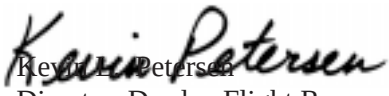
Director's Message

Since 1946, NASA engineers and their NACA predecessors have pioneered flight research above Rogers Dry Lake in the Mojave Desert. As Dryden proceeds into the 21st Century, we reflect proudly on our heritage and look to the future of atmospheric flight research where we seek out new opportunities and challenges.

A few years ago, remotely piloted, autonomous, and long duration vehicles were merely concepts and "imagined capabilities." Today, they are the new generation of flying machines – revolutionary technology made real. The men and women of Dryden have played a key role in the development and maturation of these vehicles and Dryden is poised to make even greater contributions in the future.

Dryden will continue to be a forerunner in bringing new ideas and concepts to fruition. Dryden's research efforts will further expand our knowledge of aeronautics and develop the flight research tools and techniques needed for the future. Building on our X-15 and Space Shuttle heritage, we support new access to space technologies needing flight validation in order to demonstrate improved reliability and capability and enhanced safety. Dryden will maintain its leadership position in flight validating NASA technologies that will expand the complex airspace and air transportation systems and reduce pollution and noise to the benefit of society. I am confident Dryden will eagerly take on these challenges and continue doing what we do best –"make known the overlooked and unexpected."

The Dryden Center Implementation Plan provides our customers, partners, product users, and employees a clear vision of our mission and capabilities alignment, roles and responsibilities, and our goals, objectives, and commitments. Dryden's vision within NASA is exciting, and I look forward to the future.



Kevin L. Petersen
Director, Dryden Flight Research Center

Celebrating 100 Years of Powered Flight — A panoramic mural commissioned by NASA Dryden to depict highlights of the first century of flight was unveiled on July 30, 2003 at the world's largest aviation event, the Experimental Aircraft Association's AirVenture 2003 in Oshkosh, Wisconsin. The mural, by aviation artist Robert McCall, depicts a host of milestone aircraft and spacecraft swirling around the original Wright Flyer, symbolically airborne in front of the sun at the dawn of the age of flight, as well as the pilots and astronauts that flew them. The mural will soon grace the front lobby of Dryden's administration building.

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X-1E

I

Dryden in NASA'S Vision and Mission

X-1E Enshrined — On display in front of Dryden's administration building for more than four decades, the X-1E is representative of the early experimental research aircraft that propelled the NACA High Speed Flight Station, now Dryden Flight Research Center, into the forefront of high-speed research. A modified version of the original X-1, the X-1E was flown from 1955 to 1958 to obtain in-flight data at twice the speed of sound, with particular emphasis placed on investigating the improvements achieved with an extremely thin high-speed wing. The X-1E reached a maximum speed of 1,471 miles per hour (Mach 2.24) and an altitude of 73,000 feet.

The purpose of this implementation plan is to document the roles and responsibilities of the Center and provide a detailed review of the capabilities we provide in support of the Agency's programs and projects. Annual performance goals will be documented in the annual insert, Volume 2 of this plan.

NASA Vision

To improve life here,
To extend life to there,
To find life beyond.

Dryden's primary role within NASA is to make breakthrough technology and scientific advances through flight research and concept validation that improves the quality of life for the Nation's citizenry.

NASA Mission

To understand and protect our home planet,
To explore the universe and search for life,
To inspire the next generation of explorers
...as only NASA can.

Within the concept of NASA's Mission, Dryden is a leader in implementing the Aerospace Technology Enterprise's program strategies and fulfilling key support roles for other Enterprises. We build partnerships and alliances with the scientific and technology communities, academia, and industry, tapping into each other's strengths, for our continuing journey of exploration.

We use our programs' content to nurture developing minds. We seek and develop new knowledge that promises to improve lives, enhance security, and stimulate economic growth. We will use our resources to do those things that Dryden is uniquely qualified to do, particularly complementing the capabilities of the other centers. We are committed to innovation and the origination of transformational technologies needed to further enable NASA's ability to achieve its Mission objectives.

Dryden's Commitment to NASA's Transformation Efforts

All investments will contribute to a single set of Agency goals and will be directly traceable to our Vision and Mission.

Dryden shares a vision and a set of values characterized by achievement and the knowledge that the work we do is critical to the Nation.

Human space flight capabilities will be expanded to enable research and discovery.

Dryden will be recognized as the premier flight research and test organization for validating high-risk, emerging aerospace technology concepts.

Technology developments will be crosscutting.

Dryden will perform flight research and technology integration to revolutionize aviation, advance space transportation, and pioneer aerospace technology.

Table 1. Value Alignment

NASA's Core Values†	Dryden's Integration of NASA's Core Values††
	NASA's Core Values are integrated throughout Dryden's Leadership Philosophy, Individual Behavioral, and Operating System Values. These values inspire and drive our actions to constantly achieve what others only imagine. Among our values are these:
Safety NASA's Mission success starts with safety. A commitment to safety permeates everything we do. We are committed to protecting the safety and health of the general public, pilots and astronauts, the NASA workforce, and our high-value assets on and off the ground.	We assure a commitment to safety by employing systems and processes that ensure the safety of the public, the employees, and assets. We ensure safety in all aspects of personal endeavors and we are committed to ensuring the safety of others.
People Our greatest strength is our workforce, a team of highly qualified individuals that is representative, at all levels, of America's diversity. We foster a culture of trust, respect, teamwork, communication, creativity, equal opportunity, and empowerment.	We support personal leadership by employing systems and processes that encourage growth and empowerment, innovation and responsible risk-taking, and freedom to manage, and by providing foundations for higher performance. We respect diversity in culture and experience, and we are fair, open-minded, courteous, and discreet. Together we create a workforce that values people, communicates openly, and expands our knowledge and skills.
Excellence We are committed to excellence. We continuously improve our processes, products, and services to better serve our customers.	We focus on customer satisfaction by being effective, excellent, high value, on-time and budget, consistent, competitive, and service oriented. We have a "can-do" attitude. We are creative, resourceful, proactive, efficient, and courageous, and we strive for win-win relationships. We are a unified organization of diverse, talented, honest, and hardworking professionals, dedicated to safely providing the highest value service and products.
Integrity We are honest and ethical in all that we do. We deliver on our commitments, and we are accountable for our performance.	We reward leadership, management, and technical efforts that align with organization vision, mission, and values. We are accountable, reliable, responsive, disciplined, and dedicated. We believe personal integrity is our most important asset. We are honest, trustworthy, ethical, and respectful of others and ourselves.

†NPD 1000.1c, February 2003 ††Dryden Management System Manual

Education and inspiration will be an integral part of all our programs.

Dryden will capitalize on its unique position to entice and engage educators and students in order to nurture and enhance their technical skills through active participation in our aeronautic and airborne science cutting edge education, research, and flight programs.

We will operate as One NASA in pursuit of our Vision and Mission.

We will achieve One NASA through teamwork within, among, and between organizations and by sharing competencies and knowledge.


180
225
270

II

Dryden Support to NASA'S Enterprises and Themes

Dryden From the Air — A wide range of engineering, laboratory, aircraft maintenance, technical, and engineering support facilities make up NASA Dryden today. This southerly aerial view shows the Dryden campus on the edge of Rogers Dry Lake at Edwards Air Force Base, with the compass rose on the left and the Air Force main base complex above.

The NASA Vision and Mission are the guiding principles for Enterprise and Center strategic planning. Seven strategic and three enabling goals have been defined to focus the Agency's research and development activities to achieve its Vision and Mission in the coming decades. Dryden is aligned with and contributing to these goals and supporting the One NASA philosophy by collaborating with other NASA Centers to meet the Enterprises' objectives. Dryden also teams with other government agencies, industry, and academia to integrate and demonstrate new technological capabilities in flight, "as only NASA can".

Dryden Support to NASA Enterprises

NASA's Enterprises have the principle responsibility for achieving NASA's goals through supporting organizations such as Dryden. Dryden directly supports four of the six Enterprises. Our contributions are described very briefly in the context of our Enterprise roles.

The Aerospace Technology Enterprise
The Aerospace Technology Enterprise (AST) contributes to the NASA Vision as a "technology provider," pioneering and developing advanced aerospace technologies. Within NASA, these technologies enable the other five NASA Enterprises in their far-reaching mission roles. The development of technologies and other enabling capabilities such as advanced tools, engineering processes, and system concepts are accomplished at the AST Centers through the variety of technical and scientific expertise and unique research facilities resident at the Centers.

This Enterprise also helps others use its technology for both aerospace and non-aerospace purposes. In particular, the aeronautics technologies are transferred to other government agencies such as the Federal Aviation Administration (FAA) and the Department of Defense (DoD) to provide leadership in air transportation and access to space. These technologies are used by the aerospace industry to improve safety and environmental compatibility of commercial aircraft, and to enhance military aircraft performance. Technology partnerships with industry and academic entities outside of traditional aerospace fields are also formed to both ensure broad use of NASA technology for greater public benefit and to capture innovative technologies that can be applied to NASA missions. The Aerospace Technology Enterprise is composed of four themes: Aeronautics Technology, Space Launch Initiative, Mission and Science Measurement Technology, and Innovative Technology Transfer Partnerships.

Dryden provides support to all four themes through its conduct and support of flight research. We maintain and operate a variety of research and multi-purpose aircraft to meet the demands of flight research and concept validation.

The Earth Science Enterprise
The Earth Science Enterprise (ESE) seeks to understand and protect our home planet by conducting Earth system observation, research, and knowledge transfer advancing Earth-system science as only NASA can. NASA conducts and sponsors scientific research and technology innovation to answer questions that are on the frontiers of science, that have profound societal importance, and for which our view of the planet can make a defining contribution. To answer the primary questions of "How is the Earth system changing, and what are the consequences for life on Earth?" the ESE has established a strategic approach framework. One of the main components of this framework is the design and implementation of an integrated strategy for observing the Earth by using the satellite, suborbital, and surface-based platforms needed to collect the types and quantities of observations required to research climate, weather, and natural hazards

Dryden's main support of the ESE is through the Earth System Science (ESS) theme whose purpose is to "Understand how the Earth is changing, better predict change, and understand the consequences for life on Earth." In this regard, Dryden operates suborbital platforms for atmosphere-based observations (to complement space-based observations); develops and demonstrates new suborbital platform capabilities to enable new and improved observing methodologies; assists in transferring proven, mature platforms to science partners with operational responsibilities and missions; and validates experiments and demonstrations in support of ESE's technology maturation process.

Space Flight Enterprise
The Space Flight Enterprise (SFE) provides many critical enabling capabilities, including the Space Shuttle, that make possible much of the science, research, and exploration achievements of the rest of the Agency. This includes advancing the boundaries of human and robotic exploration, and providing safe, routine access to space in support of human operations in low-Earth orbit. The Shuttle first launched in 1981, provides the only capability in the United States for human access to space. In addition to transporting people, material, and equipment, the Shuttle allows astronauts to service and repair satellites and build the International Space Station. The Shuttle can be configured to carry different types of equipment, spacecraft, and scientific instruments that help scientists understand and protect our home planet, explore the universe, and inspire the imagination of the American people. Dryden's primary SFE support is in the Space Shuttle Program theme, maintaining and operating the Shuttle's primary alternate landing capability.

Education Enterprise
The Education Enterprise (EE) plays a leading role in NASA's Mission to inspire the next generation of explorers. Serving as the focal point for NASA education planning and implementation, EE conducts program reviews and evaluates the performance of all education programs. The EE mission to inspire students to pursue the study of science and engineering has the ultimate goal of having them choose careers in science, technology, engineering, or mathematics. It is from this pool that NASA will draw its future workforce to fulfill its mission.

