Required Supplementary Stewardship Information

Heritage Assets

DEPARTMENT OF DEFENSE CONSOLIDATED
HERITAGE ASSETS
For Fiscal Year Ended September 30, 2003

Categories	Unit of Measure	As of 10/01/02	Additions	Deletions	As of 9/30/03
Museums	Each	261		105	156
Monuments & Memorials	Each	1,464	79		1,543
Cemeteries & Archeological Sites	Sites	25,592	110		25,702
Buildings & Structures	Each	18,929	320		19,249
Major Collections	Each	10	1		11

Heritage Assets are real and personal property with "national" importance due to significant historical (e.g., buildings on the National Registry of Historical Buildings), natural, cultural, educational, artistic, or architectural (e.g. aesthetic) value. Heritage Assets can include museums and/or their collections, art and other collections, archival records, cemeteries, monuments and memorials, and archeological sites.

The FY 2003 categories are defined as follows:

Museums. Buildings that house collection-type items including artwork, archeological artifacts, archival materials, and other historical artifacts. The primary use of such buildings is the preservation, maintenance and display of collection-type Heritage Assets.

Monuments and Memorials. Sites and structures built to honor and preserve the memory of significant individuals and/or events in history.

Cemeteries and Archeological Sites. Land on which gravesites of prominent historical figures and/or items of archeological significance are located.

Buildings and Structures. Includes buildings and structures that are listed on, or are eligible for listing on, the National Register of Historic Places, including Multi-Use Heritage Assets. These buildings do not include museums.

Major Collections. Significant collections that are maintained outside of a museum.

The processes used to establish items as having heritage significance vary among categories and types of assets. Subject matter experts, criteria such as listing on the National Register of Historic Places, and Federal statutes, all play a significant role in characterizing these assets.

The condition assessment of Heritage Assets is based on whether the assets are being cared for and safeguarded in accordance with relevant regulations. The Department's Heritage Assets are in acceptable or good condition and are appropriately safeguarded.

Heritage assets that are also used for general government operations, such as the Pentagon, are classified as Multi-Use Heritage Assets and are reported as both Heritage Assets and Balance Sheet items.

Supplemental information pertaining to Army, Navy and Air Force Heritage Assets follows.

Department of the Army

The Army museum system consists of 117 museums and museum activities worldwide. In addition, historical property is displayed in numerous locations, e.g., regimental and trophy rooms, officers clubs, visitor centers, and chapels. Also, the U.S. Army Corps of Engineers manages one major collection of historical memorabilia, including artifacts and records.

Department of the Navy

The Navy-wide Heritage Asset Management System has been implemented, and has unified the collections management process for Naval Heritage Assets, including historical artifacts, archival items and artwork. The Department of the Navy is in the process of evaluating and cataloguing each of its items.

Department of the Air Force

The United States Air Force Museum, located at Wright-Patterson Air Force Base, Ohio, houses the main collection of historical artifacts that are registered as historical property in the Air Force museum system. The other Air Force museums are considered Air Force Field Museums or Heritage Centers. These entities also contain items of historical interest; some however, are specific to the general locality.

Stewardship Land

DEPARTMENT OF DEFENSE CONSOLIDATED
STEWARDSHIP LAND
For Fiscal Year Ended September 30, 2003
(Acres in Thousands)

Land Use	As of 10/01/02	Additions	Deletions	As of 9/30/03
1. Mission	16,747	--	65	16,682
2. Parks and Historic Sites	1	--	--	1
Total	16,748		65	16,683

Stewardship Land is land that is not acquired for, or in connection with, items of General Property, Plant and Equipment. All land, regardless of its use, provided to the Department from the Public Domain, or at no cost, is classified as Stewardship Land. Stewardship Land is reported in physical units (acres) rather than cost or fair value.

Nonfederal Physical Property

DEPARTMENT OF DEFENSE CONSOLIDATED
NONFEDERAL PHYSICAL PROPERTY
Annual Investments in State and Local Governments
For Fiscal Years 1999 through 2003
(In Millions of Dollars)

Categories	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
Transferred Assets:					
National Defense Mission Related	$20	$5	$95	$7	$85
Funded Assets:					
National Defense Mission Related	$17	$7	$20	$21	$11
Total	$37	$12	$115	$28	$96

The Department incurs investments in Nonfederal Physical Property for the purchase, construction, or major renovation of physical property owned by state and local governments, including major additions, alterations, and replacements, and the purchase of major equipment; and the purchase or improvement of other physical assets. In addition, Nonfederal Physical Property Investments include federally-owned physical property transferred to state and local governments.

