



DELIVERING VALUE

100% Mission Success



26 Nov
Atlas V



20 Jan
Delta IV



24 Feb
Atlas V



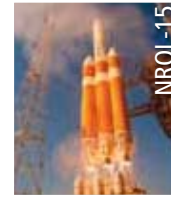
3 Apr
Delta IV



4 May
Atlas V



20 Jun
Atlas V



29 Jun
Delta IV Heavy



13 Sep
Atlas V

Fiscal Year 2012 Milestones

OCT

NOV

DEC

JAN

FEB

MAR

APR

MAY

JUN

JUL

AUG

SEP

November

NASA's Mars Science Laboratory rover Curiosity was launched to the red planet from Cape Canaveral on an Atlas V rocket. Aerospace supported NASA's Safety and Mission Assurance organization for this launch. Curiosity landed on Mars in August.

January

A Delta IV lifted the Wideband Global SATCOM-4 satellite into orbit on January 20. WGS-4 will provide enhanced communications capabilities for the military.

February

Launched on February 24, the Mobile User Objective System is a narrowband military satellite communications system. When operational, it will provide increased communications capabilities to ultrahigh frequency users.

April

A Delta IV rocket lifted off from Vandenberg Air Force Base (AFB) on April 3, carrying a classified satellite for the National Reconnaissance Office.

May

The second Advanced Extremely High Frequency military communications satellite was launched on an Atlas V. Aerospace monitored SpaceX's first commercial launch and reentry of the capsule that went to the International Space Station.

June

The 50th launch in the EELV program took place from Cape Canaveral with the launch of an Atlas V. Nine days later, America's most powerful launch vehicle, the upgraded Delta IV Heavy, blasted off from the Cape

on the first flight of this version. It carried a satellite for the National Reconnaissance Office.

August

Two Radiation Belt Storm Probe spacecraft were launched by NASA from the Cape on another EELV Atlas V to study Earth's radiation belts. Aerospace supported NASA's Safety and Mission Assurance organization for this launch.

September

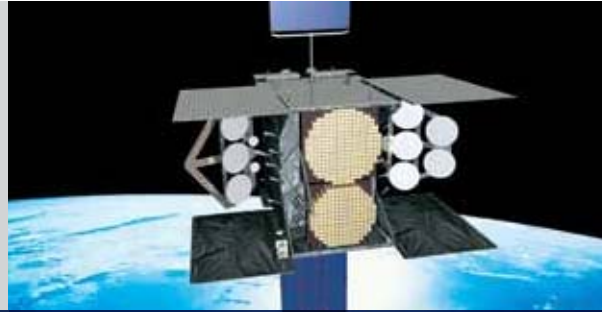
An Atlas V rocket lifted off from Vandenberg AFB carrying a national security satellite, as well as 11 cube satellites, or CubeSats.

Delivering Value

System Architecture Planning and Development

Program Systems Engineering and Integration Management

engineering
analysis
evaluation
investment strategies
collaboration



Artist's concept of WGS satellite



Advanced Flight Telescope

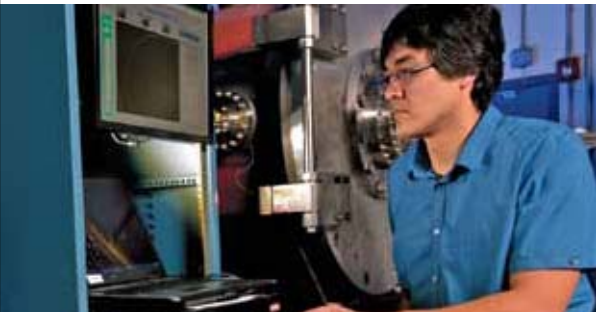
The engineering expertise of the company is applied across the national security space community and helps address a wide variety of crucial and time-sensitive problems, including new investment strategies; new tools and methods in design, test, and manufacturing; and reduced risk to programs.

Aerospace Takes Leadership Role in Future Satellite Communications Architectures

Aerospace took a leadership role in a study to assess the future of protected and wideband satellite communications initiated by the under secretary of defense for acquisition, technology, and logistics in June 2011. The study utilized key concepts and analysis tools developed at Aerospace. Aerospace developed, simulated, and analyzed several government reference architectures designed to satisfy SATCOM requirements in benign, contested, and nuclear environments. The analysis included an evaluation of resiliency and industrial base issues, and illuminated the benefits and risks of disaggregating SATCOM missions, including the possible separation of tactical and strategic missions. This study will be used to establish budget priorities and policies for these missions for FY14 and beyond.

Innovative Systems Engineering Design Technique Resolves Subtle Design Problem and Saves Months in Schedule

During testing of a new space telescope, a problem with lens focusing at mission temperatures was discovered. To address this problem, Aerospace created an interdisciplinary engineering team that used a collaborative technique called "model based engineering." This approach allowed team members from different specialties to exchange analysis results in realtime, permitting identification of a subtle deformation in the lens system caused by constriction in the surrounding structure that occurred only at cold temperatures. Using this information, Aerospace suggested a design change that solved the problem. This collaborative method reduces design team costs and shortens design cycles by factors of two to three, and in this case saved one to two months during the most cost-intensive test phase of the program.



Preventing RF component breakdown

United Launch Alliance Atlas V

Artist's concept of the twin RBSP spacecraft in orbit around Earth

Unexplained Electrical Breakdown on Spacecraft Traced to Exotic Plasma Physics Phenomenon

Aerospace is frequently asked to diagnose unexplained failures in spacecraft electronics and materials. When these failures occur in orbit, they often do so without warning or the ability to recover the mission. In one case involving a communications spacecraft, crucial RF filters began failing, putting critical communications at risk for military users. Components in other satellite systems also failed without explanation. Aerospace scientists determined that these seemingly unrelated failures were caused by a phenomenon called "multipaction," a runaway electrical condition that results in arcing, damage, and component failure. Aerospace's research and explanation of the phenomenon suggested precise, cost-effective solutions that were implemented by the government and allowed the programs to proceed with significantly reduced risk.

New Process Reverses Launch Vehicle Battery Capacity Loss

Recently, a loss of electrical isolation in an Atlas V flight termination system silver-zinc battery caused a one-day launch delay. Using x-ray diffraction analysis, Aerospace scientists detected unreacted mercury salts in battery samples. Additionally, Aerospace testing demonstrated conditions under which some zinc electrodes generated high amounts of hydrogen gas that could reduce cell capacity. These findings indicated the problems were caused by incomplete mercury amalgamation during the manufacturer's zinc electrode fabrication process. Based on the Aerospace results, a battery-level charge/discharge process was developed that restored the zinc electrode stability. Remediating this zinc electrode instability problem results in an estimated savings of \$1.6M over the next 10 years of Atlas V launches.

Space Radiation Research Results in Long-Lived Spacecraft

Since its inception, Aerospace has held a leadership role in characterizing the space radiation environment in which the country's spaceborne assets operate. Aerospace-designed instruments recently flew on NASA's Radiation Belt Storm Probes mission. The instruments will detect and measure energetic electrons and ions, and provide crucial information to DOD mission planners on the behavior and structure of Earth's radiation environment. Aerospace has also developed an innovative, low-cost, low-power "microdosimeter" that can fly on nearly any space platform to provide timely and accurate radiation dose information from inside the spacecraft to evaluate materials and shielding effects. Results from these and numerous other scientific probes have been used by Aerospace to provide a vastly improved radiation model to the spaceflight community.

Corporate Profile



Corporate Values

The corporation's commitment to its core values has made it the leading architect and principal technical resource for space programs of national significance.

Dedication to Mission Success

Committed to assuring 100-percent space mission success.

Technical Excellence

As the technical conscience of national security space, Aerospace tackles the tough questions and delivers the candid answers.

Commitment to Our People

A rare collection of the smartest people in the field, fully empowered to do their best thinking and work.

Integrity

A truly independent and unbiased nonprofit organization, with no competing agendas or incentives.

Objectivity

Always delivering the technical truth, no matter what.

The Aerospace Corporation is a private, nonprofit corporation that has operated a federally funded research and development center (FFRDC) for the United States Air Force since 1960, providing objective technical analyses and assessments for space programs that serve the national interest. As the FFRDC for national security space, Aerospace supports long-term planning as well as the immediate needs of the nation's military and intelligence space programs. Aerospace's involvement in concept definition, design, acquisition, development, deployment, and operation reduces costs and risks, and increases the probability of mission success.

FFRDCs are unique nonprofit entities sponsored and funded by the government to meet specific long-term needs that cannot be met by other organizations. FFRDCs typically assist government agencies with scientific research and analysis, systems development, and systems acquisition. They bring together the expertise and outlook of government, industry, and academia to solve complex technical problems. FFRDCs operate as strategic partners with their sponsoring government agencies to ensure the highest levels of objectivity and technical excellence.

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The Letter | Chairman of the Board and Our President – CEO



Peter B. Teets



Dr. Wanda M. Austin

Aerospace continued its tradition of delivering technical excellence throughout FY2012 even as our customers are challenged by an era of fiscal restraint and reduced budgets. As the space community is faced with the daunting challenge of modernizing while cutting costs, responding to new threats that are evolving faster than the development pace of our space systems, and doing all this while delivering essential space-related services to warfighters, Aerospace has successfully focused on “doing more with less” while continuing to assure space mission success. Throughout the year, Aerospace has demonstrated it is well-positioned to assist with complex, high-consequence national security issues; the development of highly efficient long-term architecture plans; and in providing end-to-end systems engineering support by leveraging the outstanding competencies that have existed within Aerospace since the

company’s founding in 1960. All of these factors contribute to the theme of this year’s Annual Report: Delivering Value.

The company’s dedication to realizing this goal has resulted in significant contributions to a number of programs during the fiscal year. Customer successes that we are proud to have contributed to include: the achieving of final operational orbit by the first Advanced Extremely High Frequency satellite, and the launch of the second satellite in that constellation; launches of the Wideband Global SATCOM-4 satellite, the Mobile User Objective System satellite, the National Polar Partnership satellite, and National Reconnaissance Office missions NROL-25, -38, -15, and -36; and the continued successful operations of the Space Based Infrared System, the Space Based Surveillance System, and the Global Positioning System. We assisted in the develop-

ment of the certification strategy that NASA, the NRO, and the Air Force will use to certify new launch providers who wish to supply services to the government. We also helped develop the New Entrant Certification Guide that provides the risk-based engineering process that will be used to certify new launch vehicles for DOD missions.

As we move forward, the challenges our customers face in terms of cost constraints and increasing capability needs will require us to continue to cultivate our long-term relationships with our sponsors and invest in the expert capabilities they will need for their future.



We have improved the value of our services in the following ways:

- Creating innovative architectures that identify cost-effective opportunities to leverage existing capabilities and to integrate emerging technologies.
- Identifying threats to gaps in national security space capabilities and developing opportunities for new or improved capabilities using emergent technologies, programmatic changes, or new architectures.
- Improving the capability and capacity of The Aerospace Corporation to be the advisor of choice for the acquiring and fielding of national security space systems that are able to operate through cyber degradation or attack.
- Improving the capacity of Aerospace to support government initiatives to achieve comprehensive U.S. space situational awareness and the protection of U.S. space assets from attack or interference.
- Improving the effectiveness of mission assurance and risk management practices throughout government, industry, and within The Aerospace Corporation.

Facing the twin challenges of significantly reduced budgets and delivery requests, the corporation met its cost-efficiency targets and took actions to shape our workforce to sustain the required talent in critical technical areas. We took these

actions in a manner consistent with our corporate values, primarily dedication to mission success and commitment to our people.

As we move forward, the challenges our customers face in terms of cost constraints and increasing capability needs will require us to continue to cultivate our long-term relationships with our sponsors and invest in the expert capabilities they will need for their future.

Some of the ways we can provide end-to-end lifecycle support to our customers include:

- Discussing with our customers our role in architecting resilient, affordable systems, and delineating our specific responsibilities in this area.
- Mobilizing the company's resources to develop new space cyber solutions.
- Applying our systems engineering and rigor to acquisition processes to help programs be more successful and execute to cost and schedule goals more effectively.
- Rebalancing our support to all of our customers to help them find innovative ways to develop evolved space systems with minimal nonrecurring development funding.

The Aerospace Corporation will continue to focus on our long-term support to our customers in assuring space

mission success. Even in this cost-constrained environment, our customers tell us space remains important to the future of the Department of Defense, the Intelligence Community, and other government agencies. In fact, space technology was mentioned specifically this year by the secretary of defense as one of the key enablers for the more agile and modern military force he envisions. Our partners in the national security space community, at NASA, MDA, and elsewhere, continue to call upon our innovative capabilities to help plan the way ahead, define affordable alternatives, execute programs efficiently, and ultimately succeed in spite of risks and difficulties.

Above all, we must keep in mind that when we live our corporate values – Dedication to Mission Success, Technical Excellence, Commitment to Our People, Objectivity, and Integrity – as we work to deliver value, our customers always benefit.

Peter B. Teets
Chairman of the Board

Dr. Wanda M. Austin
President and CEO

Our Strategy

To operate in this cost-constrained environment and be increasingly responsive to our customers' needs, Aerospace has refined its focus and processes to better deliver effective, efficient, enhanced value.

The challenge as we move forward will be in addressing emerging threats and the need to design and deploy more resilient systems, all while working to reduce program costs.

This will require new and unique approaches to ensure mission success. In the near term, there will be increased emphasis on systems engineering earlier in the process, allowing more effective allocation of resources and permitting early identification of potential problems. Any necessary corrective action can then be taken much sooner, when the cost to resolve issues is significantly lower.

Key Challenges and Opportunities

Shifting global and national priorities

Government support contractors and FFRDC regulatory constraints

Customer diversity and the complexity of national security space enterprise

Evolving customer needs

Changes in the aerospace industry workforce

Corporate Vision and Values

Corporate Vision

Be the leading architect of the country's national security space program and the principal technical resource for programs of national significance

Corporate Values

- Dedication to Mission Success
- Technical Excellence
- Commitment to Our People
- Objectivity
- Integrity



Strategic Intent

Be the trusted technical advisor of the DOD and the Intelligence Community for space, launch, and ground systems of national significance

Contribute our capabilities in the broader public interest

Serve the nation with a world-class organization

Initiatives

Improving the Value of Our Services

- Cyberspace and information assurance
- Space situational assurance and protection
- Space program lifecycle mission assurance and risk management
- Innovative architectures and improved decision support

Shaping the Future

- Civil and commercial business
- Capabilities engineering and cost management
- Innovation through technical investments

Improving Organizational Effectiveness

- Tools that empower people
- Promote excellence in individual and corporate performance through professional development and improved institutional processes

SPACE SYSTEMS GROUP

Atlas V lifts off carrying the first Mobile User Objective System satellite for the U.S. Navy

Space Systems Group (SSG) assists the Air Force Space and Missile Systems Center (SMC) in the conception, design, acquisition, and operation of Air Force space systems. SMC utilizes Aerospace's extensive expertise in all these areas as it pursues the goal of becoming the Department of Defense (DOD) leader in acquisition success. SSG provides the critical skills necessary to assure 100-percent mission success through mission assurance focus, technical reviews, and systems engineering processes as space programs are architected, acquired, and fielded. Emphasis through all phases of system lifecycles is on effectiveness for the operational end users.