EE's Education Program provides a wealth of opportunities for educators and students at all levels of the education system. Dryden's exciting missions provide a one-of-a-kind venue for engaging and inspiring the next generation of explorers in a relevant and stimulating atmosphere. Dryden supports NASA's Education Program theme through programs and technology projects designed to incorporate our research and flight capabilities and activities, with emphasis in reaching under-represented and under-served communities.

The matrix on the next page lists the goals and shows their relationships to budget themes and the Enterprises that implement them. Overlaid on the matrix are Dryden's roles on the One NASA Team.

Dryden Support to NASA's Themes

Enterprises use themes to implement programs and tasks. Themes are the Agency's structure for budget planning, management, and performance reporting. Dryden has primary contributing roles in five themes, substantial support roles with another two, and smaller, but important, roles in three more themes. Additionally, Dryden adds further benefit to the themes and programs it supports by providing meaningful educational and outreach programs to inspire and motivate a great number of students, from diverse populations, to pursue careers in science, technology, engineering, and mathematics. This section provides an overview of our theme roles and involvement.

NASA Goals

Goal 2 - Enable a safer, more secure, efficient, and environmentally friendly air transportation system.

Goal 3 - Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

Goal 10 - Enable revolutionary capabilities through new technology.

- NASA Strategic Plan

Aeronautics Technology
Dryden's heritage and primary focus is atmospheric flight research, which is an essential element of the work conducted under the Aeronautics Technology (AT) theme. The AT theme is the sole administrator of the Agency's aeronautics investments. By developing and transferring technologies, NASA's investments in AT play a key role in creating a safer, more secure, more environmentally friendly, and more efficient air transportation system. The results of this investment, in turn, increase performance of military aircraft and develop new capabilities for science or commercial missions. This theme also enhances the Nation's security through its partnerships with the DoD and the FAA.

Dryden's strategic objectives within the AT theme are to safely conduct, enable, and improve NASA's atmospheric flight research capability. As the Agency's lead for atmospheric flight research, the Center will promote technological innovation, discover new phenomena, and accelerate development of new aerospace concepts. Concept input to the Center can come from a number of sources, including all four themes within the Aerospace Technology Enterprise, industry, academia, and DoD. Flight research areas include advanced propulsion technologies, lightweight high-strength adaptable structures, adaptive

Table 2. Objectives Alignment

NASA 2003 Strategic Plan Objectives Mapping

MISSION		GOALS	Themes: Solar System Exploration (SSE)	Mars Exploration (MEP)	Astronomical Search for Origins (ASO)	Structure & Evolution of the Universe (SEU)	Sun-Earth Connection (SEC)	Earth System Science (ESS)	Earth Science Applications (ESA)	Biological Sciences Research (BSR)	Physical Sciences Research (PSR)	Research Partnerships & Flight Support (RPFS)	Aeronautics Technology (AT)	Education Programs (EP)
			Enterprises: Space Science					Earth Science		Biological & Physical Research			Aero Tech	Ed
Understand and protect our home planet	1	Understand Earth's system and apply Earth system-science to improve the prediction of climate, weather, and natural hazards.	■				■	P	■					
	2	Enable a safer, more secure, efficient, and environmentally friendly air transportation system.											P	
	3	Create a more secure world & improve quality of life by investing in technology & collaborating with other agencies, industry, & academia.							▪		■	■	P	
Explore the universe and search for life	4	Explore the fundamental principles of physics, chemistry, and biology through research in the unique natural laboratory of space.								■	■			
	5	Explore the solar system and the universe beyond, understand the origin and evolution of life, and search for evidence of life elsewhere.	■	■	■	■	■							
Inspire the next generation of explorers	6	Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.	▪	▪	▪	▪	▪	▪	▪	▪	▪	▪	S	P
	7	Engage the public in shaping and sharing the experience of exploration and discovery.	▪	▪	▪	▪	▪	S	▪	▪	▪	▪	S	S
Enabling Goals	8	Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.												
	9	Extend the duration and boundaries of human space flight to create new opportunities for exploration and discovery.		▪						■	■			
	10	Enable revolutionary capabilities through new technology.											P	

Dark Blue = Primary; Light Blue =Supporting

Dryden's Contributions: P = Primary; S = Supporting

controls, advanced vehicle designs, and new collaborative design and development tools. In collaboration with the FAA, research is conducted in air traffic management technologies for new automation tools and concepts of operations. Many vehicle types, including subsonic, supersonic, and remotely operated aircraft (ROA), are addressed. ROA encompasses unmanned and uninhabited aerial vehicles (UAV), remotely commanded vehicles, and robotic aerial vehicles. Dryden supports the AT theme primarily through flight research and demonstrations for the Vehicle Systems and Aviation Safety and Security programs contributing to Goals 2, 3, and 10.

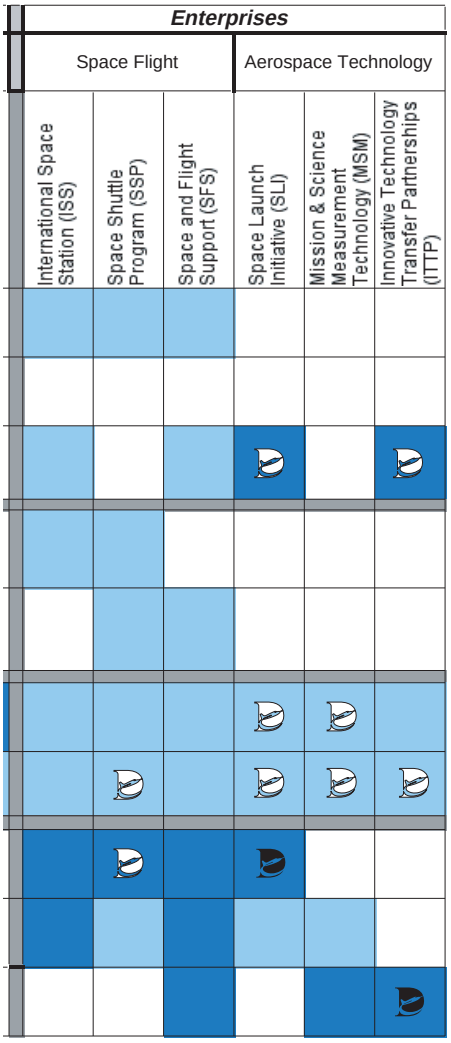
To support our primary mission of flight research and demonstration, Dryden maintains and operates a variety of multi-purpose aircraft. These aircraft are used

- as research vehicles,
- to carry research vehicles to launch altitude,
- to position instruments and experiments in the atmosphere,
- to provide research pilots with airborne simulation opportunities for test maneuver practice,
- to provide safety chase, and
- to provide aerial photography for data and project imagery.

These multi-purpose aircraft are loosely grouped into three categories: Test Bed and Platform aircraft, Support aircraft, and Mission Management aircraft. See Appendix A for more information about the aircraft.

Space Launch Initiative

New space transportation capabilities are needed to ensure that America continues its leadership in space.



The Space Launch Initiative (SLI) theme gives special emphasis to NASA's unique needs, including crew escape and survival systems, which will not be developed by the private sector without Government funding. The initiative is structured to develop technologies to help ensure safe, affordable, and reliable access to space in the critical areas of space transportation and hypersonics. Dryden's contributions to the SLI theme provide primary support to Goals 3 and 8 and come through flight demonstration efforts supporting the Orbital Space Plane and Next Generation Launch Technology programs.

Orbital Space Plane

The Orbital Space Plane (OSP) program is driven in large part by the need to provide transportation to and from the International Space Station (ISS). Dryden's role in the development of the OSP is to help define the requirements of and test an OSP flight demonstrator with regard to safe atmospheric re-entry, approach, and landing. Our roles in OSP flight validation would include:

- applying our expertise to vehicle and systems requirements,
- verifying subsonic performance
- demonstrating Guidance, Navigation, and Control (GNC)/landing systems,
- testing and evaluating competing avionics systems, and
- developing reliability data in a flight environment.

Dryden has a long history of testing the Shuttle for approach and landing data and played a key role in the more recent X-40A approach and landing tests at Edwards. Dryden is also presently providing significant support to SLI/OSP as part of the X-37 flight validation program, with the first atmospheric flight anticipated in late 2004 – early 2005.

Next Generation Launch Technology

Next General Launch Technology (NGLT) program is focused on developing next generation Reusable Launch Vehicle (RLV) technologies, including key investments in propulsion, structures, and operations.

NASA Goals

Goal 3 - Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

Goal 8 - Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

- NASA Strategic Plan

NGLT includes hypersonic vehicles, hot-structures, launch system technologies, propulsion technology, and vehicle systems research and technology development related to hypersonic flight. Specific projects supported by Dryden include Hyper-X (X-43A, B, and C) scramjet engine flight experiments with X-43A flights in late 2003 and 2004 and X-43C and X-43B flights occurring in 2008 or later. Dryden has unique capabilities for launching hypersonic vehicles from the B-52B to initiate the hypersonic flights and, later, with the newly acquired B-52H. Dryden also has unique test facilities and extended range capability for these long-range, high-speed configuration experiments.

Mission and Science Measurement Technology

The Mission and Science Measurement Technology (MSM) theme is responsible for developing crosscutting technology for a variety of aviation and space applications such as communications, power and propulsion systems, microdevices and instruments, information technology, nano-technology, and biotechnology. These technology

Illustration of the X-37 Advanced Technology Demonstrator in a Shuttle cargo bay.

advances will have the potential to open a new era in aviation and allow space missions to expand our knowledge of Earth and the universe. By developing advanced science instruments, sensors, communications, autonomy and data analysis technologies, MSM contributes to NASA's Mission to understand and protect our home planet and explore the universe. MSM technologies are unique to NASA because they focus primarily on space mission applications. Quality and performance requirements usually exceed those of all other potential users and end-use applications may have no known customer outside NASA. By providing support to Goal 10, Dryden contributes to the integration, flight validation, and the technology transfer of intelligent flight control systems to DoD and industry for the Engineering for Complex Systems program.

Innovative Technology Transfer Partnerships

Under the Innovative Technology Transfer Partnerships (ITTP) theme, Aerospace Technology Enterprise (AST) works to form partnerships with industry and academia in order to develop new technology that supports Enterprise programs. AST will also license and transfer NASA technology to U.S. industry through the Small Business Innovation Research (SBIR) and Small Business Technology Transfer (STTR) programs. Dryden contributes to this theme by managing SBIR grants for the Small Business Innovation Research program, contributing to Goal 3.

NASA Goals

Goal 10 - Enable revolutionary capabilities through new technology.

Earth System Science

NASA uses the vantage point of space to observe Earth and understand both how it is changing and the consequences for life. The Earth System Science (ESS) theme works with the science community to answer questions on the frontiers of science that have profound societal importance and for which remote sensing of the Earth can make a defining contribution.

Goal 3 - Create a more secure world and improve the quality of life by investing in technologies and collaborating with other agencies, industry, and academia.

Within the ESS, the Research Program is designed to answer pressing science questions, including: How is the global Earth system changing and what are the consequences for human civilization? How can we predict future changes in the Earth system? The Research Program studies the Earth as a whole system, using measurements made by Earth satellites as well as by suborbital and surface assets.

Through the Research Program, Dryden contributes to Goal 1 by providing a key piece of the suborbital observation mission supporting the Suborbital Science Program. The suborbital environment allows in-situ atmospheric measurements with varying vertical and horizontal resolutions, targeted observations of regional or localized phenomena at high spatial and temporal resolutions, and payload attendance during flight and/or recovery after flight.

Goal 1 - Understand Earth's system and apply Earth-system science to improve the prediction of climate, weather, and natural hazards.