Investment values included in this report are based on Nonfederal Physical Property outlays (expenditures). Outlays are used because current DoD accounting systems are unable to capture and summarize costs in accordance with Federal Accounting Standards Advisory Board requirements.

Department of the Army

The total reported transferred asset values are for non-cash items that were transferred to state and local governments by the Department of the Army. These properties are essential in accomplishing the mission of the Army National Guard. The Army National Guard funds maintenance costs for these nonfederal assets.

Department of the Air Force

The total reported funded asset values are Air National Guard investments in Military Construction Cooperative Agreements. These agreements involve the transfer of funds and allow joint participation with states, counties, and airport authorities for construction or repair of airfield pavements and facilities required to support the flying mission assigned to civilian airfields.

Investments in Research and Development

DEPARTMENT OF DEFENSE CONSOLIDATED
INVESTMENTS IN RESEARCH AND DEVELOPMENT
Annual Investments in Research and Development
For Fiscal Years 1999 through 2003
(In Millions of Dollars)

Categories	FY 1999	FY 2000	FY 2001	FY 2002	FY 2003
1. Basic Research	$1,115	$812	$1,311	$1,356	$1,444
2. Applied Research	2,985	3,095	3,843	4,311	4,388
3. Development					
A. Advanced Technology Development	4,444	3,753	4,383	4,604	5,080
B. Demonstration and Validation	6,564	6,557	8,166	10,525	11,928
C. Engineering and Manufacturing Development	7,934	8,353	8,831	9,500	11,234
D. Research, Development, Test & Evaluation Management Support	3,146	2,954	2,946	3,351	3,210
E. Operational Systems Development	9,801	10,124	11,000	11,804	12,289
4. Other	1,636	1,906	--	--	--
Total	$37,625	$37,554	$40,480	$45,451	$49,573

DoD Research and Development programs are classified in the following categories:

Basic Research is the systematic study to gain knowledge or understanding of the fundamental aspects of phenomena and of observable facts without specific applications, processes, or products in mind.

Applied Research is the systematic study to understand the means to meet a recognized and specific national security requirement. It is a systematic application of knowledge to develop useful materials, devices, and system or methods.

Development takes what has been discovered or learned from basic and applied research and uses it to establish technological feasibility, assessment of operability, and production capability. Development is comprised of five stages defined below:

1. Advanced Technology Development includes development of subsystems and components, and efforts to integrate subsystems and components into system prototypes for field experiments and/or tests in a simulated environment.

2. Advanced Component Development and Prototypes includes efforts necessary to evaluate integrated technologies, representative modes or prototype systems in a high fidelity and realistic operating environment.

3. System Development and Demonstration includes programs that have passed Milestone B approval and are conducting engineering and manufacturing development tasks aimed at meeting validated requirements prior to full-rate production.

4. RDT&E Management Support includes research, development, test and evaluation efforts and funds needed to sustain and/or modernize the installations or operations required for general research, development, test and evaluation.

5. Operational Systems Development includes development efforts to upgrade systems that have been fielded or have received approval for full rate production. The activities include hardware and software upgrades for major weapons systems, information and communications networks, and other major end-items.

Investment values included in this report are based on Research, Development, Test and Evaluation (RDT&E) outlays (expenditures). Outlays are used because current DoD accounting systems are unable to capture and summarize costs in accordance with the Federal Accounting Standards Advisory Board requirements.

Representative program examples for each of the major Research and Development categories are as follows:

Department of the Army

Basic Research:

Defense Research Sciences. This program sustains U.S. Army scientific and technological superiority in land warfighting capability, provides new concepts and technologies for the Army's Future Force, and provides the means to exploit scientific breakthroughs and avoid technological surprises. It fosters innovation in Army niche areas and where the commercial

incentive to invest is lacking due to limited markets. It also focuses university single investigators on research areas of Army interest. The in-house portion of the program capitalizes on the Army's scientific talent and specialized facilities to expeditiously transition knowledge and technology into the appropriate developmental activities. The extramural program leverages the research efforts of other government agencies, academia, and industry, ultimately translating into a coherent, well-integrated program that is executed by the five primary contributors: 1) the Army Research Laboratory, which includes the Army Research Office; 2) the Research, Development and Evaluation Command Research, Development and Engineering Centers; 3) the Army Corps of Engineers Research and Development Center; 4) the Army Medical Research and Materiel Command laboratories; and 5) the Army Research Institute.