Space Launch Operations (SLO)

Launch Operations Division

Evolved Expendable Launch Vehicle (EELV)

The EELV program successfully launched seven national security space (NSS) payloads during this fiscal year, with an eighth scheduled for early October. Each received full mission assurance support using the rigorous Aerospace launch verification process. The manifest included one Navy, two Air Force, and four National Reconnaissance Office (NRO) missions. The year was especially noteworthy for executing six launches within a six-month period, beginning with the Delta IV WGS-4 in January 2012 and culminating with the Delta IV NROL-15 mission in June 2012. The launch team was further challenged to launch two critical NRO missions, Atlas V NROL-38 and Delta IV NROL-15, within nine days of each other.

Three previously unflown vehicle configurations were flown for the first time this year, with Aerospace engineers ensuring that each was fully qualified and acceptable for flight. An Atlas V 551 vehicle, the most powerful rocket in the Atlas family, was used to place the Navy's Mobile User Objective System (MUOS)-1 spacecraft into orbit in February 2012. The 551 configuration consists of a five-meter payload fairing encapsulating the spacecraft and single-engine Centaur upper stage, sitting atop a Common Core Booster

with five strap-on solid rocket motors. A Delta IV Medium Plus (5,2) launched the NROL-25 mission in early April 2012. The M+(5,2) configuration consists of a Common Core Booster with two strap-on solid rocket motors, a five-meter upper stage, and a five-meter payload fairing. It is essentially a lower-performing variant of the M+(5,4) used for the Wideband Global SATCOM launch earlier this year. The Delta IV Heavy Upgrade (HUG) vehicle, with upgraded RS68A engines, was used to launch the NROL-15

Three previously unflown vehicle configurations were flown for the first time this year, with Aerospace engineers ensuring that each was fully qualified and acceptable for flight.

mission into geosynchronous orbit in June 2012. This culminated a six-year design, development, qualification, and certification effort funded by the NRO to increase the flight performance of the Heavy Launch Vehicle configuration. The upgraded RS68A engines, which were integral to the upgrade, provide the foundation of the Air Force Fleet Standardization Program, which is intended to reduce the manufacturing costs and provide additional launch flex-

ibility to the Delta IV program. Aerospace was fully engaged throughout the HUG program.

A number of incremental design enhancements were also flown for the first time this year. The Atlas V AEHF-2 launch in February 2012 utilized redesigned solid rocket boosters, eliminating a concern with the structural integrity of the motor case. The Atlas V NROL-38, launched in June 2012, incorporated the Moog RL10 oxidizer inlet valve, addressing a propulsion system risk identified early in the program. The Global Positioning System Metric Tracking System, which will replace the C-band beacons that have been traditionally used for range safety tracking of space launch vehicles, was used for the first time on the MUOS-1 mission. The NROL-38 mission was also the first mission to utilize a controlled reentry maneuver to deorbit the upper stage from a geosynchronous transfer orbit. The Atlas V NROL-36 mission, the last mission to launch this year, was the first to employ an aft bulkhead carrier, deploying 11 CubeSat secondary payloads after completion of the primary mission. Aerospace performed independent assessments of the design and qualification of each of the product improvements and mission design efforts.

Dedication to Mission Success

Mission Success



Given the replenishment needs of the GPS constellation, the Air Force is pursuing dual launch of GPS III spacecraft to reduce the total future cost-to-orbit. The approach, building on United Launch Alliance's internal research and development efforts, involves use of a canister-type payload attachment system, allowing two spacecraft to be flown on one launch vehicle in a stacked configuration and separated from the launch vehicle sequentially. The five-meter Dual Satellite System (DSS-5) preliminary design review and the GPS III Dual Launch Phase I study were completed in December 2011. The Air Force seeks to optimize the DSS for GPS III satellites. Initial studies indicate that development costs can be recovered within two dual-launch flights. Aerospace Space Launch Operations and Navigation Division engineers have collaborated to support this high-visibility

Space and Missile Systems Center effort with independent assessments and recommendations. Efforts have included initial evaluation of two competing canister designs and development of a rigorous verification plan in anticipation of full-scale development. The target date for the initial launch capability for GPS III dual launch is in 2019 for the GPS III SV09/10 pair.

Aerospace conducted an orbital debris mitigation standard practices (ODMSP) compliance study to assess possible options where satellite vehicle injection modification would allow launch vehicle compliance to policy. Compliant orbits were identified for WGS, Space-Based Infrared System, Advanced Extremely High Frequency, and MUOS. Spacecraft program offices are assessing potential impacts to their programs, and an initial assessment from SBIRS indicates

that the modified orbital insertion may be acceptable if a waiver for secondary payload requirement is approved. This is a significant achievement, reflecting better-than-expected progress toward ODMSP compliance.



Launch Systems Division

Global Positioning System Metric Tracking System (GPS MTS)

GPS MTS is the first development of hardware for use on both Atlas V and Delta IV EELVs as a part of the Air Force's Launch Enterprise Transition Initiative. Aerospace proactively participated in the system requirements and specifications development and in the preliminary and critical design reviews, and contributed to the resolution of several technical issues. In addition, the Engineering and Technology Group developed the capability to perform simulations of the GPS MTS performance during actual Atlas and Delta launch trajectories.

Four certification flights are planned: one each on Atlas and Delta on both the Eastern and Western ranges. The first certification flight of GPS MTS was conducted aboard the Atlas V MUOS-1 mission from Cape Canaveral Air Force Station (CCAFS) on February 24, 2012. The second certification flight will be on the Atlas V NROL-36 mission from Vandenberg Air Force Base (VAFB), scheduled for September 2012. A certification readiness review was held on July 9, 2012, establishing that all airborne and ground GPS MTS systems are ready to support that mission. Full operational capability (and C-band divestiture) will occur following the success of GPS MTS on Atlas V from VAFB and successful GPS MTS flights aboard Delta IV missions from

both CCAFS and VAFB, expected to be complete in the third quarter of FY13.

Federal Aviation Administration Office of Commercial Space Transportation (FAA/AST)

In FY12, the first task was awarded under a five-year follow-on task order contract covering Aerospace technical work for FAA/AST. Under the requirements of the new task, Aerospace is providing independent assessment and analysis of safety-critical components and issues associated with commercial rockets in order to assist AST with its launch and reentry, licensing, and compliance-monitoring activities. Aerospace is also performing independent verification and validation of contractor hazard assessment tests on new nontoxic nitrous-oxide fuel blend monopropellants being developed for use in commercial space applications.

Protection of Occupied Orbiting Assets During Collision Avoidance (COLA) Gap

Occupied orbiting assets are vulnerable to collisions with newly launched objects during the COLA Gap, which exists between the end of launch COLA protection and the onset of orbital COLA protection. Procedures developed by Aerospace have been used successfully during the past five years to close this gap for Space and Missile Systems Center/ Launch and Range Systems Directorate (SMC/LR) launches.

In 2011, NASA requested that SMC/LR and Aerospace continue to provide COLA Gap protection for the International Space Station (ISS) during SMC/LR launches until NASA could develop a standard procedure for use by all launchers. During 2012, Aerospace provided ISS COLA Gap protection for the Delta IV WGS-4 and Atlas V AEHF-2 launches.

Both launches required that portions of the launch window be closed to eliminate the potential for collisions between the spent upper stage and the ISS during the COLA Gap. NASA recently completed development of a proposed standard procedure for providing COLA protection to the ISS during the COLA Gap. Aerospace was tasked by SMC/LR to evaluate the proposed standard procedure to determine its operational feasibility, level of protection, and potential impact on launch windows. Aerospace is using the WGS-4 and Advanced Extremely High Frequency-2 launches as test cases for this evaluation. Evaluation results are expected in Fall 2012.

Evolved Expendable Launch Vehicle Independent Research and Development (IR&D) Programs

The United Launch Alliance (ULA) is making a significant investment over the next five years in a diverse array of projects, ranging from common avionics to Atlas V human spaceflight certification. The Air Force and Aerospace are fully engaged in review of the IR&D programs. All of the IR&D projects, including those with NASA focus, have direct benefits to the EELV product line, and in the long term could provide lower cost and higher reliability to national security space missions.

Aerospace participated in two quarterly reviews and is monitoring 20-plus projects. Special attention is being given to fuel cell development and Integrated Vehicle Fluids (IVF); the latter is an innovative concept that uses an onboard hydrogen/oxygen internal combustion engine to generate electrical power. Fuel cells and IVF are high-payoff technologies that could enable long-duration missions, increase mass-to-orbit performance, and facilitate orbital disposal of the second stage. Aerospace has initiated independent evaluations of the IVF concept. ULA is actively seeking Aerospace expertise on these and other select advanced technology projects.

Alternative Launch Vehicles (ALV)

In FY12, Aerospace helped with the technical coordination and publication of SMC's new entrant certification guide (NECG). Aerospace participated in the NECG Industry Day and assisted the Air Force in question-and-answer sessions with prospective new entrants. The NECG provides a risk-based approach that SMC will use to certify the capability of potential new entrant launch companies to provide launch services for Department of Defense national security space missions on EELV-class launch vehicles. The ALV department gradually increased its staffing to help start the evaluation of statement(s) of intent from prospective new entrants and work on the new entrant certification plan for SpaceX's Falcon 9 (v1.1) launch vehicle.

Earlier in FY12, Aerospace completed the procurement and installation for special-purpose plant equipment for both the El Segundo and Eastern Range Directorate Spacelift Telemetry Acquisition and Reporting System (STARS)-SpaceX interface to obtain voice, video, and telemetry data on future Falcon 9 missions. This implementation was exercised as part of the second Commercial Orbital Transportation Services (COTS) Space Act Agreement demonstration mission launched in May 2012, and it was the first time

the Aerospace team performed realtime launch support in STARS using SpaceX's graphical user interface and Aerospace independent screen development for independent verification and validation assessments. Aerospace continued its support to the program executive officer for space launch on deep-dive and early-insight incremental design reviews at SpaceX, in addition to managing early integration studies (e.g., GPS-III) to provide useful technical insight on SpaceX-proposed vertical integration concept of operations, timeline, and cost and schedule estimates.

Aerospace also supported the Orbital Sub-orbital Program (OSP-3) that SMC is planning to use as an onramp for new entrants via the SMC/Space Development and Test Directorate contract. The team provided key input to the OSP-3 performance work statement and mission requirements document for the DSCOV and STP-2 EELV new entrant onramp missions.

Finally, Aerospace supported the successful launch of SpaceX's second COTS demonstration launch. Data from this mission was analyzed for a comprehensive independent postflight review held in August 2012.



Launch and Satellite Control Division

Range and Satellite Control Enterprise

Aerospace supports both the Launch and Test Range System (LTRS) and the Air Force Satellite Control Network (AFSCN). The mission of LTRS is to support evolving launch and test missions and to provide assured access to space. The mission of the AFSCN is to provide highly reliable command and control, communications, telemetry, and tracking for more than 170 Department of Defense, National Reconnaissance Office, civil, and allied satellites.

Aerospace systems engineering and project management support continued to play an integral role in the Space and Missile Systems Center/Satellite and Launch Control System Program Office (SMC/RN) deployment of modernized LTRS capabilities on the Eastern and Western Ranges and modernized AFSCN capabilities around the world, along with sustainment of these capabilities to ensure continued, responsive, and effective support to warfighters. The Aerospace focus was on systems engineering and integration, architectural management, and modernization efforts.

The Modernization of the Eastern Range Network is an acquisition project that will develop a new ground communications system for the Eastern Range. The new system will be Internet Protocol (IP)-based and will connect to the Global Information Grid. Aerospace has played a key role in



RBC antenna located at Vandenberg AFB



ULA Delta IV Heavy rocket blasts off with NROL-15 payload

developing the system requirements, the performance work statement, the concept of operations, and the test requirements. The project request for proposals is expected to be released in September 2012.

Aerospace concluded its oversight and support of the Range Standardization and Automation Program with the delivery of the final product, the Western Range Mission Flight Control Center (MFCC). The new center introduced automated flight analysis functions, robust flight operations, and an improved information assurance (IA) posture. When the MFCC experienced problems that led to the scrub of an NRO mission this summer, Aerospace played a critical role in investigating the problem, assessing the situation, defining activities to restore confidence in the system, and ensuring that those activities were carried out properly.

Over the past year, Aerospace supported SMC/RN in facilitating the fielding of Remote Tracking Station Block Change (RBC) antenna systems at several AFSCN locations. Aerospace supported the segment verification test (SVT) at Guam Tracking Station, paving the way for a combined development and operational systems test; completed the Colorado Tracking Station integrated systems test with a contact success rate of over 98 percent; validated the Thule Tracking Station 90-percent civil design; ensured the successful completion of SVT testing on all five RBC transportable configurations; and applied Aerospace IA expertise to define solutions and corrective actions to resolve RBC IA deficiencies.

Space Program Operations (SPO)

Environmental Satellite Systems Division



Image of Earth's city lights captured using data from the Defense Meteorological Satellite Program Operational Linescan System

Defense Meteorological Satellite Program (DMSP)

The Defense Meteorological Satellite Program provides timely and accurate worldwide terrestrial and space environmental data to DOD and national program users. The program celebrated its 50th anniversary in 2012. Satellites are currently deployed in two low-Earth/sun-synchronous orbits to support both strategic and theater users. The current DMSP constellation is healthy and is meeting all mission requirements for the warfighter. Factory integration and test of satellite F19 is almost complete and on schedule to support a March 2014 launch date. Per USSTRATCOM direction, DOD will now only cover the early morning orbit plane for this mission area.

A new DMSP mission data downlink and recovery capability has been successfully installed and is operational at McMurdo Station, Antarctica. This capability significantly improves time latency of weather satellite data, and for the first time provides full-orbit fine-resolution cloud data for end users. In recognition of Aerospace's contributions to McMurdo Station, the ground site was officially named the George Iwanaga Ground Station, or "GIGS." Mr. Iwanaga has supported the DMSP program as an Aerospace employee for almost two decades, and is now a retired casual employee.

Weather Satellite Follow-On

The Weather Satellite Follow-On will provide a timely, reliable, and high-quality space-based remote sensing capability that will make global and regional environmental observations of atmospheric, terrestrial, oceanographic, solar-geophysical, and other phenomena for military and civilian users, replacing the DMSP satellites that are currently on orbit. The Defense Weather Satellite System, initially intended to replace DMSP, was terminated in February 2012. Aerospace has provided significant support to the SMC program office and Air Force Space Command (AFSPC) in support of a Defense Space Council-initiated Space-Based Environmental Monitoring Study, which was intended to inform a follow-on system architecture as well as the FY14 budget process. Aerospace efforts included developing viable future weather satellite system architectures and assessing their performance in satisfying capability gaps. Aerospace is providing technical and management support to the program office and AFSPC for the upcoming analysis of alternatives study. Additionally, Aerospace has provided significant technical support in risk-reduction activities for the follow-on system.



MILSATCOM Division

Advanced Extremely High Frequency (AEHF) Program

The Advanced Extremely High Frequency (AEHF) program is the successor to Milstar as this nation's core, protected communications system for strategic and tactical missions, capable of mitigating a broad spectrum of natural and manmade threats. AEHF represents a tenfold improvement in communication capacity as well as significant improvements to coverage and access. Aerospace is integrally involved in all aspects of the program, working with the Air Force contractors to ensure the success of this critical mission area.