- NASA Strategic Plan

Dryden's continuing suborbital science role is managing the high altitude (above 30,000 feet) portion of the program. This consists of the safe operation and maintenance of core platforms, mission management, payload integration, and the procurement/management of flight hours on new technology and cooperative platforms. Dryden will also support the Suborbital Science Program vision to evolve to new technology platforms and transition mature platforms to science partners with operational responsibilities. Dryden's future support to the Suborbital Science Program will enable new observing capabilities such as extreme endurance missions measured in weeks and distances not feasible by inhabited air vehicles. A new capability such as this can contribute towards answering the questions society poses about our home planet.

Dryden will also position itself to support the Earth Science Applications (ESA) theme. The ESA theme plays a critical role in the transfer of knowledge and technologies to the private sector and society. Dryden will support ESA's effort to benchmark decision support systems and technologies to demonstrate the civil applicability and benefit of NASA's Earth science investment results.

Space Shuttle Program

The Space Shuttle Program (SSP) ensures that the Nation will have reliable, safe, and affordable access to space for our human and robotic explorers and open new exploration and research opportunities through the extension of human presence off the Earth. The Space Flight Enterprise enables research by delivering transportation systems such as the Shuttle, providing operational research facilities in space

[eg. the International Space Station (ISS)], and by providing space communications systems and supporting space infrastructure. Dryden's contribution to Goal 8 is through the Space Shuttle Ground Operations Program as the primary alternate Shuttle landing facility. Our focus is to support program efforts that implement facility and process modifications that will safely return the Shuttle to flight. In addition to ground operations support, Dryden will continue to provide atmospheric flight dynamics consultation and analysis through participation in specialist team activities.

Dryden also provides ongoing on-orbit radar tracking support of the Shuttle, ISS, and other low-Earth orbiting vehicles. Astronaut voice communications and two-way data communications, are provided as well. Video coverage and a full complement of range instrumentation including a mission control room are provided during Edwards Shuttle landings. Dryden's ongoing role will be to contribute to the Shuttle's primacy as the world's most versatile launch system throughout its life cycle and to provide the support needed to the ISS that will help maximize its potential.

Education Program

NASA Goals

Goal 8 - Ensure the provision of space access and improve it by increasing safety, reliability, and affordability.

From the excitement of the countdown to the awe-inspiring images of planets and galaxies, NASA's explorations have a unique capacity to fire the imaginations of young and old alike, but the road to discoveries does not begin at the launch pad; it begins at the classroom door. NASA's Mission "to understand and to explore" depends upon educated, motivated people with the ingenuity to invent tools, solve problems, and have the courage to always ask the next question. It is not enough to depend on the excitement generated by our images. We must capitalize on our progress and achievements in understanding and exploration by providing meaningful educational programs that inspire and motivate students in greater numbers and from more diverse populations to ultimately pursue careers in science, technology, engineering, and mathematics.

Dryden supports the Education Program (EP) through efforts to expand the pool of human capital to meet the Nation's needs for a highly skilled technical workforce while concurrently supporting Dryden's own future research needs, providing a direct and relevant contribution to Goal 6. Through its three thrust areas, pipeline program development, workforce enhancement, and research and development opportunities, we are uniquely positioned to entice and engage educators and students in order to nurture and enhance their technical skills through active participation in aeronautic and airborne science. Workforce enhancement is discussed in Section IV, Dryden Support to Human Capital.

• Pipeline Programs - Dryden's approach is to integrate NASA's education programs and the Center's aerospace education projects. We will implement the Educator Astronaut Program (EAP) and NASA Explorer Schools (NES) using Dryden's mission content. Dryden develops new, innovative technology projects to support our core research and education mission. We also support the Solar System Exploration theme's sponsorship of the FIRST (For Inspiration and Recognition of Science and Technology) Robotics Competition by providing engineers and educators for team leadership and mentoring.

• Research and Development - Universities and industry play a major role in conducting NASA's research and development. Dryden will build stronger partnerships with the academic community to increase the research infrastructure necessary to accomplish our mission using grants, cooperative agreements, contracts, and fellowship programs. The Center's Office of Academic Investments is part of the Dryden Research Council, ensuring that the Education Enterprise's funded student and faculty research programs are aligned with strategic research goals and objectives.

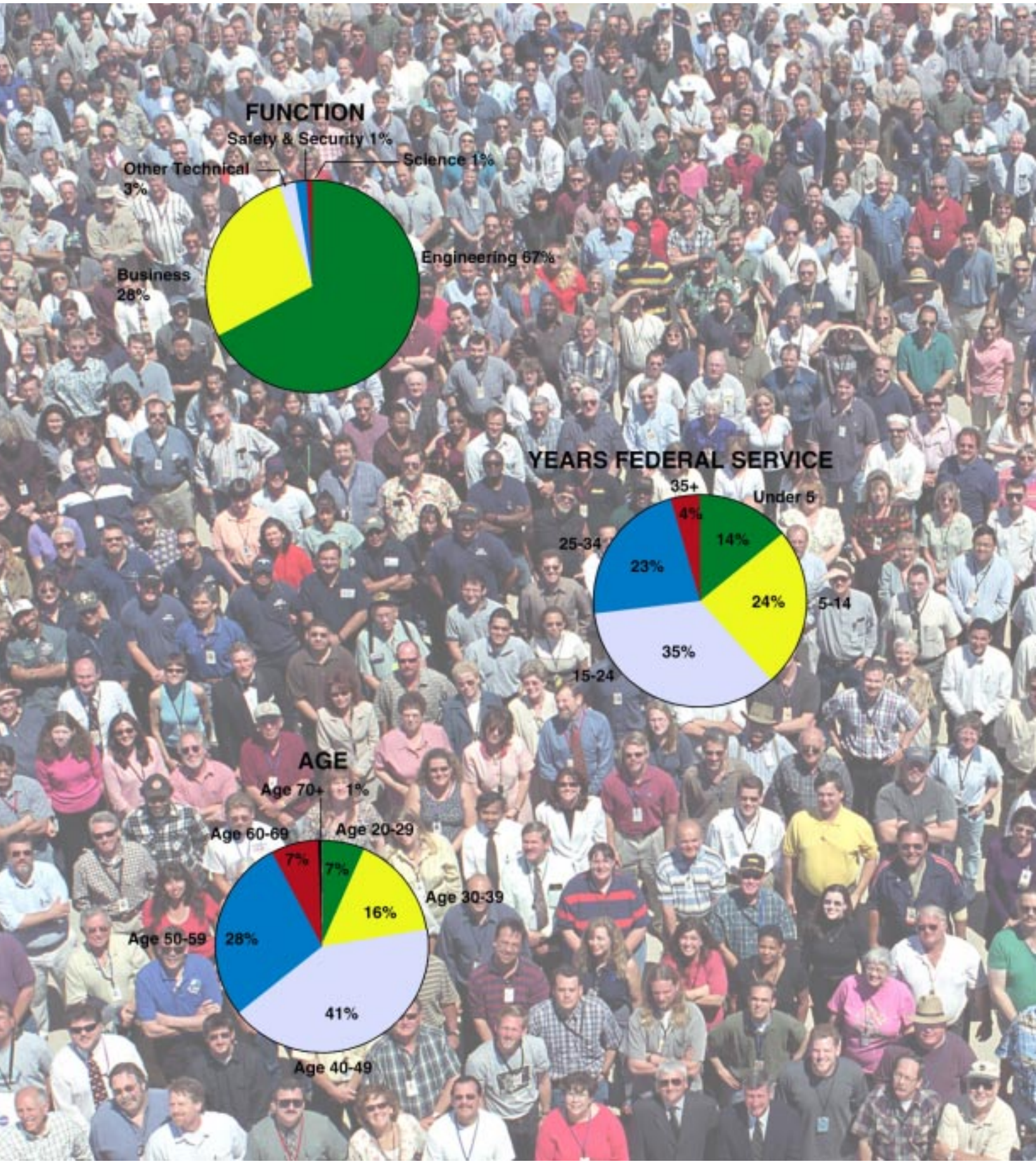
Goal 6 - Inspire and motivate students to pursue careers in science, technology, engineering, and mathematics.

- NASA Strategic Plan

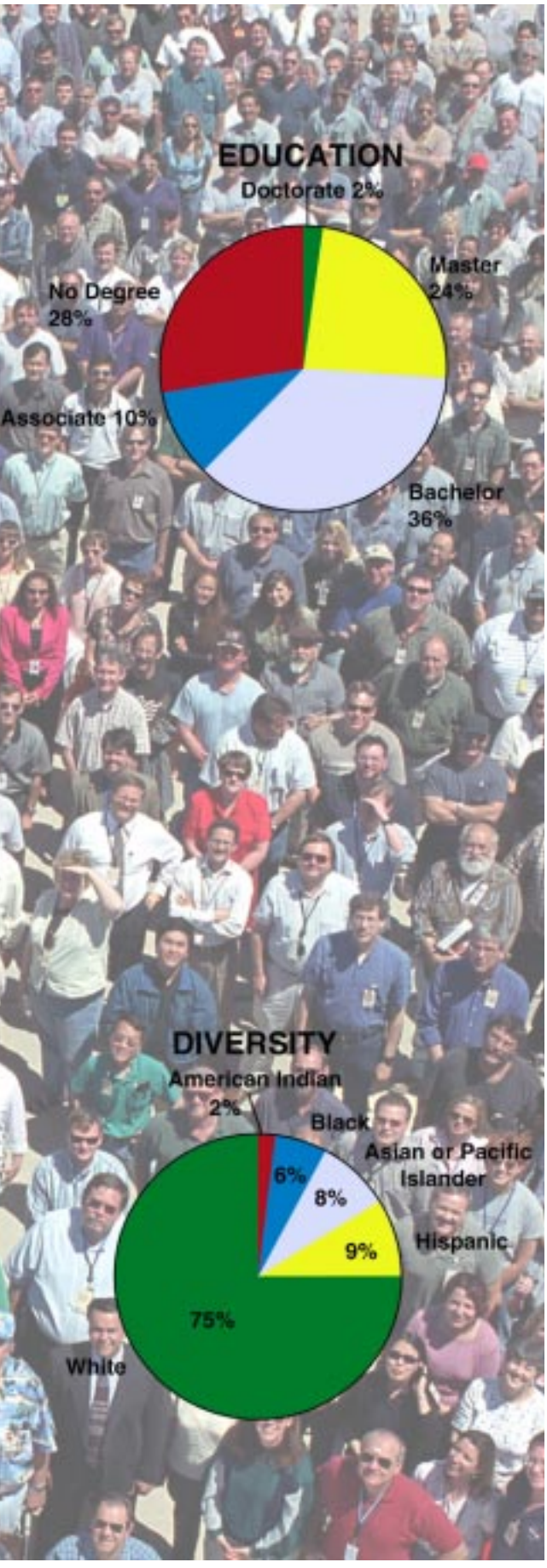
III

Current Dryden Capabilities

Active Aeroelastic Wing — NASA Dryden's highly-modified Active Aeroelastic Wing F/A-18A shows off its form during a 360-degree aileron roll during a research flight. In a 21st-century high-tech update of the Wright brothers wing-warping control system, the Active Aeroelastic Wing project is researching wing aeroelastic flexibility for improved maneuverability, weight reduction, and extended range.



Data for the demographic charts are current as of July 12, 2003 for full time permanent civil servants. The most current information can be found at the NASA People website http://nasapeople.nasa.gov/ under the section labeled NASA Workforce Profile.



To provide substantive support to existing projects in seven Agency themes areas and support to others as required, Dryden has developed world-class capabilities. Dryden's capabilities stem from an expert workforce, world-class facilities and aircraft, flexible management, and a proven operating system. The product of these factors is a set of capabilities that doesn't exist anywhere else and that fills the demanding needs of NASA and the Nation. These are the capabilities that provide Dryden the ability "to fly what others only imagine" and prove and enhance transformational NASA aeronautical concepts and technologies. These are the capabilities that enable NASA discovery.

