Orbiter
March 2015

Vogel Heads Sensors, Signals, and Electronics Subdivision

by Kimberly Locke
March 31, 2015

Susan Vogel

Susan Vogel has been appointed principal director of the Sensors, Signals, and Electronics Subdivision, Electronics and Sensors Division, Engineering and Technology Group (ETG). The subdivision provides technical support to the Department of Defense, the intelligence community, and Civil and Commercial Operations' customers in the areas of performance modeling, space systems design, and remote sensor hardware and data exploitation.

Vogel joined Aerospace in 1985 as a member of the technical staff in the Image Exploitation Department, Sensor Subdivision, ETG. Her most recent previous assignment was principal director of the Advanced Sensor Applications in the Advanced Technology Division, National Systems Group, focusing on sensor systems phenomenology, advanced data exploitation and analysis of multi-source data sources against problems of interest to the intelligence community. This organization transitioned to primarily support the National Geospatial-Intelligence Agency and National Air and Space Intelligence Center customers in 2008 and became part of the National Intelligence Operations in 2013.

Vogel holds bachelor of science degrees in mathematics and computer science from Purdue University and a master of science in computer engineering from the University of Southern California.

Countdown to Launch: It's Showtime!

by Lindsay Chaney
March 26, 2015

The Orbiter is publishing a series of articles that follow one launch vehicle through preparation activities to when it lifts its payload to orbit. The payload, GPS IIF-9, launched on March 25 on a Delta IV launch vehicle. This article highlights day of launch activities.

Analysts in the STARS lab monitor hundreds of tests on the day of launch. (Photo: Eric Hamburg)

For the Aerospace men and women involved in a Delta IV launch, the actual day of the launch is like a final exam on steroids. All the studies and analyses have been done. The rehearsals are finished. "Assuring Space Mission Success" is more than a tagline today – it is a promise to the customer. Now it is time to stand and deliver.

On Wednesday, March 25, the staff of the El Segundo Spacelift Telemetry and Reporting System (STARS) lab showed up for work at 4 a.m. Pacific Time. The analysts arrived to take their positions in the control room at 4:30 a.m. The day's countdown to the launch of the Delta IV carrying the GPS IIF-9 satellite had begun.

The Delta IV would fly in what is called the Medium+ (4,2) configuration, meaning it has a four-meter-diameter payload fairing and two solid rocket boosters in addition to the RS-68 liquid-hydrogen-fueled main engine. Built by Pratt & Whitney Rocketdyne, the RS-68 develops 663,000 pounds of thrust on liftoff.

On the other side of the country, a handful of Aerospace employees and Air Force personnel were also "on console" at the Cape Canaveral mission control room, where United Launch Alliance personnel were in the majority.

Analysts in the STARS lab, in realtime, can view the same data to which their counterparts at the Cape have access. They are the second pair of eyes to view testing results and verify those results are within the normal range.

By 7:30 a.m., it was three hours into the day of launch countdown. The analysts in STARS had been going through what amounts to probably the world's largest checklist of things to do in the morning. The checklist includes testing pressures, electrical circuits, the time it takes valves to open and close, loads on various parts of the rocket, and the list goes on and on. About 80 analysts were working in the STARS control room, with another eight in the day of launch winds rooms, and five in the data reduction center, where telemetry from the Cape arrives and is sent to the STARS lab.

The tests are done according to a planned schedule, which is reflected in the countdown clock. Two countdown clocks are displayed on the large screen at the front of the STARS control room. The "L" clock shows the time remaining until the opening of the launch window. The "T" clock shows a shorter amount of time, and is basically the time allotted for testing and checkout. At 7:36 a.m., the "L" clock showed exactly 4 hours, while the "T" clock showed 3 hours and 30 minutes. The "T" time has a

built-in half-hour hold when the clock reaches four minutes. This buffer allows extra time to do catch-up work and resolve anomalies. When the “L” clocks reaches four minutes, if all goes well, the “T” clock starts again and both count down the last four minutes together until liftoff.

Every launch has a “launch window” – the time interval during which the rocket can launch and put its payload into the desired orbit. Some launch windows are several hours long, allowing time to fix last-minute glitches or wait out dangerous weather; at the other end of the spectrum is the instantaneous launch window, when a rocket must launch immediately or the launch is scrubbed. The launch window for the GPS IIF-9 launch opened at 11:36 a.m. Pacific Time and lasted for 18 minutes.