AEHF SV-1 was successfully launched on August 14, 2010 from Cape Canaveral Air Force Station. An anomaly with the bi-propellant propulsion system precluded execution of the nominal orbit raising and led to a year-long effort to reach orbit using electric propulsion. The Aerospace Engineering and Technology Group provided critical support to enable the success of this mission by developing and optimizing the orbit transfer strategy that saved critical

spacecraft fuel. The satellite reached its operational location at 69 deg. W in October 2011, followed by a successful payload deployment, on-orbit test campaign, and integration with the Milstar constellation. Aerospace was instrumental in monitoring test progress, evaluating planned configuration changes, and resolving minor anomalies.

AEHF SV-2 was launched on May 4 from Cape Canaveral Air Force Station and successfully reached its test location of 120 deg. W on August 10. The completion of the AEHF SV-2 on-orbit test campaign on September 24 demonstrated the performance of a constellation comprising AEHF satellites exclusively and proved that multiple AEHF satellites can operate seamlessly within a Milstar constellation.

The third AEHF satellite is in storage, with a planned launch date of September 2013. A fourth satellite is in production, and acquisition activities for two more satellites are in progress.

The Atlas V launch vehicle with AEHF-2 satellite aboard at Cape Canaveral Air Force Station

Milstar Program

The Milstar system serves as the nation's core, protected communications system for strategic and tactical missions, capable of mitigating a broad spectrum of natural and man-made threats. The five-satellite constellation consists of two Milstar Block I satellites (low data rate) and three Milstar Block II satellites (low and medium data rate).

The constellation continues its excellent performance, meeting worldwide warfighter requirements. Four of the five satellites have exceeded their design lifetimes. The longevity and performance of the Milstar constellation is critical, given the time required for the follow-on AEHF system to reach operational acceptance. Aerospace currently maintains a small but vigilant team in support of system sustainment and mission operations. This includes a strong emphasis on ensuring Milstar and AEHF intersystem capability.

Wideband Global SATCOM (WGS) Program

The three WGS Block I satellites currently on orbit and in operation continue to provide full mission support to U.S. and allied warfighters and other strategic and diplomatic users. Aerospace is integrated into the Air Force acquisition and operations teams and provides critical daily support during spacecraft assembly, integration, and test on the ground, and for on-orbit spacecraft health and safety.

Aerospace serves as the "first responder" when satellite anomalies occur and provides essential technical expertise and independent assessment during anomaly resolution.

The first of the WGS Block II satellites, WGS-4, was successfully launched in January 2012 and joined the operational constellation in August. Aerospace provided essential on-site support for the launch campaign and all satellite on-orbit testing. WGS-5 is being prepared for launch in early 2013. WGS-6 has completed system testing and is in storage awaiting its launch in June 2013. On WGS-5, Aerospace was instrumental in preventing damage to a high-value sensor during an anomaly investigation. Aerospace recommendations allowed the anomaly investigation to be successfully completed while preserving the flight hardware for eventual reuse following its reassembly. On WGS-5 and 6, Aerospace led the investigation of anomalous waveguide switches within the payload. Aerospace's ability to rapidly apply technical leadership preserved the program's scheduled launch dates for WGS-5 and -6 while providing critical mission assurance.

The WGS 7-10 program is structured to procure four additional satellites. The telemetry and command transponder is being substantially redesigned, and a significant number of design changes driven by parts obsolescence and supplier

changes are being incorporated. The digital channelizer, which is the heart of the payload, is also being significantly redesigned to increase its communications capacity starting with WGS-8. The production portion of the contract has been extensively restructured by the government to reduce production costs by adopting a commercial acquisition model.

Defense Satellite Communications System (DSCS) Program

The Defense Satellite Communications System provides wideband communication capability for the National Command Authority; strategic forces; military forces deployed and in garrison; diplomatic services; and long-haul, fixed, government communications services. The DSCS constellation consists of two prime satellites and six residual satellites.

DSCS program priorities continue to be mission life extension and enhancement to maximize the utility of on-orbit assets as the WGS constellation is being populated. A new capability under development will permit implementation of the algorithm to reduce inclination-induced pointing errors on satellites that do not have a functional inertial reference unit (gyroscope). This new software will provide immediate benefit to one DSCS satellite and will also provide backup capability for the rest of the constellation.



Cross-Program Engineering and Operations (CPEO)

MILSATCOM Cross-Program Engineering and Operations directly supports the MILSATCOM Directorate (SMC/MCE) chief engineer, the Family of Advanced Beyond Line-of-Sight Terminals (FAB-T) program, and satellite operations. CPEO also provides cross-program mission assurance, information assurance, mission effectiveness, and international partner expertise directly to the MILSATCOM portfolio. Aerospace is providing critical technical expertise and leadership to develop an enterprise architecture to inform MILSATCOM portfolio-level decisions. This initiative is bringing a model-based systems engineering approach with a common set of data and data schemas to support portfolio technical analysis and to facilitate production of architecture products for program documentation. Aerospace is leading the development of the enterprise architecture common data environment to define a common lexicon and taxonomy and to capture these definitions and artifacts in a common database and model.

Command and Control System – Consolidated (CCS-C) Program

The Command and Control System – Consolidated program develops and sustains an integrated S-band control system for MILSATCOM satellite programs. CCS-C provides telemetry, command, control, and mission planning capability for four satellite systems: DSCS III, WGS, Milstar, and AEHF.

CCS-C successfully supported launch and early orbit operations for the AEHF-2 satellite and is currently supporting on-orbit payload testing by the Lockheed Martin Mission Control Team. Development of software, databases, and command procedures to support the WGS-5 handover in 2013 has commenced. The WGS Blue Force Status project, which integrates neural network software into the CCS-C telemetry processing subsystem, is being upgraded to a version 2.0 capability, which will provide robust, realtime space situational awareness capability at Schriever Air Force Base for six WGS satellites.

Advanced Systems Directorate

The Air Force formed the SMC/Advanced Concept Division (SMC/MCX) to analyze future MILSATCOM architecture alternatives, formulate an evolutionary path for MILSATCOM programs, and execute risk-reduction and demonstration programs to advance along that path. Aerospace supports SMC/MCX on architecture, technology, and acquisition strategies applied to current and future MILSATCOM programs.

The Executive Agent for Space initiated a study to develop and evaluate alternative MILSATCOM architecture options. Aerospace provided primary input in formulating the architecture alternatives, evaluating their performance under both benign and threat conditions, and estimating their cost. Aerospace also supported refinement of warfighting

scenarios with their associated future satellite communications (SATCOM) demand, as well as the application of emerging threats to SATCOM systems. Major recommendations of the study to achieve improved performance, affordability, and resiliency were to:

- consider disaggregating strategic and tactical protected communications, like those used on the AEHF satellite;
- integrate commercial-like solutions and business processes into wideband SATCOM; and
- adopt wider enterprise perspectives, including terminal segment and ground network improvements.

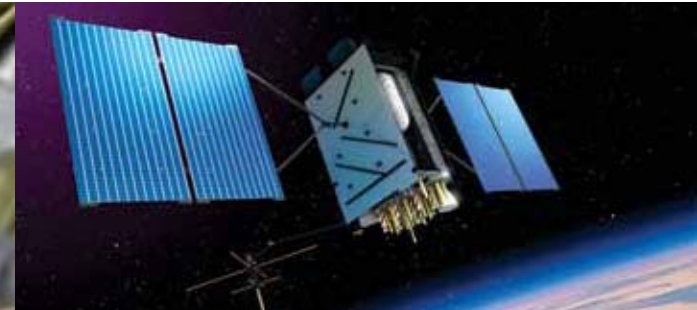
Study results will influence FY14 funding allocations, as well as more formal future analyses of alternatives for specific new MILSATCOM systems.

Navigation Division

Technical
Excellence
Technical
Excellence



Rockwell Collins Defense Advanced GPS Receiver (DAGR)



Artist's concept of GPS III satellite

Global Positioning System (GPS)

GPS provides precision signals from a constellation of satellites, ensuring continuous high-accuracy global position, navigation, and timing services to military and civilian users

This year, Aerospace continued its technical stewardship across the GPS IIF and III satellite programs: the GPS control system programs, GPS user equipment programs, and the space-based navigation enterprise.

worldwide. Since reaching full operational capability in 1995, GPS has become an essential part of the global civil infrastructure and military operations. In October 2011, GPS

was recognized with the International Astronautical Federation's one-time 60th Anniversary Award for achievement in providing the most measurable benefit to mankind since the beginning of the space age. In May, the National Space Club awarded the Goddard Trophy to the GPS Originators Team. The value and utility of GPS have far exceeded the expectations of its system designers and have led to significant system upgrades to enhance both military and civil services. Modernization is required across spacecraft, control system, and user equipment programs. This year, Aerospace continued its technical stewardship across the GPS IIF and III satellite programs: the GPS control system programs, GPS user equipment programs, and the space-based navigation enterprise.

GPS Satellite Programs

The heart of timing accuracy for GPS lies in its redundant atomic frequency clocks. GPS IIF contains precision clocks based on a rubidium frequency standard and a cesium frequency standard. The GPS IIF program opened an anomaly investigation for a rubidium frequency standard clock that exhibited unexpected behavior during life testing. An anomaly team with representatives from the government, Aerospace, prime contractor, and vendor conducted a thorough investigation, and Aerospace performed tests that verified the cause of the anomaly. With this information, the anomaly team was able to identify an improved lamp design, and began their replacement lamp production with improved processes and a screening program to estimate lamp lifetimes.



GPS III

The GPS III program is building and testing the qualification and flight hardware and software for delivery to the space vehicle pathfinder, the GPS Non-Flight System Testbed (GNST), and the first flight vehicle, SV-1. Aerospace reviewed critical areas of the payload and space vehicle bus, and provided assessments and recommendations for resolving unit/subsystem issues. In particular, the GPS III Mission Data Unit successfully completed tests following the redesign and review of its backplane manufacturing processes to address risk areas identified by Aerospace last year. Integration of bus, network communications, and antenna deck element hardware with the GNST core and structure has been completed, and space vehicle test script checkout and functional testing with the GNST is in progress at the GPS Processing Facility in Waterton, CO.

GPS Next Generation Operational Control System (OCX)

During the last reporting period Aerospace helped develop a number of options for the OCX program with the goal of producing a lower-cost control segment by identifying various affordability opportunities. The objective of the affordability initiative was to reduce the cost of the OCX program of record without sacrificing warfighter capabilities. Aerospace participated in all of the affordability workshops, took an active part in developing technical aspects of all

the changes necessary to the OCX contract, and led the technical evaluation of the final affordability proposal. The goal of the affordability initiatives was to remove \$100M from the program of record.

The Military GPS User Equipment (MGUE) program achieved major progress this year with the approval of its technical development strategy and formal approval of entry into the technology development phase.

Aerospace led the definition and implementation of an iterative critical design review (iCDR) concept for OCX. Since military standard MIL-STD-1521B was developed to address a single critical design review, the iCDR concept had to also include the allocation of all MIL-STD-1521B criteria across all iCDRs. This concept was applied to the iteration 1.4 iCDR campaign that culminated in a successful iCDR event in June 2012.

GPS User Equipment Program

The Military GPS User Equipment (MGUE) program achieved major progress this year with the approval of its technical development strategy and formal approval of entry into the technology development phase. Aerospace participated

in the subsequent development of a request for proposal and the technical evaluation of proposal responses. These activities pave the way for contracts that will develop MGUE applications for lead platforms for the air (the Air Force's F-15 Strike Eagle), ground (the Army's Raven unmanned aerial vehicle), and sea (the Navy's Arleigh Burke class guided missile destroyer).

GPS Enterprise

The GPS program office, in collaboration with the Air Force Research Laboratory, Space and Missile Systems Center/Development Planning, and Space and Missile Systems Center/Space Division, continued work to mature the NavSat concept, which consists of a smaller satellite carrying only a navigation payload and capable of being dual- and triple-launched on Falcon 9 or an EELV-class launch vehicle. This approach is being pursued with the goal of making the GPS constellation more affordable and resilient.

Space Based Surveillance Division

Space Based Infrared System (SBIRS)

The Space Based Infrared System, consisting of high Earth orbit (HEO) and geosynchronous Earth orbit (GEO) space elements, is the follow-on program to the Defense Support Program (DSP). The HEO system continues to deliver a wide array of game-changing persistent surveillance capabilities to the military and intelligence communities. The DSP constellation continues to provide global early warning of strategic and tactical ballistic missile launches. As the SBIRS GEO space vehicles are deployed in the next few years, the overall system will provide dramatically improved missile warning, missile defense, battlespace characterization, and technical intelligence products to the military and intelligence community users.

The SBIRS Engineering and Manufacturing Development program is continuing efforts to deliver the GEO-1 and GEO-2 space vehicles (SVs) into operation. After being launched in May 2011, the GEO-1 vehicle successfully completed launch and early on-orbit test and payload sensor tuning. Aerospace deployed its mobile laser beacon systems at Edwards AFB for GEO-1 line-of-sight verification tests that led to the discovery and remediation of a software error that was yielding a large line-of-sight bias error. Without this test, the software error would not have been identified and the location of targets of interest inferred from GEO-1

sensors would have been in error. In September 2012, the Program Executive Officer certified that the GEO-1 system was ready for operational testing. Full acceptance of the GEO-1 systems by U.S. Strategic Command and the National Geospatial Intelligence Agency is expected in December 2013.

The GEO-2 SV successfully completed all vehicle functional and environmental testing and is being readied for a March 2013 launch. Current activities include final space-to-ground system testing and installation of deployable components, culminating in a final factory confidence test and shipment in early CY13.

The SBIRS Follow-on Production program, consisting of the HEO-3 and HEO-4 payloads and GEO-3 and GEO-4 SVs, is continuing to make steady progress. The HEO-3 payload has completed final integration and baseline functional testing and is being readied for environmental tests. Delivery to the host contractor in mid-FY13 is on schedule. A majority of the GEO-3 components have been delivered, and both SV and payload integration efforts have started. Aerospace identified specific opportunities to streamline the test flow, while maintaining a strong mission assurance posture. More than 70 days were eliminated from the standard test schedule for both the SV and payload, primarily by eliminat-

ing redundant testing and by resequencing integration and test activities.

Development of the final Increment 2 ground system is in progress. It is composed of two major capability blocks: Block 10 and Block 20. The program conducted a successful Block 10 critical design review earlier this year and has since resolved all identified risks. Block 10 hardware installation and software code and unit test activities are underway. Aerospace completed a Block 20 requirements affordability study, to include process and risk assessments that informed the approved Block 20/Increment 2 baseline.

Aerospace provided system and sensor performance analysis results for a number of potential future architectures as part of several DOD studies. In particular, Aerospace was engaged with the Overhead Persistent Infrared (OPIR) community to implement new Joint OPIR Ground improvements to the ground enterprise. Aerospace also contributes to pre-acquisition planning activities associated with two geosynchronous wide-field-of-view payloads.



Space Support Division



SBIRS personnel in conference



Joint Space Operations Center at Vandenberg Air Force Base, Calif.