Workforce

Research and research support at Dryden are performed by nearly 600 civil service employees and approximately 600 onsite contractor support staff working with our partners in other government agencies, industry, and academia. We are bound by a shared set of values that enhance our teamwork and performance. These values are listed in Section 1.

The most up-to-date information can be found at http://nasapeople.nasa.gov

Dryden benefits by being situated in the center of the most extensive and unique concentration of aerospace expertise in the world. A large, diverse pool of independent, corporate, and government aerospace expertise is available to complement our own in-house pool of highly competent, experienced, and dedicated engineers, technicians, pilots, project managers, and support professionals. Dryden has in place the processes and agreements to responsively augment its own expert workforce with world-class capabilities that exist throughout the region.

Real Property Facilities

Dryden is located at Edwards, California, on the western edge of the Mojave Desert, 80 miles north of Los Angeles in the southeast corner of Kern County, California. Dryden, a civilian tenant organization within the boundaries of Edwards Air Force Base, occupies 834 acres. Dryden is on the northwest edge of Rogers Dry Lake, a 44 square-mile area used for aviation research and test operations. The dry lake includes runway lengths up to 7.5 statute miles. An additional 22 square miles of similar smooth clay surface is provided by nearby Rosamond Dry Lake. These dry lakebeds, along with a number of nearby off-base dry lakebeds, are used in support of missions as planned recovery areas for research aircraft and as emergency landing sites for all aircraft tested at Edwards. The absence of large population centers throughout the high desert helps limit problems associated with aircraft noise and flight patterns.

Another distinct Dryden asset is the dry climate, typically warm and dry in the summer and moderately cool in the winter, which results in excellent flying conditions an average of 345 days a year. Edwards Air Force Base, at 2,302 feet Mean Sea Level altitude and approximately 70 miles from the Pacific Ocean, is free of ocean fog and attendant humidity. In addition, because Dryden is a tenant on Edwards, we are able to utilize base-wide services such as fire and rescue services, main runway, taxiways, airfield tower, public roads, and schools.

Since 1946, Dryden has grown from an initial group of five engineers housed in temporary war surplus facilities into a center of approximately 1,200 civil servant and contractor personnel. Dryden now has approximately 966,000 square feet of building space valued at $260M including 559,000 square feet of hangar space, 128,000 square feet of lab space, and 279,000 square feet of office space. To sustain our capabilities, we have aggressively maintained our real property, which has resulted in facilities that are ready for any mission envisioned. This status is typified by a small, very manageable maintenance backlog and small demolition projects.

Dryden's specialized facilities include a unique Flight Loads Laboratory (FLL) used in performing structural loading tests, thermal tests, and large-scale combinations of the two on structural components and complete flight vehicles. The laboratory is also used to calibrate and evaluate flight loads instrumentation under conditions expected in flight.

F-18 Ironbird.

Dryden's Research Aircraft Integration Facility (RAIF) is used to carry out simultaneous checks of flight controls, avionics, electronics, and other systems on a variety of aircraft. It is the only facility of its type in NASA and is designed to speed up and enhance systems integration and preflight checks on all types of research aircraft. Agency and partner access to this facility, along with Dryden's pilots, engineers, scientists, and technicians, has given NASA programs a unique and highly specialized capability to conduct flight research projects unmatched anywhere in the world.

In addition to the RAIF's ability to integrate simultaneous systems checks, the Western Aeronautical Test Range (WATR) can provide concurrent tracking and data acquisition support through a highly automated complex of computer-controlled tracking, telemetry, communications systems, and control rooms. More than 12,000 square miles of special-use airspace over California's high desert are available for research flights with agencies monitoring flights in the area able to link directly to the WATR.

A WATR mission control center.

Other specialized capabilities include:
- a facility to carry out flight research with remotely piloted vehicles,
- an airborne science instrument integration facility,
- a calibration site for earth science imaging instruments,
- a data analysis facility to process flight research data, and
- a Shuttle Mate-Demate Device.

Details of select Dryden real property facilities are included in Appendix A, Dryden Specialized Facilities.

Aircraft

Among the most specialized of Dryden's facilities are its aircraft. Aircraft are the facilities that enable flight research to be conducted in the appropriate medium (atmosphere/transatmosphere) and transition theory from the laboratory and wind tunnels to real-world applications, demonstrating that the results of NASA's research can serve our customers and further NASA's Mission. Dryden's flight research aircraft enable performance verification of the technology, validation of its safety and reliability, and discovery of previously unknown problems.

Dryden has benefited from a very long-term relationship with DoD. By working closely with DoD, Dryden has succeeded in acquiring aircraft that benefit NASA and are no longer required for defense. This has resulted in hundreds of millions of dollars in acquisition cost avoidance because these aircraft are usually transferred to NASA at no cost. We then modify and instrument them to support flight research. The result is that NASA has developed unique, world-class

capabilities to study aeronautical concepts and demonstrate transformational technologies. These Dryden capabilities enable improving the air transportation system and demonstrating space access technologies, while concurrently being a best value to the American public. By recycling aircraft, Dryden leverages the DoD logistics system to keep operations cost more affordable. Examples of this model are Dryden's ability to refresh its mix of support aircraft from 1950s vintage F-104s to 1980s versions of the F-18 and its access to the Navy supply system for current parts and documentation. Dryden will continue to work with DoD to acquire and maintain aircraft capable of safe operation in increasingly complex research missions. A table of current aircraft is included in Volume 2.

Management

Dryden's flexible management style is a key enabler of its capabilities. To best fulfill program commitments and maintain world-class safety for its people and critical facilities, Dryden has formed five strategic business units to focus theme support efforts. Project/Mission teams are formed within the business units to manage commitments. The teams are staffed from a matrix of Dryden's organizations to obtain the right mix of skills and people to implement projects. All levels of management adhere to a unifying philosophy. Components of this philosophy are mentioned in Section 1.

Operating System

Dryden's project teams use an established, yet continually improving, operating system to provide NASA's capability for atmospheric flight operations and flight research. To make this capability possible, we have created and refined innovative flight research techniques. This has resulted in highly developed design, development, production, and operation processes. These processes and the management system are routinely evaluated, have been certified to ISO 9000 Standards since 1999, and are based on Dryden's operating systems values, which are discussed in Section 1.

Integrated Capabilities

Dryden offers NASA and its partners a full range of capabilities that enable effective and efficient execution of flight research missions. Our suite of flight research systems and tools provide the management, support, and engineering skills for the development, safe implementation, and evaluation of flight-test techniques. We also have the ability to develop advanced sensors and instrumentation systems for flight research data acquisition and provide innovative test techniques across aeronautics disciplines to obtain flight research data.

NASA Dryden's highly modified F-15B during an Intelligent Flight Control System project flight.

We can also provide advanced methods, techniques, processes, and simulation systems for piloted and UAV simulations. Among our capabilities is an expansive, safe, and controlled test range with communications, tracking, data, and control rooms. Orbital and suborbital vehicle recovery and low-Earth Orbit (LEO) communications and tracking can also be provided as needed. We are also capable of developing, managing, and implementing new and innovative platforms for suborbital monitoring. Dryden's mission management provides the processes and methods to efficiently and effectively design and execute science missions and deployments.

Safety and risk management development and application form a bedrock capability where the Center provides processes and tool

development to assure the safe flight of unique aerospace vehicles and the analyses and tools to mitigate and minimize the risk of experimental aircraft flight research.

We apply the above capabilities to such areas as experimental vehicle flight research, airborne science missions, and remotely commanded vehicle flight research.

The Altair Unmanned Aerial Vehicle shows off its lengthy high-aspect ratio wing. Photo by: GA-ASI/Alan Waide

Partnerships

Dryden's considerable capabilities are further enhanced by our location on Edwards Air Force Base and longstanding relationships with southern California DoD organizations. Dryden has leveraged our location and working relationship to develop more capability than our organic self and contributed to the capabilities of our DoD partners. Dryden has in place agreements with most DoD elements in the region but has a very special partnering arrangement with Edwards Air Force Base.

Since the beginnings of the flight test operations near Rogers Dry Lake, which pre-dated the establishment of the Edwards Air Force Base (EAFB), NASA's and the Air Force's predecessors forged a history of working together. This relationship was formalized in 1995 with the creation of a union called the Alliance, originally composed of members of Dryden and the Air Force Flight Test Center (AFFTC). In 1999, the Alliance was expanded to include the Air Force Research Laboratory (AFRL) Propulsion Directorate. The purpose of the Alliance is to develop and sustain a working relationship that will improve service and lower costs to the internal and external customers of all parties while preserving the unique missions of each organization.

As a result of the Alliance, all parties have benefited from improved services and/or reduced cost. Shared services of engineers and technicians, shops and laboratories, and flight crew support are benefits gained through the Alliance. An important quality-of-life benefit for Dryden parents is their opportunity to use the Edwards' Child Development Center

One showcase for the Alliance is the use of building 1623, which houses Dryden's Airborne Science Directorate. Two ER-2s, a DC-8, associated shops, experiment integration rooms, a warehouse, and offices are all centrally located within the same building to make this a premier airborne science facility. NASA avoided approximately $14 million in costs by using the Air Force hangar instead of building a new one.

Clockwise from left: Visiting Johnson Space Center WB-57, Dryden ER-2 high altitude science platform, B-52B research vehicle air-launch aircraft, and DC-8 flying science laboratory in building 1623 hangar.


NASA
X-43

IV

Strategic Capabilities for the Future

X-43 Hypersonic Research Vehicle — Hyper-X is an experimental flight-research program seeking to demonstrate airframe-integrated, "air-breathing" engine technologies through a series of demonstrator vehicles. Successful development of these technologies promises to increase payload capacity for future vehicles, including hypersonic aircraft (faster than Mach 5) and reusable space launchers. This is an artist's concept of an X-43 in flight.

NASA has always been a pathfinder organization, discovering new knowledge of earth and space phenomena and inventing the technologies needed for further discoveries. Dryden is also a pathfinder, continually seeking new knowledge about operating aircraft in the atmosphere and inventing flight research concepts and capabilities to continue the quest. We will continue to develop the means to live better and safer in our atmosphere, through innovative research and by developing the advanced capabilities to do it more efficiently and economically.

Dryden Support to Aerospace Technology Enterprise Strategic Objectives

Dryden's role in the Aerospace Technology Enterprise (AST) is to be the world's premier flight research facility to enable discoveries that fulfill NASA's Vision. To sustain that position, we have a focused plan to continually improve our capabilities to accomplish the AST's future mission needs.

Aircraft

To continually improve the Aerospace Technology Enterprise's (AST) flight research aircraft capability, Dryden, in its atmospheric flight operations leadership capacity, will continue its collaboration with DoD. Ongoing efforts are underway to upgrade or replace the current 1980s vintage F-18 support aircraft with aircraft made available through DoD's modernization efforts. Dryden's upgrades are essential to maintain high safety margins and program cost effectiveness and responsiveness. These aircraft will require budget investments to enable flight research. We expect that both the provision of the aircraft from DoD and the need for internal funds will be ongoing. Dryden will continue to work closely with DoD to maintain highly capable support aircraft with the capacity to enable increasingly complex research missions.

Dryden is also actively pursuing the means to keep its platform and test bed aircraft current and relevant to the Nation's needs. One such effort is the acquisition and modification of a B-52H. Dryden, in conjunction with the Air Force Flight Test Center, is modifying a B-52H bomber into a flight research support aircraft. The new air-launch aircraft will boost both NASA and USAF efforts in flight research and demonstrations of advanced technologies for future access to space vehicles. The B-52H will eventually replace the venerable B-52B, which has been in active service since 1955. The B-52H will extend NASA's heavy-lift research aircraft launch capability over 20 years with the added potential of increasing the lift capacity of the B-model's nominal 45,000 lbs to 70,000 lbs. NASA will additionally benefit from the increased reliability and economical maintenance of Dryden's new B-52H. Another effort to increase needed AST capability is the acquisition of a C-20 Gulfstream III aircraft from the Air Force. The aircraft is an ideal, cost effective research test bed to provide NASA, industry, and academia with a long-term capability for efficient test of subsonic flight experiments. Both aircraft are scheduled to be fully research instrumented and ready for program support in 2004.