The basic research program is coordinated with the other Military Services via the Joint Directors of Laboratories panels, Project Reliance, and other interservice working groups. The program responds to the scientific and technological requirements of the DoD Basic Research Plan by enabling the technologies that can significantly improve joint war fighting capabilities. Projects involve basic research efforts directed toward providing fundamental knowledge for the solution of military problems related to long-term national security needs. The work is consistent with Transformation Planning Guidance, the Army Science and Technology Master Plan (ASTMP), the Army Modernization Plan, and the Defense Technology Area Plan (DTAP).

University and Industry Research Centers. This program leverages research in the private sector through Collaborative Technology Alliances (CTA), Centers of Excellence, and the University Affiliated Research Centers. A significant portion of the work performed within this program directly supports Future Force requirements by providing the enabling technologies which will make development of Future Force equipment possible. CTAs are innovative alliances among government, industry and academic organizations to exploit scientific and technological breakthroughs and to transition these breakthroughs to exploratory development and applied research. This program includes the Army's Centers of Excellence, which couple state-of-the-art research programs at academic institutions with broad-based graduate education programs to increase the supply of scientists and engineers in materials science, electronics and rotary wing technology. Also included is eCYBERMISSION, the Army national web-based competition to stimulate interest in science, math and technology in middle and high school students. This program also includes the Institute for Soldier Nanotechnologies (ISN) at the Massachusetts Institute of Technology. The ISN will emphasize revolutionary materials research for advanced soldier protection and survivability. A Biotechnology Center of Excellence was established in 2003. The Institute for Collaborative Biotechnologies will broaden the Army's use of biotechnology to non-medical areas such as the development of materials, sensors, and information processing. The Army's Institute of Creative Technologies (ICT) is also included in this program. The ICT is a partnership with academia and the entertainment and gaming industries to leverage innovative research and concepts for training and design. Examples of specific research of mutual interest to the entertainment industry and the Army are technologies for realistic immersion in synthetic environments, networked simulation, standards for interoperability, and tools for creating simulated environments. Historically Black Colleges and Universities and Minority Institution Centers of Excellence also address critical research areas

for Army Transformation. Work is consistent with Transformation Planning Guidance, the ASTMP, the Army Modernization Plan, and the DTAP.

Applied Research:

This program matures technologies for the Army Transformation as related to High Energy Laser (HEL) weapon systems. Potential HEL weapon system missions in the areas of Information Dominance and Force Protection include countering airborne electro-optical sensors and defending against airborne threats, providing a new, low cost per shot, complement to conventional offensive and defensive weapons. At weapon system power levels, solid-state laser (SSL) technology has the potential to enhance Future Combat Systems survivability by defeating Precision Guided Munitions.

A key project within this program is the development of a multi-hundred kilowatt (kW) SSL laboratory demonstrator. This project will demonstrate a 15-25 kW diode-pumped SSL breadboard in 2004. By 2005, the Army will evaluate this concept against alternative SSL technology approaches being supported by the High Energy Laser Joint Technology Office High-Power Solid-State Laser program. The most promising technology will then be upgraded to a 100kW SSL laboratory device, scheduled for completion in 2007. The project will continue to mature the selected SSL technology into a multi-hundred kW laboratory device. The program element contains no duplication with any effort within the Military Departments. The work is consistent with Transformation Planning Guidance, the ASTMP, the Army Modernization Plan, and the DTAP.

Combat Vehicle and Automotive Technology. This program researches, investigates and applies combat vehicle and automotive technologies that will improve survivability, mobility, sustainability, and maintainability of Army ground vehicles. As combat vehicle systems become smaller and lighter to provide the necessary strategic deployability and tactical mobility, one of the greatest technological and operational challenges is providing adequate protection without reliance on heavy passive armor. This challenge will be met using a layered approach, substituting long-range situational awareness, multi-spectral signature reduction, active protection systems and advanced lightweight armor for conventional armor. This program also advances technologies for critical power, propulsion and electric components, including energy storage, power distribution and pulse forming networks. This program adheres to Tri-Service Reliance Agreements on advanced materials, fuels and lubricants, and ground vehicles, with oversight and coordination provided by the Joint Directors of Laboratories. This program is coordinated with the Marine Corps through the Naval Surface Warfare Center and with other ground vehicle developers within the Departments of Energy, Commerce, Transportation, and the Defense Advanced Research Projects Agency (DARPA). Work is consistent with Transformation Planning Guidance, the ASTMP, the Army Modernization Plan, and the DTAP.