Space Based Space Surveillance (SBSS)

The Space Based Space Surveillance program consists of an integrated space and ground system, which provides the capability to track and characterize a large number of objects in space, while not being limited by ground geometry and weather constraints. Since launch in September 2010, SBSS has been an effective space situational awareness (SSA) asset and has enhanced the value of SSA that the Air Force brings to the nation. On August 15, Air Force Space Command declared that the SBSS program had been operationally accepted and had successfully achieved initial operational capability (IOC). Aerospace was instrumental in helping the program reach this milestone. Scientists and engineers working in the Aerospace Physical Sciences Laboratories determined the root cause of a persistent anomaly that contributed to the delay in reaching IOC.

Aerospace was asked by the Air Force and the contractor community to perform experiments on engineering-grade samples using equipment and facilities uniquely available to the corporation.

Joint Space Operations Center (JSpOC) Mission System (JMS)

The Joint Space Operations Center Mission System program will deliver a space command and control capability and additional space services for the commander, Joint Functional Component Command for Space, and other users. JMS is an evolution of the legacy Space Defense Operations Center system and is being acquired incrementally. Expectations are that Increment 1 will be delivered by February 2013, and Increment 2 will be delivered in the first quarter of FY16. Aerospace led the front-end development of

Increment 2 requirements, based on a functional requirements document that was derived from the JMS capability description document. The principal technical risk to delivering JMS on time is the security architecture, which is implemented via software and hardware. The JMS security architecture defines what data will exist at specific levels of classification, where key computations take place within JMS, and what products ultimately will be made available to the majority of JMS users. Aerospace was instrumental in developing the rule sets that ensure adherence to the security policies of each data owner. The rule sets are being prototyped in a risk-reduction application for eventual migration to JMS. Aerospace is also leading the development of the JMS Enterprise Common Data Model, which facilitates the exchange of data between JMS and other applications.



RAIDRS Site 1, Lualualei, Hawaii

Rapid Attack Identification and Detection Reporting System (RAIDRS)

The Rapid Attack Identification and Detection Reporting System will develop and deliver an integrated radio frequency

This past year, Aerospace was instrumental in the site-unique design, site preparation, and site-installation activities supporting all five remote-detection locations.

satellite communication interference detection and geolocation capability consisting of five remote-detection sites and a central command and control center, referred to as the



Artist's concept of MUOS-1 Spacecraft

Common Operating Location. RAIDRS will enhance the effectiveness and efficiency of U.S. Air Force communications networks by detecting, geolocating, and contributing to the elimination of interfering signals. Aerospace personnel have served as the chief engineer for the effort since its inception. This past year, Aerospace was instrumental in the site-unique design, site preparation, and site-installation activities supporting all five remote-detection locations. Aerospace also provided the technical leadership for development of the RAIDRS trainer.

The system completed development test and evaluation in June 2009, completed factory acceptance test in August 2010, and is scheduled for initial operational capability in March 2013.

Navy Space Systems – Navy Ultra High Frequency (UHF) Satellite Communications

Aerospace supports two Navy satellite communications programs: operational support to the legacy UHF Follow-On constellation and acquisition of the Mobile User Objective System (MUOS). MUOS is the Navy's transformational narrowband communications system that will provide substantially increased communication capabilities by implementing cellular technology. Connectivity by tactical terminals to the Global Information Grid will enable worldwide communication.

To bolster the aging legacy constellation and to begin implementation of enhanced UHF communications, MUOS-1 was successfully launched on an Atlas V from Cape Canaveral on February 24. All deployments were completed, including unfurling both the 5-meter and 14-meter antenna reflectors. After verifying the bus and payload performance, the contractor completed on-orbit handover of the satellite to the government on June 21. The successful government test phase concluded with the satellite being relocated to its operational location to support legacy UHF users. The enhanced payload capabilities will begin initial service following ground system upgrades prior to the launch of MUOS-2, scheduled for July 2013.



Engineering and Integration

Specifications and Standards Applications

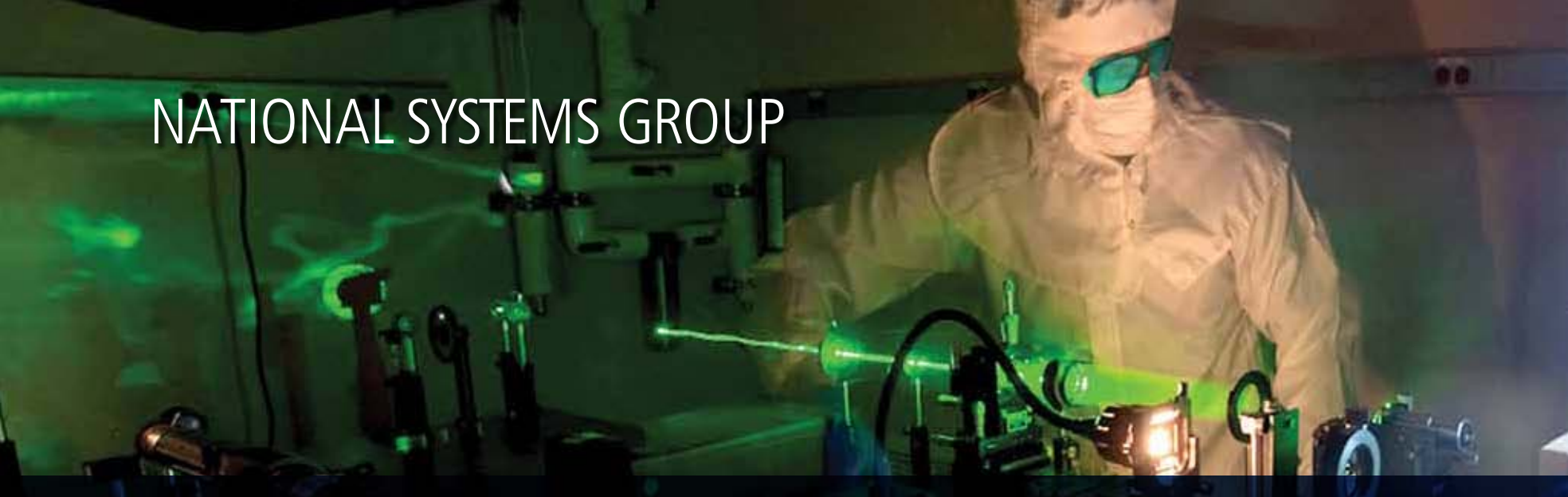
Aerospace continues to provide leadership in the development of specifications and standards and their application to national security space programs. Aerospace is supporting SMC on a follow-on to the DOD-wide “Gap Analysis” working group to address specific standards gaps in systems engineering and technical reviews, configuration management, manufacturing management and quality assurance, and logistics. Aerospace co-leads the systems engineering and technical review team and has conducted fact-finding activities with standards development organizations. Aerospace also continues to provide critical support in the development, update, and maintenance of standards used by our customers, including the development of new standards for satellite safe-mode and ground systems test and requirements for test-like-you-fly and human systems integration. Aerospace also worked with industry partners and SMC to develop Revision B of the Aerospace parts, materials, and processes technical operating reports. These reports are the basis of compliance standards used by government customers.

Successful Program Execution

Aerospace collaborated with SMC Program Management and Integration and SMC Engineering by establishing a cadre of acquisition experts to enhance SMC staff effectiveness in support of program offices. The cadre comprises a core team that works in concert with the program office and that draws upon the Aerospace backplane, senior consultants, and SMC staff as the program evolves through the lifecycle. Key to the cadre concept is early and frequent engagement with programs throughout the acquisition lifecycle. Cadre engagement through contract execution ensures that the contract baseline is complete and accurate, with effective measures of progress and quality in place.

Aerospace continues to provide leadership in the development of specifications and standards and their application to national security space programs.

NATIONAL SYSTEMS GROUP



National Systems Group (NSG) operates as a key systems engineering arm for the National Reconnaissance Office and the rest of the Intelligence Community. Using the cutting-edge technologies and core competencies that are Aerospace hallmarks, NSG aids its customers by supporting the acquisition and operation of high-impact programs designed to collect and disseminate national and tactical intelligence products. The programs and projects that follow are a few highlights of NSG efforts undertaken during fiscal year 2012 in pursuit of its continuing mission to provide exemplary systems engineering approaches and solutions for the nation's intelligence programs.



Systems Engineering and Ground Division

Electronic Programs Division



Solar array panel being prepared for humidity exposure

Future Architecture Development

Aerospace took a technical leadership role in advancing the ability of the National Reconnaissance Office (NRO) to plan, execute, and deliver a future mission architecture. The proposed architecture takes an evolutionary step toward the realization of a unified mission architecture capable of supporting a more agile, responsive, and secure mission while delivering cost-efficient operations. Aerospace provided architecture and systems engineering expertise on multiple tasks related to defining and assessing the future architecture. Aerospace also provided performance analysis for select elements of the proposed architecture, in addition to analyzing the resiliency of the architecture and making

recommendations to improve performance. Deliverable products included capability analyses architecture views, enterprise concepts of operation, a resiliency assessment, and draft requirements.

Ground Enterprise Architecture Definition

Aerospace provided essential support to the NRO ground enterprise in defining the software architecture to be used to build the future enterprise ground systems, to include defining an open-source software stack compatible with the approved ground hardware components. Using modern “cloud” technology and virtualization, the architecture will provide ubiquitous, on-demand network access for dynamic allocation of computing resources.

Time-Critical Troubleshooting of Solar Array Panel Delamination

Aerospace provided timely and critical laboratory testing and analysis, and a flightworthiness assessment, for a national security space program’s solar array panels. Several months before a launch, a silicon alloy coating used for electrostatic discharge mitigation was found to be delaminating from the solar array panel. Aerospace worked with the program office and contractor team to identify the root cause and assess flightworthiness.



Profilometer contour measurement tool

Aerospace recreated the likely failure mode in a laboratory environment and tested the samples in a simulated mission environment, concluding that the coating would not continue to delaminate on orbit and that the panels were flightworthy. These efforts enabled the program to preserve cost and schedule and meet key program milestones. Aerospace was commended by the customer leadership team and the NRO director.

Lithium Ion Battery Testing Enables Informed Decisions

An Aerospace extended battery test program was critical to enabling the customer to make informed decisions

regarding a planned transition to lithium ion (Li-ion) batteries. In 2005, Aerospace saw the energy density and weight savings benefit of Li-ion batteries and teamed with NRO program offices to develop and implement long-term testing to determine their viability for long-duration space missions. With funding from the NRO, cells from four domestic Li-ion battery cell manufacturers were procured and delivered to Aerospace. The objective of these tests was to examine each manufacturer's cell performance over various conditions such as orbit regime, depth of discharge, and temperature. The first planned flight for these batteries is in late 2014.

Mission Enabling Operations Division

Aerospace Develops Measurement Tool for Critical Booster Hardware

In December 2011, three months prior to the scheduled launch of NROL-25 aboard a Delta IV booster, an elevated risk was identified involving the potential for structural buckling of the Delta IV RS-68 engine heat exchanger (HEX). It was determined that the HEX structure had low analytical structural margins against buckling. Aerospace responded by developing, testing, and calibrating a contour measurement tool to create a three-dimensional map of the as-built HEX contour to detect manufacturing defects. The contour measurements allowed for a more precise structural analysis to be performed by both Aerospace and the contractor, leading to an enhanced assessment of the structural margin of safety and higher confidence in the predicted margin of safety for the HEX structure. Through the use of this Aerospace tool, the decisionmakers had increased confidence that the flight hardware was acceptable for flight. To date, in addition to clearing the NROL-25 HEX for flight, the tool has been used to clear the NROL-15 HEXs before flight and the NROL-65 HEXs prior to shipping from the factory to the launch site.



Aerospace Conducts Testing To Mitigate Delta IV Ignition Heating Risk

Aerospace initiated insulation flame testing to investigate excessive insulation burning and booster heating experienced during the Delta IV NROL-49 launch. Aerospace worked with the booster contractor to gain a better understanding of the combustive properties of the booster paint, insulation, and associated insulation adhesives. The test program determined that the combined use of cryo adhesive and epoxy paint led to sustained burning when exposed to the Delta IV Heavy ignition heat loads. These

findings prompted the contractor to implement thermal mitigation on NROL-15, NROL-65, and future Delta IV launch vehicles. The test results dramatically improve the anchoring of thermal and structural modeling that will be used to determine launch readiness for future Delta IV missions. This work is especially critical for West Coast Delta IV Heavy missions in which staggered engine start, in combination with booster thermal protection, is crucial for lowering the booster heating environments.



Sequence of images from insulation flame test



Delta IV Heavy launch vehicle blasts off with NROL-15 payload onboard



Mission Transport Service Architecture

The NRO is pursuing a Mission Transport Service intended to reduce costs while improving performance and maintainability of its communications information transport architecture. This effort impacts all elements of the information transport architecture, including the communications subsystems on spacecraft, the Earth terminals used to communicate with the spacecraft, the terrestrial communications segment, and overall system management. Network resiliency is a critical goal of this effort.

Aerospace applied its systems engineering rigor to address technology and performance assessments and transition planning, as well as to develop the resulting budget

submission. Aerospace analyzed and provided data and recommendations to the government in areas such as radio frequency link performance, data latency, and network throughput, which informed the decisions surrounding technical scope, schedule, and budget. Aerospace also provided critical assessments of industry responses to a request for information soliciting industry ideas on ways to introduce more commercial-like practices into future acquisitions to reduce costs.

The first product of this effort is the FY14 budget submission. Next, the government program office team – with Aerospace support – will enter into the acquisition process for the Mission Transport Service.

Imagery Programs Division

Fielding Critical Capability in Record Time

Personnel from the Imagery Programs Division and the Engineering and Technology Group performed key roles in the testing and delivery of a critical national security space capability. Using lessons learned from previous efforts, Aerospace participated in activities that resulted in schedule savings with no significant increase in risk. Aerospace staff filled on-site roles, teaming with the customer and contractors to successfully field the capability in record time. The staff was recognized by senior customers for their dedication and effectiveness.

Establishing Design Baseline

Imagery Programs Division and Engineering and Technology Group personnel supported customers and contractors in a months-long effort to baseline the design of a major new national security space system. Thousands of pages of documentation were reviewed, with a focus on technical accuracy and programmatic soundness. Many aspects of the design were simulated, modeled, and analyzed to determine the efficacy of the approach. Aerospace's effort culminated in a formal review that was highly praised for completeness and resulted in moving the system to the next phase of development.



Advanced Technology Division

Satellite Universal Modular (SUMO) Architecture and Standards Development

Based on Aerospace studies, the Office of the Director of National Intelligence is pursuing an effort to use modular electrical/data buses and universal components with standard interfaces in satellites. Aerospace analysis showed strong potential for reduced nonrecurring engineering costs and enhanced global competitiveness for the U.S. space industry if the space enterprise adopts this approach. Aerospace played a key role in coordinating the SUMO effort across government and commercial satellite stakeholders, as well as establishing the technical framework, which will include existing and evolving standards to enable modular architectures. SUMO is now being encouraged at high levels within the government. Aerospace is facilitating collaboration with industry groups, such as the Consultative Committee on Space Data Systems, that are working to achieve consensus on standards. As Aerospace continues to facilitate the SUMO effort, long-term benefits are being defined, including greater interoperability of space components, reduced satellite costs, and a more robust space industrial base.