Western Aeronautical Test Range (WATR)

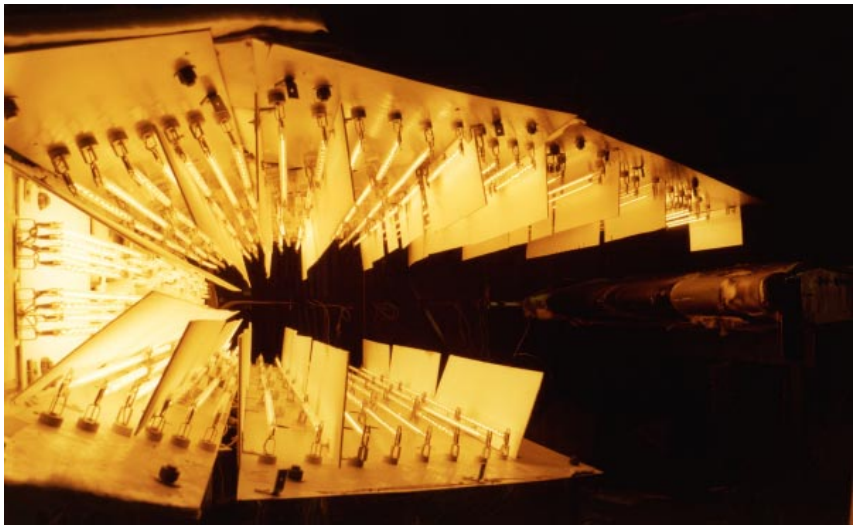
WATR research systems and facilities continue to evolve in keeping with rapid technological developments. Improvements in the method in which data is processed, distributed, displayed, and stored will be made to keep pace with the demands of higher data rates and quantities, customer diversity, and the requirement to interface with remote operations facilities. Mission Control Center (MCC) technology enhancements will make it possible for research projects to complete project goals with significantly fewer missions. To improve efficiency, data will be made available in real-time to locations other than the control room. Mobile systems will be upgraded to keep pace with the demand for remote operations of UAVs and hypersonic test vehicles. The WATR is currently studying satellite tracking and range safety systems to replace ground-based tracking systems in the future.

Research Aircraft Integration Facility (RAIF)

As Dryden continues to collaborate with more partners in industry and other parts of the Agency, the technology used in the RAIF needs to continually respond to the wider range of requirements and users in support of future projects. One of these efforts is to progressively make our simulation and

testing capabilities more easily accessible for project team members throughout the Center as well as those located off-site. While our simulations are already scalable to varying project scopes and budget constraints, these capabilities will continue to become more mobile and platform independent. The growing emphasis on information technology will also help the facility improve its ability to organize and document its simulation capabilities as well as facilitate the transfer of simulation technology outside of Dryden to its research partners.

Flight Loads Laboratory (FLL)



Interior of custom radiant heater for Pegasus wing glove test.

The Flight Loads Laboratory is a unique world-class facility and national asset in which critical structural tests are conducted to support flight research and structures programs of national importance. The FLL is prepared to continue to play an important role in the next generation of flight and structural research of advanced aerospace and hypersonic programs.

Sustaining and enhancing the capabilities of the FLL will enable continued structural test support to critical NASA programs including 21st Century Aeronautics and Access to Space. For example, we are currently in negotiations with Langley Research Center (LaRC), Marshall Space Flight Center (MSFC), and Boeing regarding hot structures testing of X-37 Orbital Vehicle control surfaces. We are the only facility in the country with both the facilities and staffing ready to support this kind of testing.

Our Partnerships with Other NASA Centers, Agencies, and Industry

Although it has expertise in aerospace programs, Dryden does not usually develop programs, but rather focuses on specific flight project areas. Our ability to work in cooperative programs has been a major strength for the Center. Dryden has a long history of cooperative programs such as the X-1 program with the Air Force and, more recently, the X-43A (Hyper-X) with the Langley Research Center, Orbital Sciences, and Micro Craft. Additionally, our Airborne Science program, which operates two ER-2s and a DC-8 for Earth observations, has conducted missions for the Department of Commerce and the Federal Emergency Management Agency. To facilitate those and other missions, we pool resources with science and instrument teams at Ames and Langley Research Centers, Goddard and Marshall Space Flight Centers, and the Jet Propulsion Laboratory (JPL) to enable unique capabilities. Our plans are to increase Earth science UAV technology efforts with the Wallops Flight Facility.

To meet the goals and objectives of the Agency and Enterprises, the Center has a proven track record of working cooperatively with the other NASA Centers. This cooperative activity enables the agency to more effectively utilize unique facilities and capabilities while reducing its reliance on duplicate capabilities where appropriate. As the Agency's lead for atmospheric flight research and validation, Dryden teams with all NASA Centers where atmospheric flight validation and research are required. NASA's program-centric organization requires cooperation, coordination, and communication with and between participating NASA Centers. To this end, Dryden is participating in and expanding our capabilities in the NASA Collaborative Engineering Environment.

A major challenge to our partnering arrangements will be the transition to full cost accounting, budgeting, and management in FY 2004. Dryden will closely work with our customers to educate them on this major change in order to ensure continued cooperation.

Extending Partnerships with Department of Defense

Within the Mojave Desert of southern California lies the most extensive and unique concentration of aerospace test ranges and aerospace expertise in the world. Dryden's plans are to further extend and enhance the partnering opportunities between NASA, the DoD, and commercial and industrial organizations in this unique complex of aerospace entities. Our focus is on developing complementary capabilities, sharing best practices, and being the best value to the Nation. Dryden's primary DoD partnering opportunities are with:

Air Force Flight Test Center

Dryden's plans are to continue to build on the exceptional relationship it has with the Air Force Flight Test Center (AFFTC) by contributing to the joint effort to make the Edwards' complex as UAV friendly as possible and make the Hypersonic Corridor a reality. Dryden has joined with the AFFTC and industry in the AFFTC/Dryden UAV Working Group that is identifying issues that impact UAV operations. The goal within the next three years is to have a UAV friendly operation that will encourage research and test flight opportunities and be the benchmark operation. Also working with the AFFTC Access to Space office, Dryden is collaborating on providing telemetry service to a proposed Hypersonic Corridor for Mach +5 demonstrations potentially needed for future space transportation systems. As an Associate Member of the DoD Range Commanders' Council, Dryden will continue to coordinate its upgrade activities with the Council to ensure standards compatibility and optimize co-utilization of our state-of-the-art facilities.

Air Force Research Laboratory

Dryden has had an on going collaboration with the Air Force Research Laboratory (AFRL) through the Aeronautical Flight Technology/ Research Activities' Strategic Planning Panel and its predecessors. Some of the primary objectives of the panel are to identify potential fixed-wing flight research opportunities, evaluate the potential for joint and interdependent flight research efforts, and promote complementary technology demonstration and research activities. In 1999, the Air Vehicles Department of the Naval Air Systems Command became a partner of the panel. Dryden's efforts in the future will be to reinvigorate the panel to increase collaboration and continue to build on recent AFRL/NASA successes such as the Autonomous Formation Flight and Aerial Refueling research projects at Dryden.

Defense Advanced Research Projects Agency

Dryden works with the Defense Advanced Research Projects Agency (DARPA) to develop technologies and systems that enable multiple robotic aerial vehicles to fly cooperative and collaborative missions. Through Dryden, DARPA has access to some of the most UAV

friendly airspace available, a state-of-the-art range system through the WATR, and a flexible management system that meets their innovative research requirements. Dryden's expertise in systems engineering, project management, and automated systems, teamed with DARPA's expertise in establishing and guiding highly aggressive research and development programs, can support the development of new, agile technical approaches to previously intractable problems associated with multiple autonomous robotic aerial vehicles. Dryden benefits through insight into the technologies, concepts, engineering tools, and processes that DARPA is researching, making this a win-win arrangement for both organizations.

Opposite page top: Entrance sign to Edwards Air Force Base.

Opposite page center: Two Dryden F/A-18 aircraft in AFRL Automated Aerial Refueling project mission.

Opposite page bottom: X-45A Unmanned Combat Air Vehicle (UCAV) technology demonstrator during collaborative NASA Dryden, DARPA, Boeing, Air Force research flight.

This page below: General Atomic-Aeronautical Systems, Inc. Altair. The Altair UAV was jointly developed with NASA for civil applications, such as making Earth observations for scientific purposes.

Naval Air Warfare Center Weapons Division, China Lake

Dryden and the Naval Air Warfare Center Weapons Division (NAWCWD) at China Lake, California, exchange, share, and manage scientific, engineering, and technical research in areas that support both NASA and the Department of the Navy. We will continue to collaborate across the spectrum of ground and flight test engineering, aerospace scientific research and development, modeling and simulation facilities, aerospace vehicle instrumentation, unique aircraft/platform test bed capabilities, and range and mission control assets. Unique opportunities exist to use multiple organizational range facilities for future proof-of-concept testing in a large, remote, and controlled airspace prior to proceeding to implementation. This will include scenarios involving control of multiple types of vehicles (aircraft, spacecraft, and UAVs) in common airspace. These scenarios will be supported by demonstrations of current and future safe airspace control techniques for application to the National Air Space using development and prototyping of rapid vehicle identification techniques, conventional and autonomous flight decision making, and intelligent vehicle systems while in a controlled airspace environment with a mix of conventional and non-conventional flight vehicles. Specific future cooperative project areas will expand in the areas of UAVs, hypersonic propulsion experimentation, unique aircraft hardware design, and fabrication, innovative recovery systems, and analysis.

Dryden Support to Strategic Objectives from Enterprises/Themes

In addition to the capability improvements Dryden will make to fulfill NASA's and AST's long-term goals and objectives, we are making capability improvements needed for near-term requirements. Dryden works closely with theme and program managers to develop the right capabilities when they are needed. Most capabilities cut across many themes and programs, and we will facilitate the teamwork needed to develop the most beneficial capability. Listed next is an example of some near-term capability improvements we are developing.

Uninhabited Aerial Vehicles - Dryden's UAV initiatives will push the new paradigm in Earth System Science experiment construction for aircraft and enable unprecedented atmospheric observational capabilities. Dryden has partnered closely with the ESE science and technology communities to develop a mutually beneficial, collaborative roadmap that addresses anticipated mission needs and technology development plans. Central to this effort are the common objectives of the Aeronautics Technology and Mission and Science Measurements Technology themes where the rapid infusion and checkout of technologies from MSM and the Earth Science Technology Office will provide the first step into space by requiring smaller, smarter (automated/autonomous), more integrated Earth science payloads on cost-effective platforms. In addition, Dryden's RAIF will seek to establish the capability to create and demonstrate standards for common UAV ground control stations. UAVs and other vehicles will become more capable and more relevant checkout platforms for potential space flight systems than most of the current fleet.

Education - The Virtual Flight Loads Laboratory is an education and research program that involves Dryden's engineers, a 4-year university, a community college, and a local middle school. The program's main purpose is to provide educators with unique tools for enhancing instruction by creating a virtual lab to infuse the K-12 education system with opportunities for students to experience the process of discovery with Dryden's cutting-edge technology research and assets and commercially available software. These tools allow participating schools to perform tests through the Internet that typically cannot be conducted in the classroom. The program also includes teaching modules and laboratory test demonstrations that are consistent with national and state science and math standards. While the virtual lab is primarily educational, NASA engineers use this newly developed technological tool for research engineering and demonstrations.