Development

Combat Vehicle and Automotive Advanced Technology. The goal of this program is to mature and demonstrate leap-ahead combat vehicle automotive technologies to realize the

Army's vision and enable transformation to the Future Force. The Future Combat System, the Army's top priority Science and Technology program, is the primary effort funded here in support of Army Transformation. A Memorandum of Agreement between the Army and DARPA delineates the collaborative enabling technologies, cost-shared funding profile and responsibilities associated with this partnership.

This program supports maturation and demonstration of enabling technologies in the areas of survivability, mobility and intra-vehicular digital electronics, and funds efforts to integrate and evaluate diverse vehicle technologies matured by the Army, other DoD agencies, and industry. These advanced technologies are demonstrated in coordination with Army warfighter organizations through vehicle component and system level technology demonstrations. The program adheres to Tri-Service Reliance Agreements on advanced materials, fuels and lubricants, and ground vehicles with oversight and coordination provided by the Joint Directors of Laboratories. This program is coordinated with the Marine Corps through the Naval Surface Warfare Center, the Naval Research Laboratory, Air Force Armaments Command, and other ground vehicle developers within the Departments of Energy, Commerce, Transportation and DARPA. Work is consistent with Transformation Planning Guidance, the ASTMP, the Army Modernization Plan, and the DTAP.

Army Test Ranges and Facilities. This program provides the institutional funding required to operate the developmental test activities required by Department of the Army weapons systems developers and Research, Development, and Engineering Centers. This program provides resources to operate Army's Major Range and Test Facility Bases: White Sands Missile Range, New Mexico; Aberdeen Test Center, Aberdeen Proving Ground, Maryland; and Yuma Proving Ground, Arizona.

This program also provides the resources to operate the Army's developmental test capability at: Aviation Technical Test Center, Fort Rucker, Alabama; and Redstone Technical Test Center, Redstone Arsenal, Alabama. It also provides the resources for test planning and safety verification and confirmation. Developmental test capabilities at the test range have been uniquely established, are in place to support test and evaluation requirements of funded weapons programs, and are required to assure technical performance, adherence to safety requirements, reliability, logistics supportability, and quality of materiel in development and in production. This program sustains the developmental test and evaluation capability required to support all elements of Army Transformation, as well as Joint Service or other Service systems, hardware, and technologies.

Department of the Navy

Basic Research:

Light Emitting Devices. The first-generation display based on polymers that conduct electric current and emit light is being produced and distributed for evaluation. These polymers called "organic light-emitting diodes" (OLED) are self-emissive, by eliminating the need for background lighting that is used in conventional liquid-crystal displays, yet producing a crisp,

sharp image. OLEDs also support moving images and offer wider viewing angles without image inversion or loss of contract ratio. Products using this type of technology have the potential of producing such items as computer displays, lighted faces of cell phones, and personal digital assistants.

Designer Proteins. Proteins designed to follow marching orders are the latest in the new field of "synthetic biology," where scientists can create certain organisms to perform specific tasks. A new technology that is being developed would enable plants to change color in the presence of chemical and biological agents. A new computational method for designing sensor proteins is the key. Plants that detect groundwater pollution around chemical facilities, for example, and react by changing color, could be feasible in the near future. A variety of uses are possible from this research such as a TNT-sensing protein to assist the U.S. Navy's underwater robots with locating and disarming explosion devices.

Applied Research:

Applied Research is the systematic study to gain knowledge or understanding necessary for determining the means by which a recognized and specific need may be met. It is the practical application of such knowledge or understanding for the purpose of meeting a recognized need. This research points toward specific military needs with a view toward developing and evaluating the feasibility and practicability of proposed solutions and determining their parameters. Major outputs are scientific studies, investigations, and research papers, hardware components, software codes, and limited construction of, or part of, a weapon system to include nonsystem specific development efforts.

The following are two representative program examples for the above major category.