Intelligence Community (IC) Study for Future Sensing Technology

Aerospace provided key technical and programmatic contributions to a multi-agency plan to develop, deploy, and exploit a new sensing technology on ground, air, and space platforms. The plan emerged from a cross-agency study with an initial scope of determining the key intelligence needs satisfied by the sensing technology and the overall priority of deploying the technology independent of platform. The study was later extended to evaluate and prioritize different Intelligence Community investments measured by intelligence value, technical readiness, programmatic feasibility, and cost. This study had high visibility within the community, was briefed to multiple IC agency directors, and has resulted in a joint way forward for these agencies. The government study team depended heavily on Aerospace expertise in formulating its final recommendations due to the breadth and depth of Aerospace corporate knowledge of the sensing technology.



ENGINEERING AND TECHNOLOGY GROUP

Verification of multi-function solar cell performance

Engineering and Technology Group (ETG) is a matrix of nationally recognized space systems experts that supports both external customers and the other corporate groups in the pursuit of mission success. Comprising nearly half of the company's technical talent, the group consists of six specialty organizations equipped with state-of-the-art computing, testing, diagnostic, research, and simulation facilities, as well as unique Aerospace databases that have evolved since the beginning of the space era.



Commitment
to
Our People
Our People

Making an adjustment on the slit scanning imaging polarimeter

Designed Polarimeter for Remote Sensing

With the resurgence of interest in exploring the use of polarimetry for remote sensing, Aerospace has developed a unique polarimeter that measures all of the polarization properties of light simultaneously. Polarimetry exploits the nature of light as a transverse wave with a defined plane of vibration. This polarimeter, which Aerospace specifically designed for use in remote sensing, operates in a manner similar to an imaging spectrometer. In the Aerospace design, a prism disperses light from an entrance slit into six components that contain all the polarization information in the light. Aerospace is building this concept into a visible-light polarimeter; there are also plans for an infrared polarimeter designed to measure polarized emission from objects day and night.

Performed Integrated Fatigue Life Assessment to Preserve Launch Schedule

Aerospace has developed an integrated fatigue analysis technique that combines finite-element stress modeling and probabilistic methods to quickly and accurately assess the likelihood that flight hardware will experience functional anomalies during ground processing or space operations. These failures in spacecraft and launch vehicles, which usually manifest as electrical performance anomalies, can lead to loss of mission or critical functions.

This Aerospace-developed technique has been used on many successful investigations to prevent launch delays by either substantiating that suspect components could be used as-is or showing that adequate margin exists with

operational changes. It has also provided rationales for effective design enhancements.

A critical solder joint analysis and risk assessment is a recent example of how this technique helped to prevent a lengthy launch delay of a classified spacecraft. The assessment showed that 82 suspect joints in the spacecraft, which likely contained severe cracks, could be used as-is by implementing a software change to eliminate power thermal cycling during the mission. The assessment showed that the operational change reduced the mission's failure risk to an acceptable level.



Artist's concept of International Space Station with HTV-3

Launched Reentry Breakup Recorder to the International Space Station

Two Aerospace-designed and built reentry breakup recorders (REBRs) were delivered on time for a July 21 launch to the International Space Station aboard Japan's H-II Transfer Vehicle 3 (HTV3). The REBRs are designed to activate during reentry to record accelerations, rotation rates, temperatures, and other information during breakup of the host vehicles. The recorded data is then transmitted via the Iridium satellite system before the REBRs land in the ocean. The data returned from REBRs will enable an improved understanding of reentry breakup and provide a benchmark for models that predict reentry hazards and footprints for surviving debris.



Picosatellite solar cell testbed nanosatellite

One of the two recently launched REBR devices successfully reentered inside HTV3 on September 14. The REBR survived the violent breakup, made the planned recordings, and successfully transmitted the data before splashing into the ocean. The second REBR successfully reentered inside the European Space Agency's Automated Transfer Vehicle-3 (ATV-3) on October 3. The two REBRs included upgrades designed to eliminate potential failure modes discovered during the ATV-2 reentry event.

Demonstrated Maneuverable Picosatellite Prototype

Aerospace has developed and flight-tested the world's first solid-rocket-motor-propelled, picosatellite-class vehicle (weighing approximately one kilogram) under full thrust

vector control. The final test flight demonstrated full attitude control during a five-second motor burn, achieving 1 g and 50 meters per second.

Leveraging spare AeroCube 4 hardware, the two-year project was conducted at a fraction of the cost typical of new satellite and missile concept development programs and has established Aerospace as a leader in small, lightweight, cost-effective, and highly maneuverable space vehicles.

In June, telemetry and video data confirmed successful testing of the launch, guidance, and recovery systems, which led to three successful guided test flights. Partly as

Aerospace has developed and flight-tested the world's first solid-rocket-motor-propelled, picosatellite-class vehicle (weighing approximately one kilogram) under full thrust vector control.

as a result of Aerospace's efforts, the technology now exists for picosatellites to execute controlled maneuvers and orbit changes, significantly expanding their mission capability.



Artist's concept of Phobos-Grunt Spacecraft reentry
(credit: Michael Carroll)

Provided Analysis of the Reentry of the Phobos-Grunt Spacecraft

Aerospace was the principal U.S. source for analysis of the reentry and breakup of the Russian Phobos-Grunt mission, which failed shortly after being placed in an initial parking orbit on November 8, 2011. The Phobos-Grunt mission was to return a soil sample from the Martian moon Phobos. As a result, the vehicle carried a large quantity of toxic fuel and oxidizer in multiple tanks that presented a significant hazard. Aerospace identified the possibility that toxic fuel could survive the breakup and reach the ground. As the event approached, Air Force Space Command closely monitored the spacecraft orbit in order to predict the time and location

of reentry. Aerospace used multiple existing tools to predict the time and location, and developed new tools to predict the probability and location of the debris field.

Updates to the predictions were provided on a daily basis, and onsite, realtime support was provided at the Joint Space Operation Center (JSpOC) for reentry on January 15, 2012. Working together, a geographically dispersed Aerospace team at JSpOC, El Segundo, Chantilly, Colorado Springs, and the National Air and Space Intelligence Center provided situational awareness using a new modeling

framework. The framework enabled visualization of analysis products into a modular dashboard display, with software that automatically provided updates in near realtime.

Analysis products provided by Aerospace included indications of sensor visibility, the position and orientation of the spacecraft relative to the ground tracking sites, an impact probability distribution, atmospheric descent profiles, and impact ellipses of the major surviving components.



Aerospace collocated with Air Force Space Command



Fly's Eye Energetic Particle Sensor

Performed Military Utility Analysis in Support of New Customers

Aerospace has expanded its area of military utility analysis (MUA) by supporting an array of new projects. Working with system and military subject matter experts, the MUA team used an agent-based simulation environment from the System Effectiveness Analysis Simulation (SEAS) tool to evaluate the impacts that a system has on warfighter operations. Such evaluations of system utility in an operational context have become criteria that have seen considerable growth recently. In FY12, the corporation increased its support to a number of new MUAs, including:

- Army Comm-On-The-Move architecture for Air Force Space Command Global Mission Support Division and the Resilient Basis Study in Washington, D.C.

- New system concept of operations for the National Geospatial-Intelligence Agency
- A portfolio of Precision Guided Munitions for the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics
- Weather satellites for Aerospace's Environmental Satellite Systems Department, and others

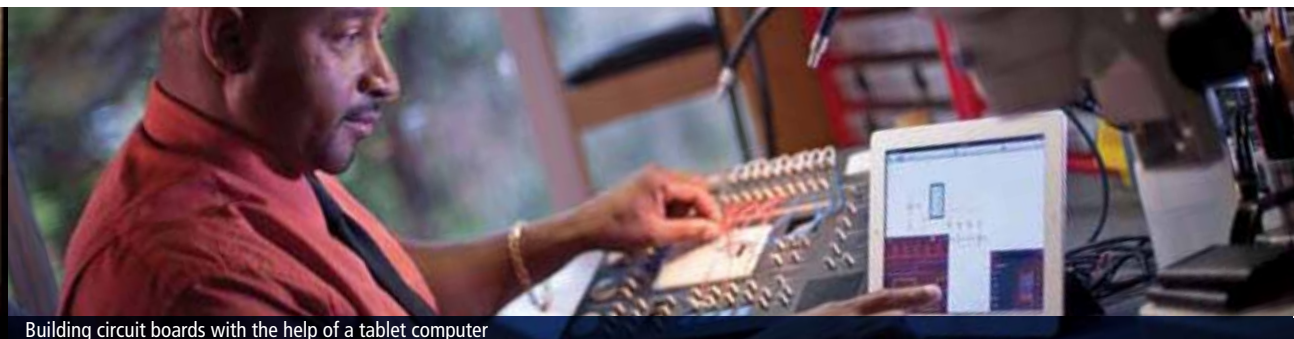
While a majority of the work requests for analyses on systems remains in postdesign phase, the corporation has been developing capabilities that support up-front analysis that aids in the design or investment phase of new, or evolving, systems. Much of the work is continuing as expansion studies that will yield higher-fidelity models, more in-depth analysis to support the customer, and a more diverse portfolio of scenarios to inform future studies.

Delivered FEEPS Flight Instruments for the Magnetospheric MultiScale mission

Two Fly's Eye Energetic Particle Sensors (FEEPS) instruments, which were designed, fabricated, and tested by Aerospace, were delivered to NASA Goddard Space Flight Center in May. FEEPS is part of the scientific instrumentation that will fly on the Magnetospheric MultiScale (MMS) mission, consisting of four identical satellites flying in a tetrahedral formation to study magnetic reconnection. Reconnection is a plasma process for the transfer of energy between particles and electric and magnetic fields, and is thought to be the "engine" that drives numerous phenomena in Earth's magnetosphere. The FEEPS instruments will measure energetic electrons on the MMS mission scheduled for launch in 2014. These are the first two instruments of eight total that Aerospace will deliver to Goddard.



Aerospace data center



Building circuit boards with the help of a tablet computer

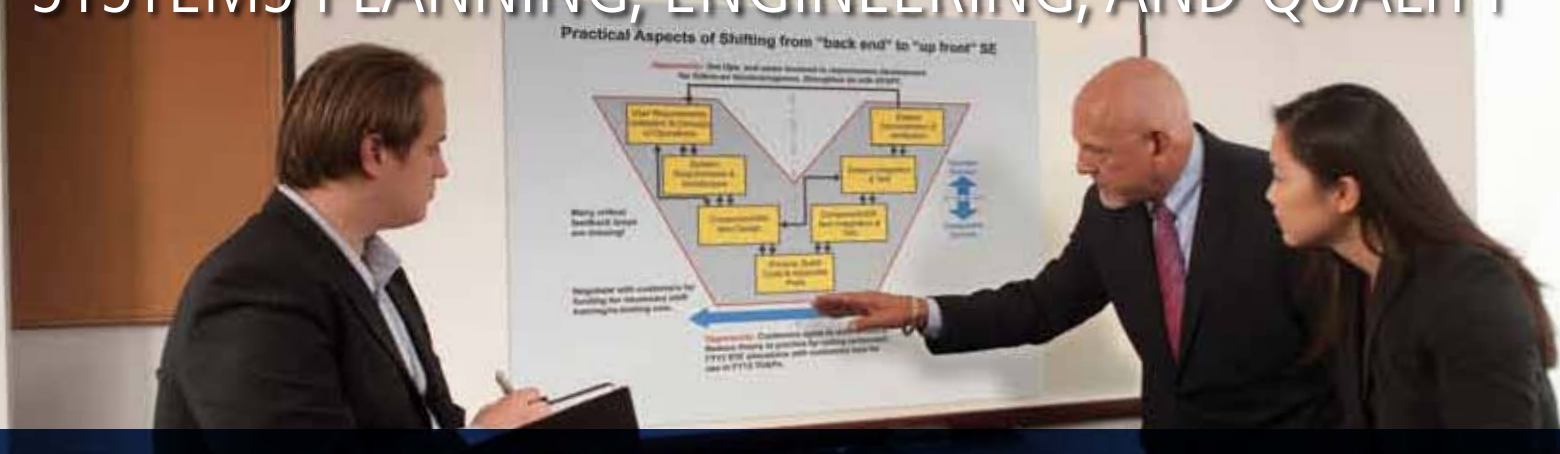
Completed Datacenter Transition

Aerospace transitioned its primary unclassified datacenter to a new hosted facility. The former datacenter had reached its end of life and required costly upgrades that would have disrupted core operations for extended durations. Aerospace opted instead to put its servers and storage into an existing hosted facility with modern power and cooling. The transition occurred over 11 discrete move events, working around launch schedules and minimizing disruption to corporate services. The new datacenter uses less power and cooling, improves reliability and availability of computing services, and gives Aerospace the agility to respond to future methods of computation.

Improved Capabilities for Technical Innovation

Collaboration is at the heart of many Aerospace technical innovations and analyses, as evidenced in the enterprise search capabilities that have been expanded to provide better interfaces, with more control and recommendations, over a wider array of repositories. The corporation has increased its Web-based and mobile access to more information to enhance the usability and utility of existing data sources, as well as improve its access to and usability of repositories of classified information. Aerospace also greatly increased its technical computing power and storage to address the needs of increasingly complex analyses, and developed internal computing capabilities that provide scientists and engineers easy access to computing resources.

SYSTEMS PLANNING, ENGINEERING, AND QUALITY



Systems Planning, Engineering, and Quality (SPEQ) provides analysis-based decision support to senior leaders on space architectures, developmental planning, system-of-systems engineering, threat reduction, and mission assurance that helps shape future national security space (NSS) missions. SPEQ provides a broad range of services across the NSS enterprise and supports major NSS customers, including the Under Secretary of the Air Force; Under Secretary of Defense for Acquisition, Technology, and Logistics; Under Secretary of Defense for Intelligence; Air Force Space Command; Missile Defense Agency; Air Force Materiel Command; Space and Missile Systems Center; National Reconnaissance Office; and Operationally Responsive Space Office.



Missile Defense and Space Sensors



Ballistic Missile Defense System at Fort Greely, Alaska

Integrity Integrity

Aerospace made key contributions in systems architecting and engineering, mission assurance, space system integration, and the evaluation and insertion of advanced technology in support of the Missile Defense Agency (MDA). MDA manages an extensive program to develop, produce, and utilize target vehicles for major integrated tests of the Ballistic Missile Defense System (BMDS). Current demonstration systems include the Space Tracking and Surveillance System (STSS) and the Near-Field Infrared Experiment. Under development are the Precision Tracking Space System (PTSS, the STSS follow-on) and an advanced sensor system.

STSS demonstrator satellites carry first-of-a-kind electro-optic infrared sensor payloads designed to track missiles from launch to target impact. Aerospace was instrumental

in designing and exploiting data from several tests in which STSS demonstrated two impressive firsts—the first stereo track of a target that provided fire-control-quality information, and the first simultaneous track of two targets. The primary purposes of the satellites are to demonstrate the utility of the space layer to BMDS and to inform decisions about PTSS.

Aerospace helps integrate Space Based Infrared System and other sensors into the BMDS through support of the BMDS Overhead Architecture (BOA). When fully developed, the BOA will enhance the Command and Control, Battle Management, and Communications system's ability to provide precision cues to radars and other sensors, including PTSS. Aerospace represents MDA in the Joint Overhead Persistent

Infrared Ground Integrated Program Office, which is tasked to develop ground software to fully exploit overhead sensors for missile defense and other mission areas.