Dryden Support to Human Capital

Dryden strives to attract and retain a diverse, skilled, and professional civil service workforce that possesses the competencies required to achieve the Center's mission and goals. The challenge is to maintain the workforce flexibility needed to respond to the unexpected, while at the same time maintaining the right mix of state-of-the-art competencies to efficiently meet NASA program requirements and provide challenging opportunities in a high-quality work environment. To meet these challenges, Dryden will focus on the following issues:

- Align its workforce to efficiently perform the work of the Center
- Nurture a highly skilled, diverse civil service workforce that embraces continuous learning and skills development by
  - – Recognizing and rewarding teaching and mentoring and
  - – Providing training and development to build needed competencies
- Develop leaders who think strategically, inspire employees, and achieve results
- Provide challenging work and a high quality of work life by
  - – Utilizing workplace flexibilities
  - – Ensuring the appropriate level of empowerment and accountability, and
  - – Optimizing the match of employee skills with organizational need

Dryden's investment in our future workforce will be demonstrated through our continued collaborative efforts led by the Center's Equal Opportunity, Human Resources, and Education professionals. Two examples of these efforts are Dryden's Workforce Enhancement Thrust and AERO Institute.

Workforce Enhancement - In response to the major workforce challenges in science and engineering, Dryden will build stronger partnerships with the academic community and aerospace industry to expand the pool of human capital necessary to maintain and improve the Nation's base in aerospace and airborne science research and development. To foster the development of this workforce, Dryden established the Mathematic, Science, Engineering, and Technology Consortium. The Consortium is composed of local and state governments, private and public industrial partners, a local school system, and a number of the state's academic institutions (university and community college). The main mission of this consortium is to create and maintain a diversified, state-of-the-art technical workforce through high quality science, technology, engineering, and math education programs and strong community partnerships.

Dryden understands that to accomplish its aeronautic and airborne science missions, it is important that its future workforce reflects the full spectrum of the U.S. population, including women, minorities, and under-served populations. With this in mind, Dryden pays particular attention to ensuring diversity in its educational programs.

Aerospace Research, Education, and Operations Institute (AERO Institute) - In 2001, the Agency conducted the Strategic Resources Review with the purpose of developing an integrated, long-term Agency plan to ensure a national capability to support NASA's Mission. As part of this activity, Dryden established the AERO Institute to produce the next generation aerospace technical workforce by enlisting the combined forces of federal, state, and local government, industry, and academia.

Dryden Support to Real Property

The Center develops its Construction of Facilities (CoF) program in coordination with all Center functional organizations. The main focuses from the Enterprises' standpoint are the Aerospace Project and Airborne Science Offices. At yearly Program Operating Plan calls, inputs are solicited from all organizations. These inputs represent their facility needs as known from their respective Enterprises. Since Dryden has a single mission—atmospheric flight operations—most of its programmatic requirements are needs for hangar space, including special system requirements for ground test and validation in preparation for flight. In addition, we coordinate very closely with the Alliance in meeting programmatic requirements through their respective Facilities Utilization Boards. The Alliance's Facilities Integrated Project Team evaluates the common facility requirements and utilization. A prime example is the Memorandum of Agreement established with the AFFTC for their building 1623 to house the Dryden Airborne Science program.

Dryden will support the Agency's future by continuing to aggressively maintain its real property, its relevance to new programs, and continually improve its real property management processes. To stay ahead of project requirements, project managers' regular communication with facility planners will be ongoing. We will maintain the process of yearly real property reviews to evaluate facility utilization, condition, and ability to meet project requirements. Facility managers will continue to work with senior management to align and prioritize institutional and programmatic needs. Results of these efforts will be published annually in Volume 2 of this Center Implementation Plan.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NASA

V

Implementing Strategies

Airborne Science in Action — Dryden's Airborne Science aircraft supported the Earth Science Enterprise's international SAGE III Ozone Loss and Validation Experiment (SOLVE) in Kiruna, Sweden. One of Dryden's two ER-2 high-altitude science aircraft is prepared for a mission and the DC-8 airborne laboratory takes off from Kiruna on a SOLVE mission.

NASA developed implementing strategies to improve its planning and management activities. Dryden is committed to these management strategies as part of its continual improvement process. Through these, we will reinforce the management foundation necessary to further Dryden's innovative flight research excellence while maintaining our unwavering commitment to safety and fiscal responsibility.

Management and Institution Excellence

IS-1 - Achieve management and institutional excellence comparable to NASA's technical excellence.

Human Capital
Our people are the most important resource in accomplishing Dryden's Mission. We, along with the rest of the Agency and the Federal government, face major challenges due to the wave of potential retirements in the next five years and the current lack of sufficient workforce to take their places. Along with this internal challenge, we are faced with the external challenge of a severe shortage of college graduates in the science and engineering fields. Another unique challenge at Dryden is our remote location and desert climate, usually not deemed the most favorable attributes of a place to live. Given these challenges, we are participating with the Agency in their efforts to stem these negative tides via the Agency's Strategic Human Capital implementation plan. Our goal is having the right people in the right place and at the right time. Maintaining the most efficient and economic balance between the various components of this working alliance is a major goal of the Center. As such, use of scarce civil service resources is reserved for those competencies and skills required to perform tasks that are appropriate only for NASA civil servants and for those pipeline positions required to preserve proficiency in core competencies. Currently, we are targeting the majority of our hiring on new graduates and at-risk competencies as well as refocusing our recruitment efforts to improve our diversity. We are also examining ways to improve our mentoring activities and developing mechanisms to share valuable lessons learned with our employees. We have much work to do, but we are focused in our efforts and forging ahead.

Competitive Sourcing
The goal of competitive sourcing is to ensure the most efficient use of taxpayer dollars for doing the Federal government's work. In 2001, we developed a competitive sourcing plan to transition identified commercial work currently accomplished with civil service personnel to the private sector. By transitioning that work to the private sector, we are able to redeploy these civil service positions to key core competency skill areas, further helping to fill the gaps identified in the assessment of future staffing needs.

Financial Management
Our key activity in this area is the implementation of the Core Financial module of the Integrated Financial Management Program (IFMP). Initial accomplishment of this implementation at Dryden took place in June of 2003. This IFMP system will, for the first time in NASA's history, provide a single, state-of-the-art, integrated accounting system for all Centers. Along with implementing a common system, our Agency-wide business processes have been reviewed and reengineered to ensure consistency and standardization. The completion of the core financial module implementation corrects a major weakness for NASA as identified by the Office of Management and Budget.

Budget and Performance Integration
At the Center level, the corresponding Integrated Budget Performance Document (IBPD) is Volume 2 of the Center Implementation Plan (CIP). Volume 2 will identify specific performance metrics associated with accomplishing our program budgets. These metrics will be reviewed on a regular basis at the Dryden Program Management Council and Center Management Council reviews.

Electronic Government
Dryden supports the Agency goal of implementing the e-Government Act as part of its overall strategy for information technology. As the Agency's Centers align with the goals of the e-Government Act, their information technology systems become more interdependent. To help achieve the

goals of the e-Government Act, Dryden is actively participating in several Agency information technology initiatives: the Enterprise Architecture working group, the XML working group, the Account Management working group, and the NASA Shared Services Center. Dryden will support other efforts as they emerge.

Dryden has gone to extraordinary lengths to ensure that its IT system integrates with the Agency's Integrated Financial Management system. Also, Dryden is supporting the One NASA Web Portal by matching existing public content with the architecture of the Agency Portal, and new public web content is being created with the architecture of the Agency Portal in mind.

Institutions and Asset Management
As stated earlier, Dryden's real estate assets are valued at $260 million. With our transition to full cost accounting, service pool and line managers are carefully scrutinizing all facilities and services to ensure their most efficient use. This will result in more competitive rates for our customers.

Information Technology Leadership

IS-2 - Demonstrate NASA leadership in the use of information technologies.

The Agency strategy is to implement the following objectives by 2005:

1) Provide all NASA operations with secure, highly reliable, interoperable information systems.
2) Enable NASA people to communicate across an integrated, low-cost Information Technology (IT) infrastructure.

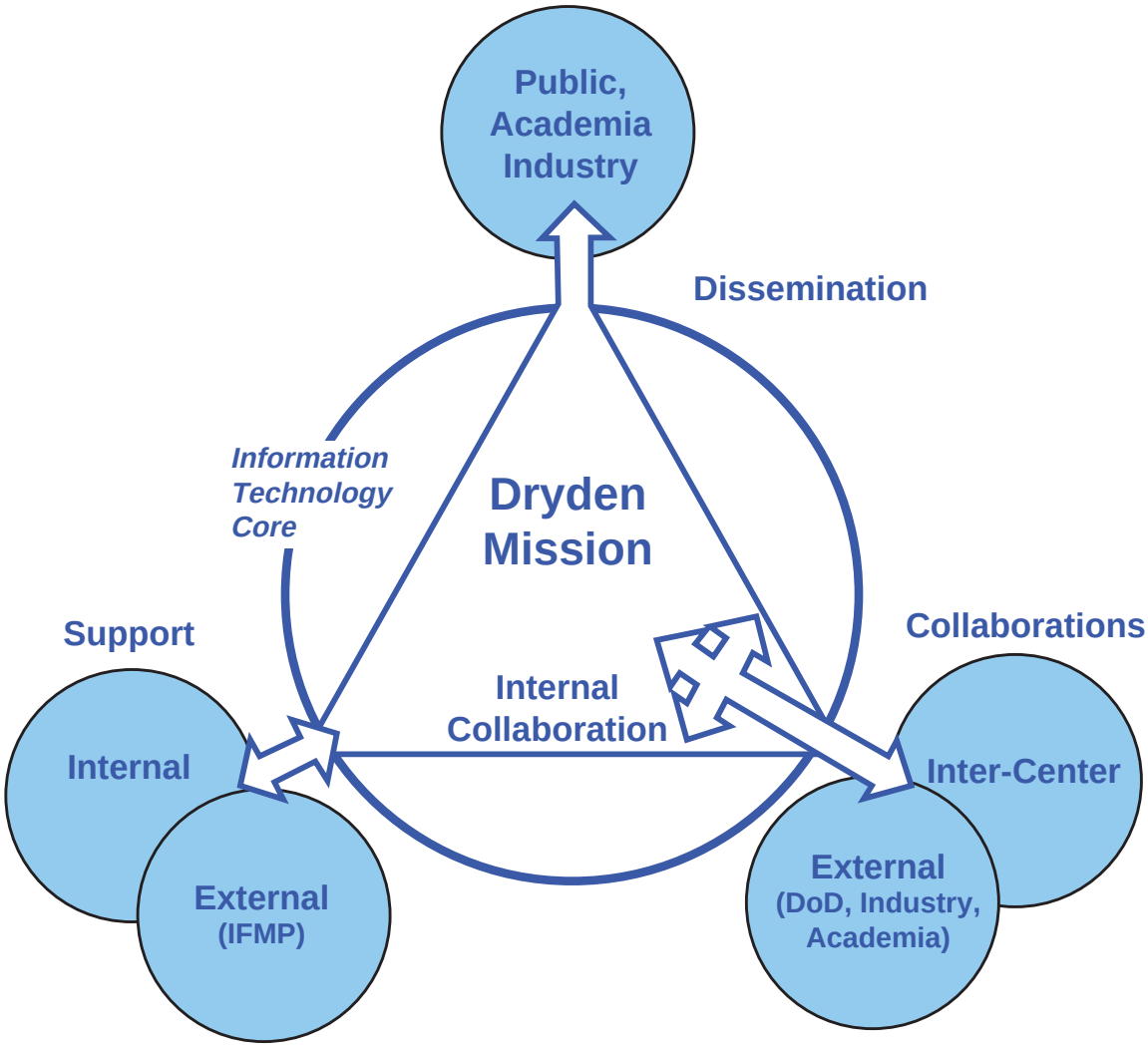


Figure 1 - Information Technology Model

3) Design and operate a One NASA network to improve organizational interactions and foster improved collaboration and sharing of accumulated NASA knowledge assets.
4) Establish systems to deliver superior information services to consumers, educators, students, researchers, and the general public as well as to government agencies, NASA contractors and suppliers, and other businesses.