Abrupt Wing Stall. For the past 50 years, all aircraft that can operate at velocities near the speed of sound, and angles of attack near maximum lift, have experienced some form of uncommanded lateral motion or abrupt wing stall. The aircraft undergoes a one-sided or side-to-side upset from the intended direction of flight. At the very least, it causes loss of advantage. At its worst, it could result in a loss of the aircraft. The question that this project researched was the following: why did the F/A-018E/F jet fighters experience abrupt wing stall (AWS) when the F/A-18C/D jet fighters did not? A team of scientists and engineers conducted high-speed wind tunnel tests, performed hundreds of computational fluid dynamics calculations, and conducted both piloted and un-piloted simulations of AWS models. An AWS simulation model was developed and flown on a flight simulator. Both qualitative and quantitative simulation data were compared with actual flight test results. The team successfully developed new tools and procedures for an early assessment of an aircraft's susceptibility to AWS. These tools and procedures include experimental, computational, simulation, and flight test figures of merit that can indicate if a new aircraft design will be vulnerable to AWS anywhere in its flight envelope.

Naval-Commercial Test Kit (NACTEK) Water Test Kits. The NACTEK water test kits to improve the Department of the Navy's water-quality program. This effort sets an example of how the Operational Forces, Naval Research Science and Technology Action Team, Office of

Naval Research program staff, and research scientists can work together as a team to develop a process that made use of commercial-off-the-shelf products rather than a Navy-developed system that would require extended development.

Development

Submarine Acoustic Warfare Development. A Submarine Defensive Warfare System is being developed to improve the effectiveness and survivability of all classes of naval submarines. Acoustic Interception consist of developing a new acoustic sensor, the Sparsely Populated Volumetric Array that will improve the performance of acoustic intercept systems. It will also provide a ranging capability for submarines through Acoustic Rapid commercial-off-the-shelf Insertion and Advanced Process build software improvements. Next Generation Countermeasures are also part of this effort.

SSN-688 and Trident Modernization. In this program, the Department of the Navy scientists continued the design and integration efforts of the Common Submarine Radio Room (CSRR) in support of the OHIO class submarines. In addition, they began the CSRR conversion of the TRIDENT Land-Based Evaluation Facility into a CSRR configuration, which will support all classes of submarines. The scientists also completed environmental and qualification testing consisting of airborne/structure borne noise, TEMPEST, humidity, overpressure, temperature, shock, inclination, and drip in support of Multifunctional Crypto System.

Department of the Air Force

Basic Research:

The Air Force's Basic Research program funded basic scientific disciplines that are core to developing future warfighting capabilities. Funding was provided to twelve different scientific project areas. These focused on atmospherics, biological sciences, chemistry, electronics, fluid mechanics, human performance, materials, mathematical and computer sciences, physics, propulsion, space sciences, and structures. One example is the development of technology that could be the breakthrough for a new generation of computers (quantum computers). The Air Force Research Lab (AFRL) demonstrated the ability to stop light and release it again without losing any of its original characteristics. This development could lead to a breakthrough in nonlinear optics with applications from telecommunications to imaging, which could be useful in designing ultra-sensitive optical switches. In another example, AFRL researchers developed a new mathematical theory that would result in a new radar wave that would aid in rapid and accurate target identification through foliage and beneath soil, better than any radar currently in use.

Applied Research:

The Air Force Applied Research program is developing technologies to support the air and space force of the future. Technology developments are focused in those areas that are essential to these warfighting capabilities. This investment strategy allows the Air Force to focus on those

military-relevant technologies that are not being developed by industry. (1) One example is the F119 turbine engine case redesign using a new casting process, with a predicted lifecycle cost savings of 35 percent. The redesign makes extensive use of thin-wall castings in place of the existing complex, multi-walled, and diffusion-bonded sheet metal assemblies. The Air Force is now looking at this technology for use on other aircraft engines. Example two, AFRL recently achieved a milestone in wireless Internet communications with the first commercial installation of the Space Communications Protocol Standards (SCPS) transport gateway over National Aeronautics and Space Administration's Advanced Communications Technology Satellite. The SCPS transport gateway offers up to several times the bandwidth utilization efficiency of ordinary internet protocols.

Advanced Technology Development

The Air Force Advanced Technology Development program demonstrates, in a realistic operational environment, integrated sets of technology to prove military worth and utility. The first example was the Air Force and DARPA accomplishing the first Unmanned Combat Air Vehicle flight. This successful flight test demonstrated the command and control links between the aircraft and a mission-oriented ground station. The AFRL then demonstrated a 330 Gigahertz detector that operates at frequencies billions of times faster than the blink of an eye. This technology will be used to produce compact solid-state circuits operating at Terahertz frequencies. Likely technology application would be to enable a new generation of sensors to enhance homeland security.