Aerospace also provides mission assurance and rapid-response problem-solving support through detailed pedigree reviews – a subset of the corporation's launch verification matrix for targets and interceptors destined for BMDS flight tests. This fiscal year, Aerospace applied its laboratory capabilities in support of failure investigations to measure fundamental material properties and gas phase transport mechanisms, hardware response to vibration environments and isolator effectiveness, nondestructive inspection of thermal protection systems, and nondestructive and destructive analyses of components and mechanisms.

Corporate Chief Engineering Office (CCEO)

CCEO is charged with bringing pragmatic and consistent mission assurance discipline to all Aerospace customers. Responding to the government's emerging efficiency initiatives, CCEO is focused on optimizing mission assurance.

Commercial Buyer Survey

Through collaboration forums such as the Space Quality Improvement Council (SQIC), Aerospace participated in a satellite-builder working group that described how commercial procurements are conducted, and compared their similarities and differences to government procurements. Aerospace identified the need to obtain the satellite-service-provider perspective and conducted a commercial buyer survey to complement the perspectives provided by the satellite-builder working group to the government. The survey results showed that established satellite buyers maintain strict oversight and heavily incentivize the manufacturers for quality and timely delivery. These results were broadly requested and were followed by a report delineating recommended terms and conditions of satellite procurement contract language under this acquisition model.

In addition to development of corporate standard practices for mission assurance, CCEO is responsible for implementing a corporate quality system. Deployment of the corporation's quality management system continued in FY12 with the development of a business operations quality manual,

which describes how the quality management system is implemented through corporate policies, practices, and processes.

Critical Factors for Acquisition Success

The Critical Factors for Acquisition Success Checklist, the result of an extensive MITRE-Aerospace collaboration, was completed. The checklist serves as an aid to program managers and others responsible for formulating and/or executing a federal acquisition program to improve the program's chance of success.

Aerospace hosts and cohosts collaborative forums with government and industry, including the Mission Assurance Summit, SQIC, and the Space Supplier Council.

Collaborative Government and Industry Forums

Aerospace hosts and cohosts collaborative forums with government and industry, including the Mission Assurance Summit, SQIC, and the Space Supplier Council. This year's forums focused on how to increase efficiency without sacrificing quality and mission assurance. Specific topics included quality audits and joint audit planning, supplier rating systems best practices, best practices for preventing

lapses in workmanship, and methods for producing more affordable systems through improved quality management.

Internal Corporate Process Improvements

- **Mission Assurance Portal 2.0**

The Mission Assurance Portal serves as a corporate resource to vetted mission assurance guidance and information. Version 2.0 of the portal leverages technology updates to aggregate news reporting from several formal corporate sources. These updates improve response time in maintaining currency of information, reduces overall maintenance costs, and supports Aerospace users who primarily work in classified environments.

- **Mission Assurance Toolset Enhancements**

The Mission Assurance Baseline (MAB) and entire mission assurance toolset suite have been significantly enhanced. Major MAB updates and additions to numerous specialty engineering areas, early phase systems engineering, and launch systems integration were completed. In addition, the entire integrated Mission Assurance Tool's user interface was overhauled, the new corporate risk matrix was incorporated, and the ability to automatically export briefing charts suitable for program reviews was deployed.



Strategic Space Operations (SSO)

Ballistic Missile Defense System Space Situational Awareness (SSA) Integrated Sensing Demonstration (BISD)

Aerospace led a successful demonstration of the ability to integrate a BMDS nontraditional radar system into the U.S. Strategic Command's (USSTRATCOM) SSA mission. The end-to-end demonstration involved the Joint Space Operations Center (JSpOC), Command, Control, Battle Management, and Communications (C2BMC) program, and the Missile Defense Agency (MDA) Transportable Radar Surveillance (TPY-2) system. Over a one-week period, JSpOC successfully tasked the radar for space collections via the C2BMC/X-Lab, and the TPY-2 radar successfully tracked hundreds of high-interest satellites, including a space launch. Aerospace briefed the results to the MDA director and Air Force Space Command vice commander. This demonstration addressed the Office of the Secretary of Defense's goals for multimission operations as well as the USSTRATCOM goals for SSA leveraging of nontraditional data sources into the greater SSA architecture. This was the first time a nontraditional radar was able to send SSA data to JSpOC to be processed operationally.

Hypertemporal Imaging (HTI) Risk Reduction

Aerospace conducted field and laboratory experiments in

support of Air Force Research Laboratory risk-reduction activities in preparation for a dedicated flight instrument for HTI missile warning research. Aerospace coordinated operations and data evaluation of field campaigns in Redstone, AL, and Woomera, Australia. In each case, existing space assets were tasked to observe static rocket motor firings through optically dense clouds. Aerospace provided on-ground instrumentation and data collection, including cloud-profile measurements and ground-based motor infrared imaging. Aerospace efforts will inform a government reference design for a flight demonstration and help anchor models as to the effectiveness of HTI methods for under-cloud detection of missile firings.

CloudSat Returns to the Afternoon Constellation

Launched in 2006, NASA's CloudSat mission flew in formation with other Earth-observing satellites in NASA's Afternoon Constellation—the "A-Train" — until April 2011 when a serious battery anomaly forced CloudSat to lower its orbit and leave the A-Train. Despite the crippled battery, the CloudSat team restored the satellite's science capability during the daylight portion of its orbit, and Aerospace designed a sequence of orbit maneuvers to return CloudSat to the A-Train. This maneuver campaign was dramatically

redesigned several times, often on short notice, in response to timing constraints and burn-execution failures. Aerospace developed tools to quickly plan maneuvers to achieve the complex final orbit configuration while staying within CloudSat's limited burn capabilities. CloudSat completed its return to the constellation in July 2012 and is again providing concurrent science measurements with the other A-Train satellites.

Resilient Basis for Satellite Communications (SATCOM) in Joint Operations Study (RBS)

Aerospace leadership and technical contributions were crucial to completing a Defense Space Council-directed study to define future SATCOM architectures to meet warfighter needs. Aerospace was the co-lead for the Threats and Scenarios Working Group and supplied the principal technical expertise and leadership to task, coordinate, and deliver a comprehensive set of counterspace, nuclear, and cyberspace threat products that were essential to execution of the overall RBS. Aerospace technical work enabled the RBS team to evaluate and compare alternative SATCOM architectures for performance and resiliency in a consistent manner across all operational environments: nuclear, contested, and benign.

Developmental Planning and Architectures (DPA)



DARPA's Hypersonic Technology Vehicle



Aerospace performed objective modeling, simulation, and analyses to enable customers to make informed investment decisions on affordable and resilient future space, ground, and launch systems capabilities. Information assurance, cyber risk management, and spectrum engineering were emphasized in the lifecycle planning of national security space systems from architecture development through sustainment. Studies using performance, transition efficiency, resilience, robustness, and affordability criteria to develop alternate approaches were presented to government decisionmakers.

Conventional Strike Missile (CSM)

Aerospace led the integration of the Air Force CSM Altitude Prediction Reporting and Accuracy flight experiment, which

quantifies the ability to fuse and detonate a weapon with extreme accuracy under hypersonic terminal conditions. Aerospace successfully concluded a complex series of integrated analyses identifying the cause of an anomaly that affected the Defense Advanced Research Projects Agency's previous Hypersonic Technology Vehicle.

24th Air Force Cyber Command Operations Center

Aerospace provided information assurance certification and accreditation expertise to expedite the completion of the 24th Air Force Cyber Command Operations Center at Lackland AFB, TX. The center provides state-of-the-art information technology infrastructure to allow the 24th Air Force to perform its cyber mission.

Spectrum Management

Aerospace provided Air Force decisionmakers with analyses of spectrum interference issues associated with commercial contention for spectrum used by key defense and Intelligence Community missions. Aerospace is leading efforts to quantify the impact of commercial cellular phone providers with the ability to infringe on receivers associated with nationally important spacecraft downlink frequencies. Concerns and potential solutions were vetted with the interagency Frequency Management Working Group, consisting of Space and Missile Systems Center, National Reconnaissance Office, Defense Information Systems Agency, NASA, Navy, and Federal Communications Commission representatives.



National Space Systems Engineering (NSSE)

NSSE provides early systems engineering, analysis, decision support, and shared situational awareness via staff assigned directly to Pentagon/USSTRATCOM leaders.

Pentagon Decision Support

A broad set of Aerospace experts provided technical leadership and analysis across an array of studies informing architecture and investment choices for FY13 and beyond. Major studies included Joint Overhead Persistent Infrared Integrated Space Trades; Resilient Basis for SATCOM in Joint Operations; Assessment of National Space Control Capabilities; Future Long-Track Airborne Intelligence; Surveillance and Reconnaissance Satellite Communications; a congressionally directed review of the Precision Tracking Space System; an evaluation of alternative liquid rocket engine solutions; and an assessment of the Joint Milli-Arcsecond Pathfinder Survey mission. Aerospace helped develop and analyze many architectural options, evaluated the benefits and “regrets” of requirement relaxation, assessed designs and technology choices, and enabled formulation of more cost-effective and technically achievable options to ultimately inform investment decisions made by the deputy secretary of defense.

Joint Overhead Persistent Infrared (OPIR) Integrated Space Trade (JOIST) Study

Aerospace supported the analytic foundation for the Joint OPIR Integrated Space Trade (JOIST) Study. JOIST was commissioned by the Office of the Under Secretary of Defense for Acquisition, Technology, and Logistics and the Defense Space Council to explore the trade-space for the potential 2017 to 2030 timeframe OPIR architecture. Aerospace supported the development of the overall study methodology and delivered evaluations of sensor and architecture options, including critical support to an assessment of associated technologies and the supporting industrial base. Modeling and simulation products from Aerospace supported JOIST leadership in making OPIR requirement trades that could yield significant cost avoidance for future architectures. Premature selection of specific architectures was also avoided by using a decision-roadmap construct, which postures DOD with a viable industrial base to support future satellite buys.

USSTRATCOM Space User Support

Aerospace supported USSTRATCOM’s efforts to enhance international cooperation and data sharing through the



U.S. Strategic Command headquarters building, Offutt AFB, NE.

Combined Space Operations Concept “period of discovery.” Aerospace led coordination efforts, assessed the utility of integrated operations, and laid out a long-range plan identifying capabilities from a dozen countries, enhancing partnerships, improving situational awareness, and increasing the resiliency of space capabilities to attack. Aerospace also supported the Purposeful Interference Response Team, providing assessments of increased interference to commercially leased Ku-band and military ultrahigh-frequency satellite communications and GPS user equipment.

CIVIL AND COMMERCIAL OPERATIONS



Artist's concept of NASA's Mars Science Laboratory spacecraft approaching Mars

The Air Force and other corporate customers recognize that broadening The Aerospace Corporation's business base is in their best interest because it not only contributes to national space programs, it also expands the corporation's knowledge base, allowing us to serve them better, and it augments the business stability of the corporation.

Since CCO's inception in 1994, the largest portion of its work has supported NASA, followed by the National Oceanic and Atmospheric Administration's civil weather and environmental satellite programs. CCO has also served national executive departments, states, nonprofit organizations, commercial companies, and international agencies. Civil and commercial work is performed either by direct contract or as an additional task on the Air Force contract.

In addition, CCO manages the Intellectual Property Programs Office, which assists in putting technologies developed by Aerospace researchers into the hands of commercial companies to create commercially viable products.



Artist's concept of NASA Mars Exploration Rover (MER)



Robotic arm on Mars rover Curiosity



Viewing spark generated by ChemCam laser for Mars rover

Jet Propulsion Laboratory (JPL) – Aerospace Provides Key Support to Mars Rover Curiosity

The Mars Science Laboratory, a robotic science probe mission to Mars launched on November 26, 2011, successfully landed Curiosity, a Mars rover, in Gale Crater on August 6, 2012. Aerospace provided critical simulations for this key event to predict separation velocities, loads, and clearance loss. Curiosity has already begun its two-year mission of investigating and assessing whether Mars has ever offered, or still has, conditions favorable to sustaining microbial life. Other key tasks performed by Aerospace for JPL during the development of Curiosity include:

- Organized and led the review of the “sky crane” concept
- Performed structural and thermal analysis of avionics circuit boards
- Reviewed the designs of the robotic arm, ChemCam instrument, propulsion subsystem, bridle umbilical device, telecom subassembly, and rover pyro fire assembly/rover battery thermal enclosure
- Provided environmental test support
- Performed requirements traceability and gap analysis
- Developed a certification-of-flight-readiness framework
- Conducted “test as you fly” and incompressible test list compliance assessment

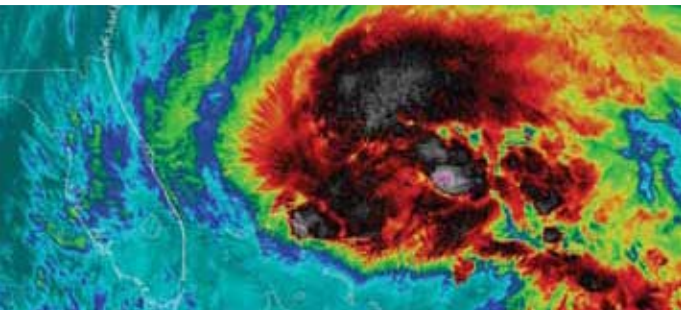


A 'Blue Marble' image of Earth taken from Suomi NPP's VIIRS instrument

NASA Goddard – Aerospace Demonstrates Expertise to NASA during NPOESS Preparatory Project (NPP) Satellite VIIRS Degradation

The NPP satellite was successfully launched on October 28, 2011. Aerospace supported NPP on-orbit activities as leaders of the operations team in mission manager and instrument flight manager roles. The NPP satellite's visible infrared imager radiometer suite (VIIRS), a scanning radiometer that collects visible and infrared imagery and radiometric measurements of the land, atmosphere, cryosphere, and oceans, acquired its first measurements on November 21, 2011. However, a significant degradation in the reflectivity of the surface of the VIIRS mirrors was soon observed by Aerospace. NASA formally stood up a VIIRS anomaly review team (ART).

Aerospace assembled a team of experts from across the



NPP satellite VIIRS infrared band image of Hurricane Sandy



VIIRS anomaly review team in lab

corporation that worked to support the VIIRS ART. Testing of the NPP satellite VIIRS witness samples was performed at Aerospace.

Aerospace assembled a team of experts from across the corporation that worked to support the VIIRS ART.

Aerospace's time-of-flight secondary ion mass spectrometry sputter analysis showed an unusual compound among the more common ones on the surface of the VIIRS mirror – tungsten and compounds of tungsten oxide. An ultraviolet (UV) analysis of the witness samples also revealed that degradation was caused on exposure to UV light and that the most probable root cause was tungsten contamination

of the telescope mirrors. The most likely source for tungsten was determined to be the optics coating process. Aerospace laboratory analysis of a witness sample from the same run used to coat the silver mirrors in the VIIRS rotating telescope assembly (RTA) revealed tungsten and tungsten oxides in two places: in a thin layer at the top of the coating and in smaller trace quantities below the silver layer. In discussions with the coating vendor it was learned that an ion source using a tungsten filament was routinely used in a cleaning step prior to deposition of the silver as part of the normal coating process. This explained the presence of tungsten below the silver, but also suggested a root cause for the presence of tungsten in the top layer of the coating. The coating vendor reported that the ion source was used a second time as a final step in coating the RTA mirrors.