The Dryden Information Technology (IT) Model

Dryden's IT implementation is influenced by the Agency's information technology strategy as well as the need to perform the Dryden Mission. Dryden's IT implementation seeks to achieve the Center's Mission requirements and align with the Agency's strategy as illustrated in Table 3. Dryden will embed key IT values throughout the model. These values include security, reliability, manageability, user friendliness, openness, and economy.

Table 3. IS-2 Model

	DFRC Objective	Methodology
Core Technology		
	To provide enabling information technologies for Dryden to perform its Mission and to communicate effectively with internal and external partners and customers. ➢ Agency IT Objective Alignment: 1, 2, 3, 4	Providing • An interoperable desktop to every user • A reliable and fast network • High-speed, remote access to critical systems • Adequate and scalable back-end services • Information Technology security
Communication Interfaces		
Dissemination	To provide scientific and research information and technology to the public, to academia, and to the aerospace industry in a timely manner. ➢ Agency IT Objective Alignment: 4	• Utilizing XML and other open standards for publishing reports and information • Developing a taxonomy of our data products and associated XML schema that allows for the broadest use of those products • Providing information products through the Agency's web portal
Collaborations		
Internal	To provide information systems that allow internal and external collaboration of project and business information and data. ➢ Agency IT Objective Alignment: 1, 2, 3	Providing • Secure digital space for all flight projects that conforms to a project template, is searchable, and is available long after a project is complete • Secure, isolated access to export-controlled flight data
External	To provide information systems that allow internal and external collaboration of project and business information and data. ➢ Agency IT Objective Alignment: 1, 4	Providing • Secure, digital space (e.g., web portals, etc.) for all flight projects to share information and data with external partners • Secure access to external partner's information systems when necessary
Inter-Center	To provide information systems that allow internal and external collaboration of project and business information and data. NOTE: Inter-Center means between Centers. The difference is that the systems used for Inter-Center collaboration have different requirements than those for collaborations with business partners; therefore, they are separate. ➢ Agency IT Objective Alignment: 1, 2, 3	• Using open and common file and data standards across the Agency • Providing a common, cross-Agency authentication method • Providing user account management and network resource access through Lightweight Directory Access Protocol (LDAP) that is coordinated across the Agency • Implementing common information technologies throughout the Agency • Being a pathfinder for evaluation of new capabilities and emerging technologies • Sharing best local practices and policies among Centers
Support	To provide information systems that allow the mission to be accomplished and to provide an interface between the institutional support organizations and the organizations providing direct mission support. ➢ Agency IT Objective Alignment: 1, 2	Providing • Digital space (e.g., web portals, etc.) for support organizations to communicate information to the Center • Reliable access to the Agency-wide business system

To understand the scope of the information system required to perform Dryden's Mission, it is necessary to understand what the mission is, who accomplishes it, and the communication interfaces necessary to get it accomplished. The three fundamental communication interfaces in the information model-dissemination, collaborations, and support-are shown in Figure 1. These critical interfaces are enabled by an Information Technology Core and need to be clearly defined and aligned with the Agency strategy.

Core Capabilities, Safety, and Mission Success

IS-3 - Enhance NASA's core engineering, management, and scientific capabilities and processes to ensure safety and mission success, increase performance, and reduce cost.

Dryden missions involve performing flight research and managing experimental vehicle projects, managing airborne platforms, integrating experiments for Earth science measurements, and supporting Shuttle and ISS operations. The majority of the Dryden workforce is involved in engineering and technical management supporting these missions. It is critical that the Center maintain high performance in management, engineering, and technology to accomplish its mission with efficacy. Project managers are constantly challenged to fully use their experience and expertise to ensure flight project safety and technical performance while reducing schedule and cost. Dryden uses Agency guidance, such as NPG (NASA Policy and Guidance) 7120.5A, and state-of-the-art tools to assure the highest quality in the formulation, approval, implementation, and evaluation of its projects.

Dryden is committed to excellence in all its projects and missions. It participates in the Enterprises' program formulation and approval processes to the maximum extent possible to ensure incorporation of "end tester/user" requirements leading to the highest probability of success for its projects and missions. During the life cycle of a project, Dryden's knowledgeable personnel participate in formulation, implementation reviews, and performance evaluation.

To ensure that Dryden achieves flight research project success and efficiency, the Center will
- Participate early in program/project development to ensure incorporation of flight research requirements;
- Improve our systems engineering capability and ensure that all Dryden flight projects follow system engineering best practices; and
- Establish a management approach that can be tailored to the needs of individual projects, based on safety, scope, complexity, cost, and accepted risk.

It is the responsibility of the Center's Chief Engineer/Systems Management Office (SMO), the Director of Research Engineering, and the Director of Safety and Mission Assurance to ensure that our engineering and technological tools, capabilities, and processes are ready to meet the Center's demanding challenges.

Assured Work Environment

IS-4 - Ensure that all NASA work environments, on Earth and in space, are safe, healthy, environmentally sound, and secure.

Dryden has a diverse, sophisticated workforce and a high-risk mission. Our programs and projects rely on unique resources, both aircraft and human. We rely on well-defined initiatives, constant vigilance, and effective communication to ensure that our projects are conducted safely, securely, and in an environmentally sound manner. This critical focus allows us to securely control risk, improve quality, enhance mission success, and more effectively manage cost and schedule across the Center.

At Dryden, safety, security, and environmental programs are driven by our management's and employees' commitment to making Dryden's work environments safe and secure – for aircrews,

the public, and the Dryden workforce – in our industrial, ground, and flight research operations. Our management and employees reflect this commitment, both in organization structure/responsibilities and in attitude. Our safety commitment spans industrial, environmental, quality, and system safety issues. Our security commitment spans physical and information technology, and our medical and employee assistance programs span the physical and psychological needs of the community of employees.

To this end, Dryden will pursue the following objectives:
- Prevent injuries from occurring during the course of activities;
- Work closely with other local, state, and federal agencies to try to remove all security threats to Dryden civil service and contractor personnel, facilities, and information;
- Protect Dryden physical assets and information technology from damage or theft;
- Eliminate the incidents of occupational health problems from our workforce;
- Maximize physical and psychological well being when and where necessary;
- Eliminate environmental incidents, toxic chemical use, hazardous waste, and environmental liability;
- Maintain a comprehensive safety mishap prevention program with full management support and employee participation;
- Sustain our record performance of zero lost time injury rate over 3 years; and
- Sustain comprehensive System Safety and Quality Assurance processes on programs/projects throughout their life cycle.

The Center Director is responsible for establishing and maintaining the programs to assure that these goals are effectively met. However, ultimate responsibility for world-class safety, security, and health programs is vested in each and every Dryden employee.

Effective Risk Management

IS-5 - Manage risk and cost to ensure success and provide the greatest value to the American public.

By the very nature of its Mission, Dryden undertakes unique and challenging programs that are inherently high risk. To ensure national aerospace preeminence, Dryden will continue to aggressively pursue new cutting-edge technology through flight research in a safe, effective, and timely manner.

In the course of Center activities, decisions are required that impact programmatic, technical, and safety issues. It is imperative that managers and other decision makers have both the tools and the information to understand the risks involved with decision alternatives. They must be able to assess options in terms of risk and arrive at a risk-informed decision.

Dryden uses available Agency tools and provides additional tools and training to ascertain risks associated with decision making for our projects. In his role as the ultimate acceptor of risk, the Center Director, through Center management, is responsible for ensuring that our decision makers have superior program management and technical risk management tools.

To achieve this goal, Dryden will ensure that NASA and other program and risk management tools are provided to decision makers, that they are trained in the use of those tools, and that they have the information required to continuously and effectively manage and communicate both technical and programmatic risk.

Managing cost and predicting cost impacts to projects and programs is also a risk challenge. We have an obligation to accurately and openly assess costs throughout the program life cycle and to report them openly and in a timely manner.

Dryden will adopt the new NASA standard cost estimation and management systems. We will also utilize NASA developed improvements for cost estimation and management of our programs and projects.

Center management is responsible for communicating Agency policy throughout the Center and ensuring that the Center uses established best practices for risk management. The Safety and Mission Assurance Office Chief is responsible for ensuring that safety risk management tools are available to individual project managers for informed risk-based trade-off decisions. The Dryden Director of Aerospace Projects is responsible for ensuring that the required processes are in place for accurate, timely cost estimation and management as well as monitoring risk based trade-offs.


NASA

Appendices

Homeward Bound — The Space Shuttle Atlantis, atop NASA's 747 Shuttle Carrier Aircraft in the Mate-Demate Device, is preparing for the return to Kennedy Space Center. NASA Dryden continues to support the human space flight program by serving as an alternate landing site for the Shuttle fleet and as the site of atmospheric flight testing of future space-access vehicles.

Appendix A: Dryden Specialized Facilities

Multi-purpose Aircraft

Test Bed and Platform aircraft are used to carry instruments of all types to a specific point in the atmosphere or in space to gather research data or launch research vehicles. Dryden has a variety of test bed aircraft with capabilities that can be customized to meet the needs of NASA, DoD, industry, and academia. Current test bed aircraft include B-52 (B&H models), F-15B, Gulfstream-III (G-III), and Beechcraft King Air. Since 1959, the B-52B heavy launch aircraft has provided a unique capability for aerial launch of research aircraft from the X-15 to the X-38. The B-52H started missions in 2003. The F-15B is the ideal research test bed for supersonic and highly dynamic flight environments. The G-III and King Air aircraft are cost-effective test beds for experiments in subsonic and less dynamic flight environments. Some test bed aircraft can be reconfigured as research aircraft when an advanced concept requires a highly integrated approach. A representative list of this type of research vehicle at Dryden includes F-18 Automated Aerial Refueling, F-18 Active Aeroelastic Wing, F-15 Active, and the C-17.

The Support aircraft consist of five high-performance F-18 jets and one twin turbo prop King Air, which are used for safety chase, photo chase, airborne simulator, pacer, small experiments carrier, and pilot proficiency. These aircraft are necessary to aid the research aircraft in performing their missions safely, swiftly, and efficiently.

A third category of aircraft is Mission Management aircraft used to provide cost effective transportation from one government location to another. A table of Dryden Aircraft is included in Volume 2 and on the web at http://www.Dryden.nasa.gov/Gallery/.

Flight Loads Laboratory (FLL)

The Flight Loads Laboratory supports a broad spectrum of flight research programs for NASA, DoD, private industry, and other aerospace organizations. It is used to perform structural loads and thermal tests of structural components and complete flight vehicles as well as combined structural loads and thermal tests. It is also used to calibrate and evaluate flight loads instrumentation under conditions expected in flight.

The FLL consists of a large high-bay test area with adjacent laboratories, offices, and storage space. The 164 by 120 foot reinforced concrete floor contains tie-down slots to anchor test setups and is accessed from the entry ramp by a 136 by 40 foot door. The open area for testing is approximately 146 x 113 square feet. A 5-ton overhead rail crane with a maximum hook height of 39 feet services the entire test area floor. The FLL incorporates systems for mechanical and thermal structural testing, as well as for data acquisition and test control. The main test area can be viewed from the data acquisition and test control room, which is on the second floor. Instrumentation and electronic support laboratories are also available. Additional features of the FLL include closed-circuit television for remote monitoring, a public address system, and a headset audio communications system.