Demonstration and Validation – The Air Force Advanced Component Development and Prototypes programs are comprised of system specific advanced technology integration efforts accomplished in an operational environment to help expedite transition from the laboratory to operational use. One example of the AF's Demonstration and Validation effort is: The Command and Control System – Consolidated (CCS-C) program. The CCS-C will replace the aging S-Band Command and Control Segment (CCS) that is currently used for the command and control of Military Satellite Communications satellites (MILSATCOM) by the 50th Space Wing (50SW) at Schriever Air Force Base. The CCS-C system selected will drastically reduce the sustainment costs that would have been needed to maintain the aging CCS and offers tremendous enhancements to ease our satellite operators' workload, enabling accurate and efficient control of MILSATCOM satellites. The system is scheduled to take over command and control of MILSATCOM satellites at the end of fiscal year 2004. In FY03, the Air Force awarded contracts for development of Transformational Communications Architecture and approved the program acquisition strategy and architecture. The Transformational Satcom Program will develop key technologies such as laser communications, internet-like communications protocols, and methods of dynamically allocating communications among users. The ultimate goal is a FY10 first launch of a transformational satellite.

Engineering and Manufacturing Development – The Air Force System Demonstration and Engineering Development efforts are development projects which have not received approval for full-production. Examples of such efforts are: (1) The Space Based Infrared System Increment 1 Mission Control Station (MCS) achieved initial operational capability on 18 December 2001.

The MCS consolidates Defense Support Program operations at Buckley Air Force Base, Colorado, reducing manpower by 58 percent and operations and maintenance costs by 25 percent. Subsequent upgrades to the MCS throughout fiscal year 2002 resulted in closure of the Air-Land Enhanced Reconnaissance and Targeting ALERT ground station on 25 September 2002, consolidating all space-based strategic and theater missile warning operations, realizing additional manpower and Operations and Maintenance funds savings; (2) The Fighter/Attack (F/A)-22 Program is developing the next generation air dominance fighter designed to penetrate enemy airspace and achieve a first look, first kill capability against multiple targets. The F/A-22's combination of stealth, supercruise, maneuverability, and integrated avionics, coupled with improved supportability, represents an exponential leap in warfighting capabilities and allows for the full realization of operational concepts that are vital to the 21st century Air Force. The F/A-22 will replace the F-15C as the frontline Air Force air superiority fighter with initial operational capability planned for December 2005. The F/A-22 has been in Engineering and Manufacturing Development since 1991 and is currently meeting or exceeding all Key Performance Parameters. Significant program accomplishments in fiscal year 2002 include:

- Continued 2nd full-scale airframe lifetime fatigue test
- Initiated avionics software Block 3.1.2 FT-3 flight testing
- Completed multiple supersonic AMRAAM and AIM-9 missile shots
- Exceeded 2000 flight test missions, logging in over 4100 hours on the EMD aircraft fleet

The F-35 Joint Strike Fighter program is developing a family of strike fighter aircraft for the Air Force, Navy, Marine Corps and our allies, with maximum commonality among the variants to minimize life cycle costs. The Conventional Takeoff and Landing variant will be a multi-role, primary air-to-ground aircraft to replace the F-16 and A-10 and complement the F/A-22. While the F/A-22 will establish air dominance, the F-35-with its combination of stealth, large internal payloads and multi-spectral avionics-will provide persistent stealth and precision engagement to the future battlespace. The F-35 has been in System Development and Demonstration since 2001 and is currently meeting or exceeding all Key Performance Parameters. In fiscal year 2003, the program completed the Air System Preliminary Design Review and the Pratt & Whitney F135 Engine Critical Design Review and continued General Electric's development of a second, interchangeable engine (F136) for competition in production. Additionally, the program continued the International Commonality Effort to identify an Operational Requirements Document compliant configuration for international partners that maximizes commonality with the U.S. baseline program consistent with National Disclosure Policy.

The B-1B Defensive System Upgrade Program was canceled in December 2002 due to repeated cost and schedule over-runs. However, the AF continued to improve the B-1B's effectiveness through integration of new computers and advanced conventional weapons. Combined Developmental and Operational Testing (DT/OT) for the new computers completed in July, and dedicated operational testing completed in December 2002. Testing showed the computers met

or exceeded all Key Performance Parameters and they were approved for full rate production in April 2003. Combined DT/OT flight test for the integration of JSOW and JASSM onto the B-1 began in September 2003 and is scheduled to complete in April 2004.