Mitch Mitchell, left, Aerospace vice president of Program Assessments and Judy Peach, general manager of the Launch and Satellite Control Division, chat with Air Force Col. William R. “Bob” Hodgkiss in the STARS visitor’s gallery. (Photo: Eric Hamburg)

At 9:36 a.m., two hours before the launch window was scheduled to open, all was looking good. Analysts in the winds room reported that upper atmosphere winds were negligible. Lt. Gen. Samuel Greaves, commander of the Space and Missile Systems Center at the Los Angeles Air Force Base, arrived in the control room and took the seat at his console toward the back of the room. The general typically is at his console in STARS during Air Force launches. Later in the morning, Greaves took time to chat with a group of cadets from the U.S. Air Force Academy who were observing the launch from the visitor’s gallery.

Mike Pinnella, STARS director for the launch, noticed an unusual spike on a strain gauge at the base of the vehicle that is used to measure vehicle loads. He called one of the analysts to discuss the situation and eventually concluded that erroneous data was being delivered due to a faulty sensor.

“Throughout the count we’re continuously monitoring system performance and reconciling with family history,” Pinnella explained.

Upstairs in the visitor’s gallery, the STARS staff was prepared for a standing-room-only crowd. In addition to the Air Force Academy cadets, observers included two United Launch Alliance executives, Air Force personnel, Aerospace corporate officers, and GPS program office staff.

At about 12 minutes before launch time, the visitor’s gallery grew noticeably quieter. People began talking in hushed whispers as they stared at the countdown clock displayed on the giant control room screen.

Final status checks began at seven minutes before launch. Both countdown clocks began ticking off the seconds at T-minus four minutes.

About three seconds before T-minus zero, the hydrogen-fueled main engine ignited, setting off a Delta IV signature fireball as excess hydrogen burned while the rocket lifted off the launch pad in the opening seconds of the launch window at 11:36 a.m. PT.

The launch team reported good chamber pressure in both solid rocket motors and the main engine as the rocket accelerated upward and over the Atlantic Ocean.

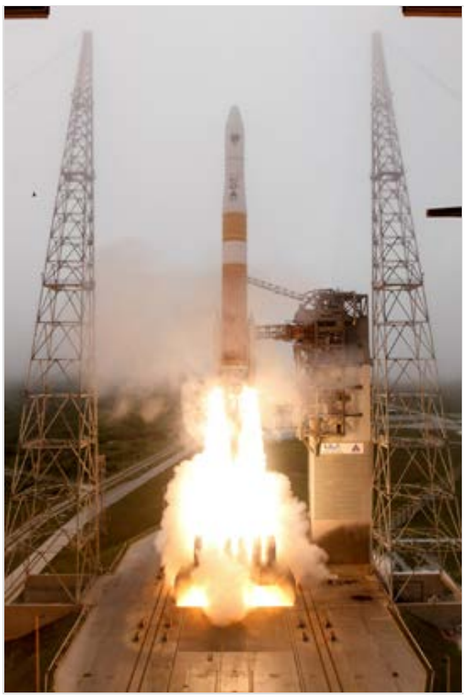
Fifty seconds into the launch, the Delta IV broke the sound barrier. At one minute and fifty seconds, the two solid rocket motors separated from the launch vehicle and dropped away. The rocket by this point had lost half of its liftoff weight. The main engine cut off at four minutes and 15 seconds, and dropped off five seconds later. A few seconds after that, the second-stage engine ignited for an 11-minute burn.

After the second-stage burn, the rocket coasted for two hours and 46 minutes, at which time the second-stage engine ignited again for one minute and 46 seconds. Ten minutes and 41 seconds later, the satellite separated from the rocket.

The analysts in the STARS lab broke into applause.

“It was a very smooth countdown, and a near-perfect mission,” said Ray Johnson, vice president, Space Launch Operations, who was at Cape Canaveral for the launch. “Congratulations to both the Delta and GPS teams. This is an outstanding accomplishment!”

“It’s a feeling of accomplishment and immense relief,” agreed Dr. Paul Brennan, deputy STARS director. “We just had a successful mission. You can’t take it away now.”



The Delta IV rises off the launch pad carrying the ninth GPS IIF satellite for the U.S. Air Force. (Photo: United Launch Alliance, LLC)

Pinnella complimented the Delta IV analysts, noting that many of them have been working together for 10 years or more. “When we say ‘go,’ it means something because of these guys,” he said. “We have a great team here.”