For more information, go to: http://www.dfrc.nasa.gov/Research/Facilities/FLL/index.html

Test setup for strain gage calibration loading.

The Dryden Walter C. Williams Research Aircraft Integration Facility (RAIF)

Named after Walter C. Williams, Dryden's Director from 1946 to 1959, the RAIF is designed to effectively and efficiently support aircraft testing and maintenance in Dryden's flight research programs. The RAIF includes two expansive hangers, partitioned as required, for various aircraft projects. Aircraft technicians, maintenance crews, and operations engineers are housed in office space located between the two hangars. Overlooking the hangar floors, high-fidelity engineering simulations are located on the second floor of the RAIF, including an area for the simulation technicians. The front of the RAIF has two stories of office space for flight research staff including simulation and systems engineers, dynamics and controls engineers, structures engineers, facility management, and computer support specialists. The RAIF also includes several small-to-large sized conference rooms

The facility provides an environment for conducting efficient and thorough testing of advanced, highly integrated research aircraft. It hosts a variety of functions supported by state-of-the-art equipment for high-fidelity flight simulation, vehicle-in-the-loop automated testing, remotely augmented vehicle operation, remotely piloted vehicle operation, ground vibration testing, and routine aircraft maintenance.

For more information, go to: http://www.dfrc.nasa.gov/Research/Facilities/RAIF/index.html

Aeronautical tracking facility.

Western Aeronautical Test Range (WATR)

The WATR provides research systems and facilities to support atmospheric flight operations and low-Earth orbit missions undertaken by NASA and other users by supplying a comprehensive set of resources for

- Control and monitoring of all flight activities,
- Real-time acquisition and reduction of research data, and
- Effective communication of information to flight and ground crews.

Working closely with the AFFTC at Edwards Air Force Base, the WATR provides access to special-use airspace covering approximately 12,000 square miles of mostly desert area. Designated areas assigned for spin and dive tests and corridors for low, medium, and high altitude supersonic flight are also available.

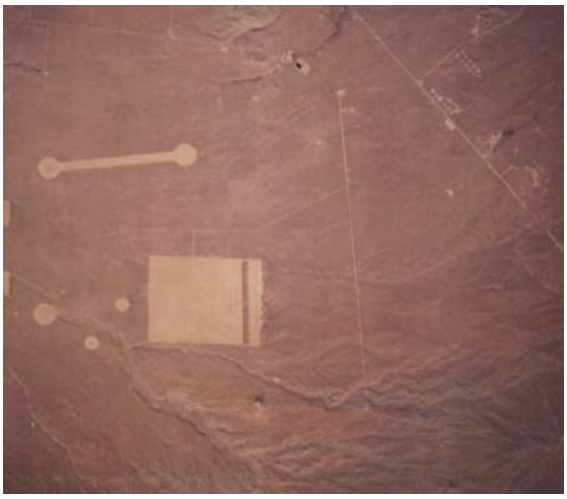
Two aeronautical tracking facilities provide tracking, telemetry downlink, command uplink, and video downlink capabilities. An outlying communications facility provides voice communications between pilots and ground controllers as well as flight termination system capabilities for UAVs. Long-range optical trackers provide broadcast quality, high-definition television and infrared images. In addition, a large secure area within the Dryden main building is set aside for real-time data processing and data monitoring in several Mission Control Centers (MCCs). Mobile systems provide communications, video, and telemetry support for specialized requirements. An extensive network of communication, fiber optic, and satellite systems is used to relay radar, audio, video, and telemetry data among Dryden facilities, other NASA centers, other government agencies, and private industry. The WATR can adapt to meet the requirements of a wide range of test articles including Reusable Launch Vehicles (RLVs) that require extended range coverage beyond the boundaries of the local range complex.

For more information, go to: http://www.dfrc.nasa.gov/Research/Facilities/WATR/index.html

Airborne Science Experiment Integration Facility (EIF)

The EIF is a suite of specialty rooms for visiting experimenters to set up, test, and integrate their science and support instruments with airborne science aircraft. There are six secure rooms capable of supporting up to 30 instrument teams, each equipped with internet connections, phones with voice mail, work benches, and chemical and equipment storage lockers. All specialty rooms have access to aircraft-like power (28vdc/20 amp and 115vac/400hz/3-phase/20 amp) to simulate installed conditions, as well as numerous conventional power outlets including 208vac/3 phase/60hz/30amp and 115vac/60hz/30 amp.

The EIF also includes an ER-2 experiment integration simulator that provides the experimenter with off-aircraft access to major ER-2 payload areas and power for electrical, control and fit checks. Most of the rooms have laser curtains for laser instrument set-up and bench check and one equipped with a fume hood, shower, and eye wash to support toxic chemical use. The 6,000 square foot EIF is easily reconfigured to accommodate a wide variety of science teams and is highly integrated into the airborne science facility with two rooms having direct access into the hangar and all six being close to program support personnel and the shipping office.



Top: An EIF specialty room with laser curtains.

Bottom: Image of PB-8 taken from an ER-2 at 65,000 feet.

Absolute Radiometric Calibration Site (ARCS)

The ARCS consists of parts of Rogers Dry Lake and the 2.8km x 1.8km calibration site is located approximately 19km east of the lakebed. Both are clearly visible from Landsat 7 imagery. The collaborative Dryden-Edwards AFB facility complements the Stennis Space Center's Modulation Transfer Function calibration site. Available calibration site data sets include spectral aerosol optical thickness, columnar water vapor, local meteorological data, and a reflectance file. Information regarding spectral optical depth and columnar water vapor data is available at http://aeronet.gsfc.nasa.gov.

Space Shuttle Support Facilities

The Space Shuttle Mate-Demate Device (MDD) at NASA's Dryden Flight Research Center is a large gantry-like steel structure used to hoist the orbiters off the ground during post-landing servicing operations and during mating and demating operations with the 747 Shuttle Carrier Aircraft (SCA). The facility consists of two 100-foot towers with stationary work platforms at the 20-, 40-, 60- and 80-foot levels on each tower and a horizontal structure mounted at the 80-foot level between the two towers. The horizontal unit cantilevers 70 feet out from the main tower units and controls and guides a large lift beam that attaches to the orbiters to raise and lower them. Three large hoists are used to raise and lower the lift beam. Two of the hoists are connected to the aft portion of the lift beam and one hoist is attached to the beam's forward section. The three hoists operate simultaneously in the hoisting process. Each of the three hoists has a 100,000-pound lift capability. Operating together, the total lifting capacity of the three units is 240,000 pounds (120 tons).

The Space Shuttle hangar, near the MDD, is a single-bay, 25,000 square-foot structure 170 feet deep, 140 feet wide, and 80 feet high.

NASA uses two modified Boeing 747 jetliners originally manufactured for commercial use as Shuttle Carrier Aircraft (SCA). One is a 747-100 model, while the other is designated a 747-100SR (short range). The two aircraft are identical in appearance and in their performance as Shuttle Carrier Aircraft. The 747 series of aircraft are four-engine intercontinental-range, swept-wing jumbo jets. The SCAs are used to ferry space shuttle orbiters from landing sites back to the launch complex at the Kennedy Space Center and also to and from other locations too distant for the orbiters to be delivered by ground transportation. The orbiters are placed atop the SCAs by Mate-Demate Devices.

For more information, go to: http://www.dfrc.nasa.gov/Newsroom/FactSheets/FS-014-DFRC.html

Subscale Flight Research Facility (Model Shop)

The Subscale Research Facility is used to evaluate innovative and unusual concepts for less expense than with full-scale systems and to assess the performance of various systems and sensors in a flight environment. The shop's primary capability is the design, fabrication, and operation of subscale flight

vehicles. Vehicle design includes aerodynamics, propulsion, structures, and 2-D CAD drawings. Fabrication uses both classic model materials and composites. Radio uplink, servo controls, and other vehicle systems are included in the fabrication. Basic machining is accomplished within the model shop. Ground testing and flight operations are conducted in a safe manner using established model operating procedures. Photo documentation and written reports provide normal documentation. In addition, experimenters often obtain flight data using their onboard instrumentation and data logging system.

Appendix B: Abbreviations and Acronyms

AERO	Aerospace Research, Education, and Operations Institute
AFFTC	Air Force Flight Test Center, Edwards AFB, California
AFRL	Air Force Research Laboratory
AFRL/PR	Air Force Research Laboratory/Propulsion Directorate
AT	Aeronautics Technology
AST	Aerospace Technology Enterprise
CAD	Computer Aided Design
CoF	Construction of Facilities
DARPA	Defense Advanced Research Projects Agency
DoD	Department of Defense
EAP	Educator Astronaut Program
EE	Education Enterprise
EIF	Experiment Integration Facility
EP	Education Program
ESA	Earth Science Applications
ESE	Earth Science Enterprise
ESS	Earth System Science
FAA	Federal Aviation Administration
FLL	Flight Loads Laboratory
FY	Fiscal Year
IBPD	Integrated Budget Performance Document
IFMP	Integrated Financial Management Program
ISO	International Organization for Standards
ISS	International Space Station
IT	Information Technology
ITTP	Innovative Technology Transfer Partnerships
JPL	Jet Propulsion Laboratory
LEO	Low Earth Orbit
MCC	Mission Control Center
MDD	(Shuttle) Mate-Demate Device
MSFC	Marshall Space Flight Center, Huntsville, Alabama
MSM	Mission and Science Measurement (Technology)
NACA	National Advisory Committee for Aeronautics
NAWCWD	Naval Air Warfare Center Weapons Division
NES	NASA Explorer Schools
NGLT	Next Generation Launch Technology
NPG	NASA Policy and Guidance
OSP	Orbital Space Plane
RAIF	Research Aircraft Integration Facility
ROA	Remotely Operated Aircraft
SBIR	Small Business Innovation Research
SCA	Shuttle Carrier Aircraft
SFE	Space Flight Enterprise
SLI	Space Launch Initiative
SMO	Systems Management Office
SSP	Space Shuttle Program
STTR	Small (Business) Technology Transfer

UAV	Uninhabited Aerial Vehicle
WATR	Western Aeronautical Test Range
XML	Extensible Markup Language

Appendix C: Reference List

NASA Homepage
http://www.nasa.gov/

About NASA Website (Budget, Strategic Plan, Performance Report)
http://www.nasa.gov/about/budget/AN_Budget_04_detail.html

Office of Policy and Plans
http://www.hq.nasa.gov/office/codez/plans.html

Office of the Chief Financial Officer
http://ifmp.nasa.gov/codeb/library/library.htm

Dryden Flight Research Center Public Homepage - "...to separate the real from the imagined."
http://www.dfrc.nasa.gov/

Dryden Flight Research Center Internal Homepage
http://xnet.dfrc.nasa.gov/

Aerospace Technology Enterprise Homepage - Enabling the Future of Air and Space Transportation
http://www.aero-space.nasa.gov/

Earth Science Enterprise Homepage - Destination Earth
http://www.earth.nasa.gov/

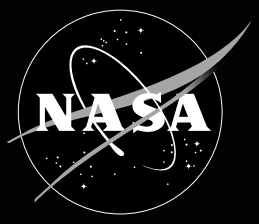
Office of Space Flight Homepage - Welcome to the Future of Space Flight
http://www.hq.nasa.gov/osf/

Education Enterprise Homepage - "To Inspire the Next Generation of Explorers...As Only NASA Can."
http://www.education.nasa.gov/

Office of Human Resources Homepage - NASA People
http://nasapeople.nasa.gov/

Integrated Financial Management Program Homepage
https://access.ifmp.nasa.gov/pc/

Federal Enterprise Architecture Program Management Office Homepage
http://feapmo.gov



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