Research, Development, Test and Evaluation Management Support

The Air Force's Research, Development, Test and Evaluation (RDT&E) Management Support efforts include projects directed toward support of installation or operations required for general research and development use. Included would be test ranges, military construction, maintenance support of laboratories, operation and maintenance of test aircraft and ships, and studies and analysis in support of the research and development program. An example of an Air Force RDT&E management support is: The Major Test and Evaluation Investment program, which funds the planning, improvements and modernization for three national asset test centers having over $10 billion of unique test facilities/capabilities operated and maintained by the Ai Force DoD test and evaluation missions, and available to others having a requirement for their unique capabilities. Many efforts are contained within this program, but two examples are the Propulsion Wind Tunnel Upgrade at Arnold Engineering Development Center. This effort replaces outdated data acquisition, processing, and control systems and drive motors. The second is the Threat Simulator Development program, which supports many of the AF electronic Warfare Test Processes. Current projects focus on improved Low Radar Cross Section threat modeling and simulation, and enhanced infrared and radio frequency countermeasures testing.

Operational Systems Development

Operational system efforts include projects in support of development acquisition programs or upgrades in System Demonstration and Development. Examples of operational systems development are: (1) AIM9X Sidewinder project, which improves seeker performance, infrared counter-countermeasures, and kinematics of the AIM-9M short range air-to-air missile. AIM-9X regains short, within visual range first-shot, first-kill capability for the U.S. warfighter. Test and Evaluation efforts have been positive, 18 of 19 successful guided launches with 10 direct hits to target drones.

Other notable accomplishments include completion of flight test activities, such as, Operations/Operational Evaluation and Developmental Test (DT) assist. A Low Rate Initial Production contract was awarded November 2002. (2) Another example of Operational Systems Development is the Airborne Warning and Control System Block 40/45 system upgrade. Block 40/45 replaces the 1970's vintage mission computer system with an open system, LAN-based architecture. It also incorporates Multi-Sensor Integration of on-board and off-board sensors into a real-time database allowing for a "single target-single track" to be displayed to the operator and transmitted to the shooter. Block 40/45 also incorporates an improved Data Link Infrastructure that decreases the latency of data link transmissions for high priority targets, thus allowing targets to be transmitted quickly to the shooter. This upgrade improves machine-to-machine interfaces that ultimately compress the kill chain timeline and postures the system to more easily integrate future modifications and support. These future modifications will support horizontal

integration and network centric operations. Initial System Development and Design began in 2003.

The first of a series of planned upgrades to the B-2 Spirit Bomber entered flight test in FY03. This bundled package of capability includes the upgraded, or "Smart" Bomb Rack Assembly; ability to drop the 500 lb Joint Direct Attack Munition Mark 82; ability to drop the Enhanced Guided Bomb Unit-28 (EGBU-28) bunker buster; and addition of improved voice and data communication via integration of a programmable UHF satellite communication terminal. Incorporation of this upgraded package into the fleet will begin in FY04. Development of an extended range variant of the Wind Corrected Munitions Dispenser (WCMD-ER) was initiated in FY03. The project extends the range and improves the accuracy of WCMD by adding a wing kit and integrating GPS into the tail kit for CBU-105 (anti-armor targets) and CBU-103 (soft and area targets) dispensers.

The AF Space program achieved nine successful launches of military satellites, utilizing Titan and Delta to launch Milstar-5 and –6, GPS IIR-8 and –9, DSCS A3 and B6, Coriolis, NOAA-M, and NROL-19. AF launch ranges successfully supported 23 military, civil and commercial launches, and the Evolved Expendable Launch Vehicle completed three successful Atlas V launches and three successful Delta IV launches.

Defense Advanced Research Projects Agency (DARPA)

Basic Research:

Brain Machine Interface. The goal of the DARPA Brain Machine Interface effort is to create new technologies for augmenting human performance by non-invasively accessing neural patterns in the brain and integrating them directly into peripheral systems or devices. Recent animal trials have demonstrated the power of the techniques. During 2003, monkeys were taught to control a computer cursor using a brain-machine interface—a suite of tools that detect brain activity and calculate the animal's intentions with respect to arm and hand movement. The monkeys initially used a joystick to move the cursor to designated positions and achieved success approximately 89 percent of the time. Gradually, the monkeys learned to use the interface and the joystick was removed. Using brain-derived signals only, without any involvement if the joystick, the monkeys were able to move the cursor correctly 85 percent of the time. In an expansion of the test, the monkeys' brain signals were interpreted by computer, and the monkey was able to remotely manipulate a robotic arm located in an adjacent room. Non-invasive brain signal monitors are the next step on the road to true human computer interaction.