This final step, which was not part of the normal coating process, brought the mirrors within the reflectance specification, but also introduced tungsten into the top layer of the coating. Aerospace determined that mirror degradation due to the presence of tungsten continues asymptotically until it reaches about 20-22 percent. Since VIIRS was designed with a 150-percent margin, this amount of mirror degradation was within specification and would not affect the quality of the images.

Objectivity Objectivity



NASA Headquarters – Aerospace Developed Framework to Assess Health of Projects for NASA Science Mission Directorate

Aerospace developed an integrated programmatic assessment framework to support senior leadership and project staff within the Science Mission Directorate (SMD) at NASA HQ. This framework consists of quantitative assessments, such as probabilistic earned value management, independent cost estimates, and the project risk evaluation

process, which are performed on a recurring basis during the lifecycle of a project. More specifically, the framework consists of performance metrics, such as lifecycle cost trending, launch readiness date trending, annual fiscal year funding profile constraints, and development threat trending. These provide a programmatic snapshot of a project's health and are incorporated into the monthly SMD flight program reviews.

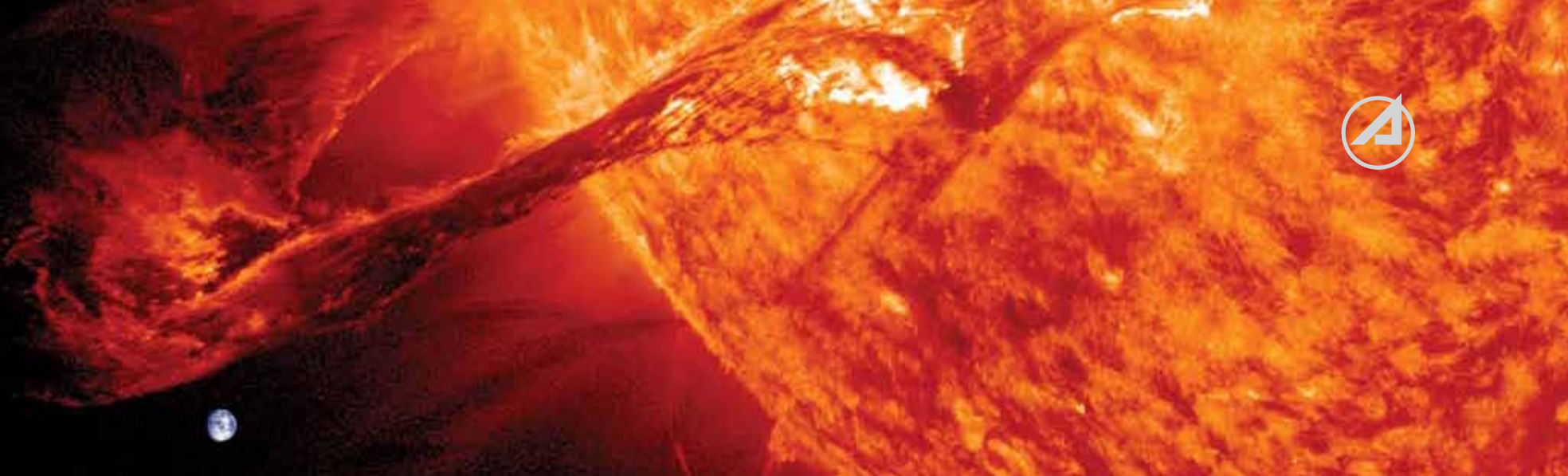


Image of massive filament eruption, with superimposed Earth for scale, captured by NASA's Solar Dynamics Observatory (SDO)

National Research Council (NRC) – Brought Cost and Technical Realism to Future Heliophysics Space Science Planning

Similar to its support to the NRC for its decadal surveys in astronomy and astrophysics (2010) and planetary exploration (2011), Aerospace played a key role in determining the future of the nation's space science mission priorities through its support to the NRC Space Studies Board decadal survey in heliophysics. Aerospace was involved in the technical evaluation and optimization of mission concepts to meet national science goals as well as the assessment of mission cost and affordability within current budget realities. Unlike prior decadal studies, for the heliophysics decadal, Aerospace was asked to be the single organization responsible for both mission design evaluation and cost and technical evaluation.

Aerospace used a streamlined approach to mission concept development that brought NASA engineers, NRC decadal steering committee members, and science community stakeholders into the Aerospace Concept Design Center with Aerospace engineers to rapidly establish requirements and iterate on mission concepts. Once concept definition was completed, a separate Aerospace team, independent of the concept definition team, performed the cost, schedule, and technical risk evaluation for each mission. Throughout a two-year process, Aerospace interacted regularly with the NRC Heliophysics Steering Committee and NRC staff to address technical, cost, and risk-assessment questions as the study converged to its final set of priorities and recommended budget allocations. The heliophysics decadal strategy report was published in August 2012.

Aerospace was involved in the technical evaluation and optimization of mission concepts to meet national science goals as well as the assessment of mission cost and affordability within current budget realities.



Department of Energy (DOE) – Performed Independent Cost/Technical Assessment of Future Nuclear Detection System (NDS) Architectures

Aerospace presented the results of an independent cost and technical assessment on future NDS architectures to the NDS study team and independent review panel composed of stakeholders from the NDS community. Aerospace performed the assessment for the DOE National Nuclear Security Administration, which is executing an analysis of alternatives to examine next-generation NDS sensors and options for hosting on future government space programs. Aerospace developed both hosted and free-flyer architecture concepts and performed an independent cost and risk assessment of each alternative under a very short timeline, utilizing the Aerospace Concept Design Center’s space seg-

ment and ground system teams, as well as NDS expertise within the GPS program office and the Space and Missile Systems Center’s Developmental Planning Directorate.

Aerospace also performed an independent expert review of the performance modeling and evaluation as part of the analysis of alternatives effort.

Federal Bureau of Investigation (FBI) – Assisted in Achieving Sentinel Final Operating Capability Milestone

Aerospace is a key participant in the development and deployment of the Sentinel software case management system. Sentinel was deployed nationally to the FBI on July 1, 2012. Aerospace key roles include: assisting with the transition from the previous Automated Case Support system to Sentinel; planning and coordinating Sentinel engineering and deployments; and leading infrastructure, evidence management, and external interface activities. Aerospace supported the Sentinel transition, serving as primary point of contact for the Boston, Los Angeles, New Haven, and Portland FBI field offices. Aerospace also has played a key role in the planning, development, and delivery of Sentinel patch builds and scheduled releases.

Allied Minds Federal Innovations (AMFI) – Signed a Five-Year Technology Commercialization Agreement for Technology Transfer

Allied Minds Federal Innovations Inc. signed a five-year, \$3.5M contract to assist Aerospace in the mission of technology transfer and commercialization as part of a broader program related to the commercialization of DOD innovations. Aerospace had been exploring new models for federal laboratories to execute the technology transfer mission. Working with other FFRDCs and DOD experts, it was determined that the challenges and costs associated with technology transfer have common elements. After exploring various alternatives, Aerospace was introduced to Allied Minds Inc., a private investment firm based in Boston. Allied Minds realized the unique opportunity to create a groundbreaking public-private partnership with Aerospace that would result in a more efficient system for licensing technologies and developing commercial applications for those innovations. They created AMFI to pursue this approach. After many months of converting the model into a pilot program and a contract, the agreement was signed for a value of between \$200K and \$700K per year for five years. AMFI has allocated an estimated \$25M for funding projects based on Aerospace technology and has access to well over \$100M in funding moving forward.



NASA Johnson Space Center (JSC) – STARS Facility Provides NASA and SpaceX Live Video Transmission of Dragon Return

Aerospace designed and managed an airborne observation campaign for NASA that used U.S. Navy aircraft to observe the SpaceX Dragon capsule reentry and splashdown, sending live video to NASA through Aerospace's Spacelift Telemetry Acquisition and Reporting System (STARS). This mission involved two Navy P-3 aircraft, one that obtained video data at various wavelengths and one that received video data from the first aircraft and passed it to STARS through the International Maritime Satellite system.

STARS then distributed the video to NASA Marshall Space Flight Center, Johnson Space Center, and SpaceX. Aerospace played the role of integration and test and operations manager for NASA. Aerospace tasks included aircraft flight path planning, imagery simulations, communications links integration, risk analysis, and overall management of the effort. Additional airborne video missions to cover the Orbital Science Antares launch and potential additional SpaceX missions are under consideration.

Robotic Arm attaches to SpaceX Dragon cargo craft at International Space Station



Corporate Social Responsibility

environment
STEM
community outreach
leadership



Aerospace CEO Dr. Wanda Austin stresses the importance of diversity

Corporate social responsibility (CSR) is a merger of business and community that works to improve the society that both share. The Aerospace Corporation's leadership and employees have been committed to CSR since the company's founding in 1960, with employees consistently contributing time and money to educational, social, and environmental programs.

Aerospace Diversity Action Committee Leadership Conference

Aerospace held its second Affinity Group Leadership Conference on August 28. Chaired by National Systems Group Vice President Bernard Chau, the leadership orientation included more than 35 participants and seven presenters.

The conference objective for the affinity group leaders was to provide them with process and business tools for leading a volunteer organization. In a separate breakout session,

the management representatives discussed their goals and expectations, as well as their role in assisting the affinity groups in becoming valued corporate business partners.

The objective of ADAC is to assist Aerospace in meeting its equal employment opportunity (EEO) and affirmative action program (AAP) commitments by providing an open forum for the discussion and development of EEO and AAP policies and diversity programs by representatives of Aerospace's diverse population.



Aerospace Latino Members Association awards check



Dancer at American-Indian and Alaskan-Native Council event



Aerospace participated in Chantilly stream restoration

Affinity Groups

Originally, Aerospace established affinity groups to expand corporate cultural awareness, enhance career development opportunities, and promote diversity in the workplace. Today Aerospace affinity groups provide leadership support to Aerospace in the areas of professional development, diversity awareness, community outreach, and diversity recruitment.

Aerospace has eight affinity groups with active membership in four states. These groups consist of the American-Indian and Alaskan-Native Council, Aerospace Asian Pacific American Association, Aerospace Black Caucus, Aerospace Lambda Alliance, Aerospace Women's Committee, Aerospace Military Veterans, Aerospace Totally Adaptable Group, and Aerospace Latino Members Association, all of

which actively represent their constituencies at Aerospace. The lead officers of each affinity group are members of the Aerospace Diversity Action Committee.

A few examples of affinity group activities include organizing and presenting cultural awareness activities, educational/career development programs, and programs of general interest to Aerospace employees; sponsoring and presenting programs that enhance advancement opportunities for Aerospace employees; participating in recruitment efforts and community outreach activities; and advising management of diversity-related concerns and recommendations.

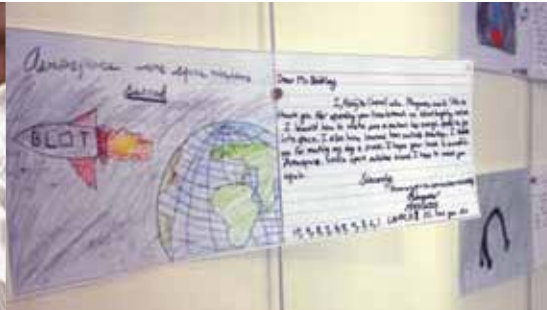
Green Initiative

Aerospace's many green initiatives include significant improvements to its operations and facilities, with a focus on the environment, energy efficiency, sustainability, and streamlined budgetary choices.

At the Chantilly, VA campus, special attention to Earth-friendly measures were undertaken, culminating in Aerospace achieving an overall 14-percent energy reduction as well as a reduction in water consumption via use of recycled water for irrigation. Aerospace is also dedicated to environmental conservation, as evidenced by the corporation's focus on limited encroachment into protected areas, stream restoration, planting of native grasses, incorporation of rain gardens, and dedicated support for a private conservation area.



Middle school science teacher discusses STEM curriculum



Students express appreciation for STARS visit



STEM outreach students participate in cyber challenge

Teaching Teachers

As part of Aerospace's commitment to science, technology, engineering, and mathematics (STEM) outreach programs, Aerospace employees met with math and science teachers in El Segundo. In this enriching exchange, Aerospace volunteers and approximately 30 math and science teachers were matched for in-classroom presentations geared toward showing students the real-world applications of the STEM disciplines. Aerospace expanded its STEM outreach to include Hawthorne, Morningside, and Gardena high schools and Hawthorne, Prairie Vista, Monroe, Frank Parent, and Peary middle schools. The corporation has similar strategic partnership programs at other Aerospace locations.

Taking It to the STARS

Aerospace's state-of-the-art Spacelift Telemetry Acquisition and Reporting System (STARS) laboratory welcomed a seventh-grade class from Bert Lynn Middle School in Torrance, CA. Hosted by Jonathan Binkley, STARS systems director, this learning experience led the students through the journey of reducing the amount of weight on the Bert Lynn Outstanding Technology (BLOT) rocket to successfully launch it to orbit. The students then donned headsets and experienced a simulated countdown to launch.

Aerospace intends for this experience to serve as a template on which a capability to visit schools and foster students' excitement about learning science, mathematics, and engineering can be spearheaded. STARS personnel are also working to build a "virtual STARS" capability as a training tool to get students excited about the space program.

Harvey Mudd College – Capstone Projects

By participating in the Corporate University Affiliates Program, Aerospace enthusiastically gives back to the nation's educational system by providing Harvey Mudd College with guidance on curriculum, strategic and succession planning, and program development, as well as by encouraging underrepresented groups to succeed in math and science.

Over the years, Aerospace has sponsored dozens of technical capstone projects in which student teams are encouraged to take on technical challenges that support our mission and our STEM outreach objectives.

In FY12, Aerospace empowered the student team to contribute to the emerging cyber challenge by asking them to help in securing a wireless Android device against cyber threats, a feat that the students successfully accomplished.



Wilson High School robotics team takes first place



Aerospace Women's Committee supports Clothes the Deal



Herndon Science Competition participant

Robotics Competition

Aerospace-sponsored FIRST Robotics teams on both coasts and in Colorado Springs, as well as a *Botball* robotics team on the East Coast, are examples of recent Aerospace employee STEM outreach efforts. These STEM activities have already paid off in handsome near-term dividends, with the Aerospace-sponsored Wilson High School team of Washington, D.C. winning the first-place prize in the FIRST Robotics Competition, held this year in the District of Columbia.

Clothes the Deal

Aerospace employees have been commended for their generosity to the community through Clothes the Deal, a nonprofit organization that provides clothing for low-income individuals seeking employment.

For the past nine years, the Aerospace Women's Committee has held a clothing drive during Women's Week in August, in which 500 to 600 articles of new and slightly used clothing items are donated to those who do not have the means to purchase professional attire to wear on a job interview. In addition to clothing, accessories such as dress shoes, handbags, belts, scarves, watches, and jewelry are collected and distributed.

The FY12 drive exceeded the typical average of 600 items, with more than 1,500 collected.