Terahertz Imaging of Shuttle Foam. DARPA's work in Terahertz Imaging has shown effectiveness in detecting defects in space shuttle foam insulation, a likely contributor to the Columbia disaster in February. In tests conducted at Rensselaer Polytechnic Institute, fabricated defects were detected in 49 out of 57 trials.

Applied Research:

Language Translation. Progress was made on all fronts of the DARPA computerized speech and text translation programs. In tests administered by the National Institute of Standards and Technology, the Text-to-Text translation program was declared the world's best algorithm for translating Arabic language news reports to English. Speech-to-Text efforts showed similar progress, reducing word error rates down from the 50 percent level (where they have hovered for over a decade) to 13 percent for broadcast news and 18 percent for telephone conversations. The on-going speech-to-speech program has been successfully deployed to Iraq where the "phraselator" has been used to translate the medical needs of Iraqi prisoners and for interrogation purposes.

Fiber Lasers. The goal of the DARPA High Power Fiber Laser program is to develop and demonstrate high efficiency single mode fiber lasers with output power approaching one kilowatt from a single aperture. Once demonstrated, the focus will shift to combining multiple fibers coherently to produce a compact and flexible 100+ kilowatt laser. Lasers of this type could enable combat platform self-protection and be used to protect theaters or areas of interest against such threats as cruise missiles, rockets, and unmanned reconnaissance vehicles. During the past year, DARPA researchers set a world record by demonstrating one-kilowatt continuous wave output power from a single fiber. This successful test demonstrated the viability of the fiber laser concept and is an initial step in the ultimate goal of portable, and affordable, laser-based platform self-protection.

Titanium Initiative. A novel approach to titanium alloy production is being explored by DARPA. Using an electrolytic process similar to that used in aluminum manufacture, titanium oxide and other mixed oxides powders are electrically reduced to directly produce high purity titanium metal and alloys. This process eliminates a number of costly steps in the current titanium production process, produces billet material without melting, and most intriguingly, allows for production of new alloys that could not otherwise be synthesized. This low cost production method opens the door for the expanded use of titanium, particularly for parts and components in high corrosion environments where the advantages of titanium are clear, but titanium's current cost prohibits its use.

Development

Command Post of the Future. The objective of the Command Post of the Future program is to improve the speed and quality of command decision-making, more effectively communicate these decisions, and reduce the staff requirements of command posts. The key thrusts of the program are to develop integrated displays that the commander and his subordinates can observe simultaneously, to improve and simplify human-computer interactions and commands, to enable collaborative communications through both voice and visual modes, and to package the components in a modular, ruggedized package. Success has been achieved. The system, now known as the BattleBoard, has been developed, tested and packaged for Service use and has been evaluated by the Army's Stryker Brigade Combat Team. In addition, prototype units are also planned for deployment into Iraq in the fourth quarter of FY 2003.

Semi-Conductor Ultraviolet Laser Radar (LIDAR) Bio-Sensor. DARPA's Semiconductor Ultraviolet Optical Sources (SUVOS) program has demonstrated the world's first ultraviolet LIDAR biological agent sensor using a semiconductor ultraviolet laser diode as a source. SUVOS components are miniaturized and operate effectively at room temperature, lending themselves to hand-held and micro-air vehicle applications. The program holds the promise for high confidence stand-off detection of biological weapons as demonstrated in a recent test where the system was able to detect and distinguish an anthrax simulant intermixed with several common interferents from a range of 20 meters.

Future Combat System. The joint DARPA/Army Future Combat System is developing a rapidly deployable, mobile-networked force consisting of a command, control, communications module, autonomous robotic systems, precision direct and indirect fires, airborne and ground organic sensors, and adverse weather reconnaissance, surveillance, targeting and acquisition capability. By leveraging advanced networking capability, these systems can be dispersed and yet function as a cohesive whole, and by their modular nature, they can be recombined as needed for specific missions. Substantial progress has been made to date. During FY 2003, the system was approved to begin System Development and Demonstration, a lead system integrator was chosen and spiral development plan finalized. At the component technology level, the Netfires direct/indirect fires portion of the FCS, successfully conducted test flights of the Precision Attack Missile. The test represented the nation's first successful flight of a solid rocket motor with variable thrust propulsion. It flew for two minutes, traveled 19 kilometers, and hit within one meter of the target. In addition, FCS communications and networking technology was successfully demonstrated. The test was particularly stressing since it required integration of a number of dissimilar tactical radios of significantly varying capability.