Herndon Science Competition

Middle and high school students demonstrated their science experiments at the 35th annual Robert H. Herndon Memorial Science Competition in El Segundo on June 7. A Herndon competition was also conducted in Chantilly on April 19.

Enthusiastic students demonstrated experiments covering renewable energy sources for the third world, the efficacy of electrokinetic remediation of soil, and an assessment of performance and emissions of diesel engines using vegetable oils.

Mary Herndon was on hand for the day's events as she has been every year to help support the event named after her husband, an inspirational Aerospace scientist, engineer, mentor, and humanitarian, who died in 1976.

2012 Achievement Awards

Trustees' Distinguished Achievement Award



James Hicks

Each year, the corporation celebrates its commitment to excellence by recognizing individuals and teams who have demonstrated excellence exceeding expectations in the areas of science, technology, engineering, analysis, systems engineering, program and business management, and administration. The following employees were selected for their exceptional contributions in 2012.

Dr. James Hicks, senior engineering specialist, Communications and Signal Analysis Department, Engineering and Technology Group, was selected as the 2012 Trustees' Distinguished Achievement Award winner "for sustained technical and programmatic leadership in resolving a critical signal intelligence problem that provides the intelligence community and combat forces a way forward to an integrated, worldwide situational awareness capability."

Hicks developed a concept of operations and a processing algorithm to detect, collect, and process a signal designated as a critical intelligence need and one of the top 10 issues for national security, a significant challenge that the customer's existing contractors advised was impossible to detect and exploit.

Hicks demonstrated that his algorithm had overcome all obstacles when he became the first to successfully collect and process this critical signal. He also supported the transition of the capability to the customer for production.

After a period of intense, detailed signal analysis and processing design, Hicks deployed to a mission ground station, where he worked tirelessly for up to 21 hours a day from a national space platform, achieving unprecedented results. Over the length of his stay, Hicks collected four times more data on a high-value signal of interest using more conventional platforms than had been assembled over the signal's entire history. He also contributed the first realtime geolocation of this signal.



President's Achievement Award Recipients



(from left to right) Brian Hardy, John Brekke, Matthew Eby, and Randall Williams

Allen Compito

The team of John Brekke, principal director, Human Exploration and Spaceflight, Civil and Commercial Operations; Matthew Eby, engineering specialist, Mechanical Systems Department; Brian Hardy, senior MTS, Mechanics Research Department, both of the Engineering and Technology Group; and Randall Williams, systems director, Civil and Commercial Launch Projects, Space Systems Group, were awarded a President's Achievement Award "for outstanding contributions made in characterizing external tank foam debris risk to the shuttle program."

The team provided first-of-a-kind critical support within the highest stress environment conceivable: a critical national program involving human life. The team provided crucial foam debris risk analyses to NASA for the space shuttle,

without which NASA would have had no clear path for return to flight after the Columbia accident.

The team developed a foam debris analysis tool to characterize the hazard of foam debris released from the external tank and striking the orbiter, which was the failure mode that caused the Columbia accident.

The team generated analytical and empirical results that enabled the shuttle community to put the foam debris issue in the proper perspective at each flight readiness review, giving NASA confidence that the risk had been appropriately characterized before each flight. The team's analyses and testing helped provide NASA leadership with the needed confidence to continue the fly-out of the shuttle program.

Allen Compito, principal director, Reconnaissance Systems, National Systems Group, was awarded a President's Achievement Award "for steadfastly applying the principles of mission assurance, leading to success on a critical national security space mission."

Compito provided exceptional leadership and solid technical expertise to a group tasked with delivering a new and critical space capability. Entering 2005, the program was virtually stalled by the years of limited execution under the Total Systems Performance Responsibility approach of the early decade. Compito's personal dedication to the success of the program was remarkable, as evidenced by his leadership in transforming the program into a viable entity as he introduced and instilled a solid mission assurance approach that was both effective and efficient.

President's Achievement Award Recipients



Timothy Graves

(from left to right) Ray De Gaston, Brian McCarthy, Robert Pan, and Ty Rudder

Dr. Timothy Graves, laboratory manager, Electric Propulsion and Plasma Science, Engineering and Technology Group, was awarded a President's Achievement Award "for pivotal contributions in identifying and mitigating RF breakdown failure modes within communication systems on multiple national security space programs."

Graves identified the root causes of multiple RF breakdown anomalies during ground tests and on orbit in the GPS IIF L1 and L2 transmitters. Using unique test capabilities he developed, Graves uncovered new multipactor breakdown processes that cause permanent damage to mission-critical transmitter devices, the discovery of which ultimately allows for successful redesigns and alterations in the on-orbit operation of the entire GPS IIF constellation.

Graves' persistent advocacy for addressing the technical risks resulted in the discovery of faulty circulators recovered from SV1, identifying an imminent failure that would otherwise have been launched. Through arduous hours, extensive travel, and dedicated commitment, Graves safeguarded the customer from a high-risk or costly redesign effort.

The team of Dr. Ray de Gaston, senior project engineer; Dr. Robert Pan, project leader; Ty Rudder, project engineer, all of Directorate L Vehicle and MSN Engineering, National Systems Group; and Dr. Brian McCarthy, engineering specialist, Component Analysis and Test Office, Engineering and Technology Group, were awarded a President's Achievement Award "for innovative, rapid response and sustained excellence in recovering national security program performance."

When critical national assets were impacted by a systemic single-point failure that surfaced in a crucial subsystem of a national security program asset, thus partially or totally removing half the program's constellation from service, the team rapidly assessed the situation, proposed the root cause, and developed an effective, innovative solution using the attitude determination and control system of the vehicle to compensate for the loss of the subsystem.

The team galvanized key stakeholder decisionmakers to adopt their solution in a timely manner, thus restoring critical mission capabilities within a short period of time.

The team also provided technical guidelines to the contractors so that effective testing and analysis techniques could be applied to the redesigned subsystem used in subsequent assets, in order to avoid similar problems in the future.



President's Achievement Award Recipients



(from left to right) Garrett Teahan, Andrew Dawdy, Wayne Hallman, Andrew Feistel, and David Garza

Sabrina Steele

The team of Andrew Feistel, senior MTS; Dr. David Garza, engineering specialist; Garrett Teahan, MTS, all of Flight Design and Optimization, Engineering and Technology Group; Dr. Wayne Hallman, department director, Flight Mechanics Department, Engineering and Technology Group; and Andrew Dawdy, principal director, EHF Systems, Space Systems Group, were awarded a President's Achievement Award "for developing and implementing an innovative mission plan to recover the Advanced EHF SV1 spacecraft."

Following the launch of AEHF-SV1, in which a failure in its bipropellant propulsion system necessitated a complete redesign of the orbit transfer to recover the satellite and its mission, the team designed, developed, and executed an innovative, optimized mission plan that successfully transferred the space vehicle to a final mission orbit that fulfilled all mission requirements of this more than \$2 billion critical asset.

The team tirelessly saw the mission plan through for a period of 57 weeks until the satellite reached its final orbit, a feat without which the first AEHF satellite would not have been able to achieve a useful orbit, and thus its mission objectives. The loss of SV1 would have been a critical blow to protected SATCOM and worldwide enhanced data rate availability.

Sabrina Steele, principal director, Corporate Communications Directorate, Operations and Support Group, was awarded a President's Achievement Award "for significantly enhancing Aerospace's reputation as the premier technical resource for all space endeavors."

Steele significantly increased Aerospace's visibility as the premier technical resource for national security, civil, and commercial space endeavors, culminating in Aerospace be-

ing actively sought by the global media as the go-to expert during the UARS satellite reentry.

Steele led a multifaceted effort to increase Aerospace's visibility, and planned and implemented a series of initiatives, including reinvigorating the corporate brand, increasing news media use, and developing strategies for the corporation to increase its involvement with STEM programs. These efforts resulted in a transformed and broadened image of Aerospace.

Steele exhibited exemplary leadership and resourcefulness by creating a positive image for the company with very little change in the resources dedicated, raising awareness of the company's value, and inspiring confidence in its achievements throughout the space community and the public.

Corporate Leadership | Board Of Trustees



(standing from left to right) Barbara M. Barrett, Daniel E. Hastings, David M. DiCarlo, Thomas S. Moorman Jr., Robert S. Walker, Tina W. Jonas, Alan C. Wade, Jeffrey H. Smith
(seated from left to right) George K. Muellner, Kevin P. Chilton, K. Anne Street, M. Elisabeth Paté-Cornell, Wanda M. Austin, Peter B. Teets, Michael Montelongo, John E. McLaughlin, Vincent Vitto

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Gen. Kevin P. Chilton (USAF, Ret.)

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Dr. Daniel E. Hastings

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Hon. Michael Montelongo

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Lt. Gen. George K. Muellner (USAF, Ret.)

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Dr. M. Elisabeth Paté-Cornell

Burt and Deedee McMurtry Professor of Engineering and past Chair, Department of Management Science and Engineering, Stanford University; Senior Fellow, Stanford Institute for International Studies

Mr. Jeffrey H. Smith

Senior Partner, law firm of Arnold & Porter; former General Counsel, Central Intelligence Agency; former General Counsel, Senate Armed Services Committee

Ms. K. Anne Street

President, Riverside Consulting Group, Inc.; former President and Chief Operating Officer, Geo-Centers, Inc.; former Vice President, Battelle Memorial Institute

Mr. Vincent Vitto

Private consultant; retired President and CEO, The Charles Stark Draper Laboratory

Mr. Alan C. Wade

President, Wade Associates, Inc.; retired Chief Information Officer, Central Intelligence Agency

Hon. Robert S. Walker

Executive Chairman, Wexler & Walker Public Policy Associates; former Member of the House of Representatives from Pennsylvania

Dr. Sally K. Ride

Aerospace lost a colleague and friend with the passing of Dr. Sally K. Ride on July 23, 2012. Sally, the first U.S. woman in space and a hero to millions, served the corporation for eight years as a member of our board. She was passionate about encouraging children, especially girls, to pursue careers in engineering and the sciences, and was an inspiration to us all.



Corporate Leadership | Executive Council



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President and CEO



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Vice President, Chief Financial
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Vice President,
National Systems Group



Malissia R. Clinton
Senior Vice President,
General Counsel, and Secretary



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Senior Vice President,
Operations and Support Group



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Systems Planning, Engineering,
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Operations



Dr. William C. "Willie" Krenz
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Chief Information Officer



Howard J. "Mitch" Mitchell
Vice President,
Program Assessments



Dr. Rami R. Razouk
Senior Vice President,
Engineering and Technology
Group



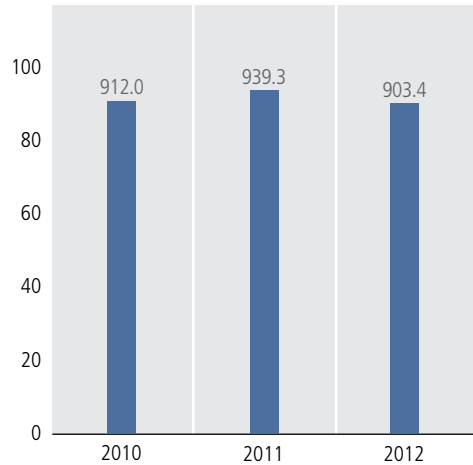
Catherine J. Steele
Vice President,
Strategic Space Operations



Dr. Sherrie L. Zacharius
Vice President,
Technology and Laboratory
Operations

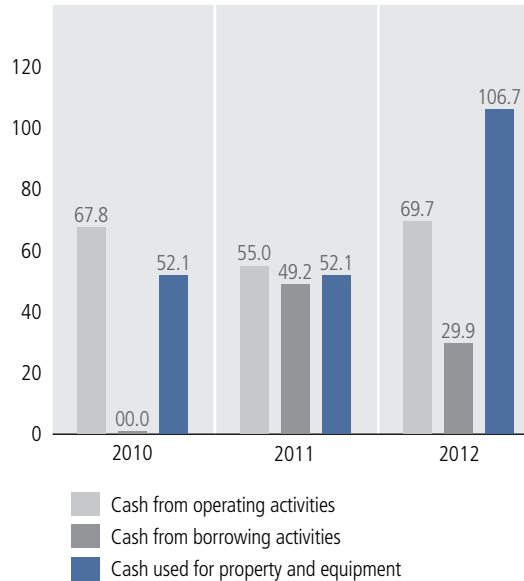
FY 2012 | Financial Highlights

Revenue From Contracts (\$ in Millions)



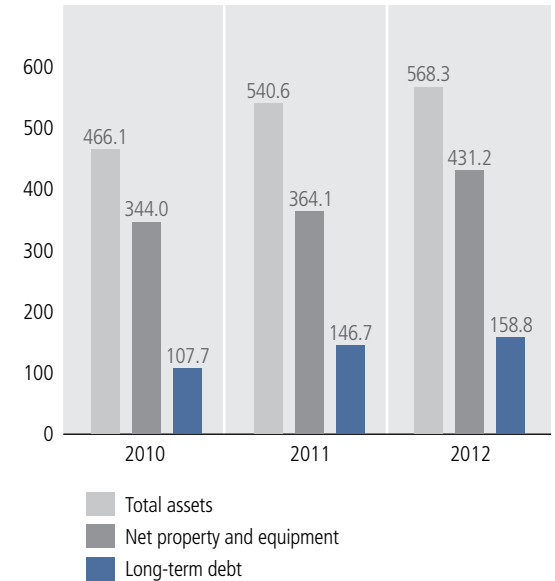
Aerospace’s revenue from contracts decreased in 2012 as compared with 2011 due to decreases in deliveries and related costs. Revenue from contracts increased in 2011 as compared with 2010 due to increases in deliveries and related costs. The current five-year contract with the Air Force expires at the end of fiscal year 2013. The company is in the process of renewing this contract.

Cash Flows (\$ in Millions)



Net cash provided by operating activities is used for capital expenditures and debt service. Net cash provided by borrowing activities is used to develop land and construct buildings. Long-term debt related to building construction is being repaid from depreciation and cost-of-money reimbursement from the related buildings over the life of the buildings and from fees from non-DOD contracts.

Total Assets and Related Debt (\$ in Millions)



The corporation’s independent auditors are Deloitte & Touche.

For a copy of the audited financial statements, please contact:

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 Los Angeles, CA 90009-2957

310-336-0426
 CFO@aero.org

The Aerospace Corporation | Locations



El Segundo, California



Artist's rendering of the new Chantilly campus

Colorado Springs
Offutt Air Force Base
Vandenberg Air Force Base
Huntsville
Columbia

Corporate Headquarters

2310 East El Segundo Blvd.
El Segundo, CA 90245-4691
310-336-5000

Washington D.C. Area

Arlington, VA
Falls Church, VA
Rosslyn, VA
Silver Spring, MD
Suitland, MD

Albuquerque, NM
Boulder, CO
Buckley Air Force Base, CO
Cape Canaveral Air Force Station, FL
Chantilly, VA
Colorado Springs, CO
Columbia, MD
Hill Air Force Base, UT
Houston and Johnson Space Center, TX
Huntsville, AL

Kirtland Air Force Base, NM
Offutt Air Force Base, NE
Onizuka Air Force Station, CA
Pasadena, CA
Peterson Air Force Base, CO
San Diego, CA
Schriever Air Force Base, CO
Vandenberg Air Force Base, CA
Wright-Patterson Air Force Base, OH