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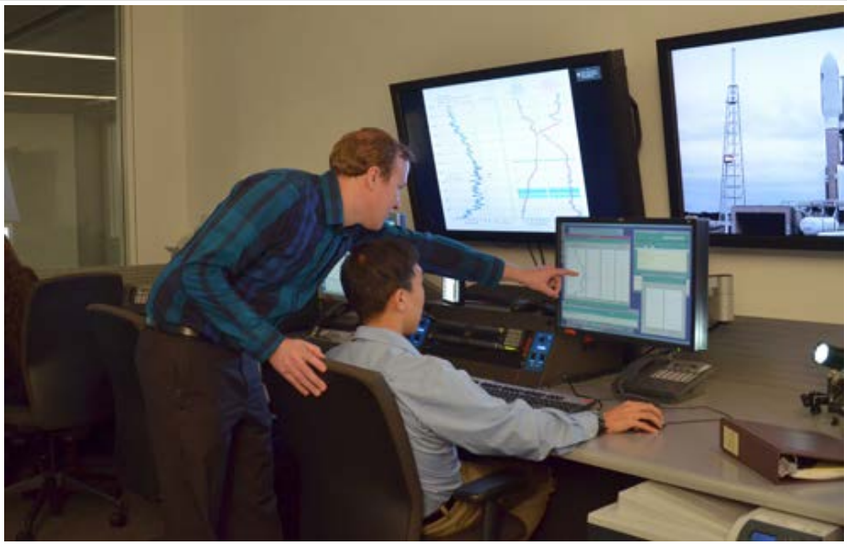
Countdown to Launch: Blowing in the Wind

by Lindsay Chaney
March 23, 2015



Tim Smith, left, reviews wind data with David Luong. (Photo: Elisa Haber)

The Orbiter is publishing a series of articles that follow one launch vehicle through preparation activities to when it lifts its payload to orbit. The payload, GPS IIF-9, is set to launch on March 25 on a Delta IV launch vehicle. This article explains the day of launch winds calculations.

In an alcove next to the ground-floor bank of elevators in the Aerospace headquarters building is a locked door with the unobtrusive sign “DOL Winds.” The people who work behind the door are responsible for analyzing critical data obtained in the hours and minutes before a launch as the countdown clock ticks toward T-minus zero.

“We monitor atmospheric wind speeds for its effects on vehicle loads and controllability,” said Tim Smith, trajectory lead for Atlas V and backup for Delta IV. “Our information comes from weather balloons that are released beginning several hours before the scheduled launch.”

Both Cape Canaveral and Vandenberg have weather stations where balloons are released. As the balloons rise through the atmosphere, instruments onboard measure wind speed, direction, atmospheric temperature, pressure, and other data. The balloons gradually expand in the thinning atmosphere and typically burst at about 100,000 feet. The weather balloon data is used to create a steering profile that minimizes structural loads on the rocket while maintaining controllability as it flies through the atmosphere.

COUNTDOWN TO LAUNCH

Activity in the DOL Winds room will culminate for GPS IIF-9 on Wednesday morning when the last analysis is run just prior to the opening of the launch window at 11:36 a.m. PT.

The short video below explains winds and other weather-related analysis.

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Countdown to Launch: Ready for Review

by Laura Johnson
March 19, 2015

The Aerospace President's Review was held on March 6 for GPS IIF-9. (Photo: Lester Chung)

The Orbiter is publishing a series of articles that follow one launch vehicle through preparation activities to when it lifts its payload to orbit. The payload, GPS IIF-9, is set to launch on March 25 on a Delta IV launch vehicle. This article discusses the reviews that take place before a launch.

As the GPS IIF-9 launch gets closer, it’s necessary to decide whether the rocket and spacecraft are really ready to go. To that end, the Air Force holds a series of reviews to ensure things are going smoothly.

Aerospace, to best advise the Air Force, holds its own set of reviews and then provides input to the Air Force ones.

For each launch, Aerospace has an Aerospace Readiness Review, in which the different responsible Aerospace parties present to Aerospace’s vice president of Space Launch Operations, Ray Johnson. This review, held on Feb. 24 for GPS IIF-9, is a look at the work that has been completed, what remains to be done, and what the risks are. The spacecraft team holds a review as well.

After these reviews, the launch vehicle and spacecraft groups come together for a half-day review for the Aerospace president. This is known as the Aerospace President’s Review, and was held on March 6 for GPS IIF-9.

All this activity gets Aerospace ready to participate in the Air Force’s Flight Readiness Review, which was held March 17 for GPS IIF-9. At this review the Space and Missile Systems Center commander decides whether to move forward with the launch.

In conjunction with this activity, Aerospace provides an official letter to the Air Force, stating that Aerospace deems the launch

vehicle flightworthy.

The Air Force also holds a Launch Readiness Review at the launch site shortly before launch. Aerospace has the Aerospace Launch Site Readiness Review the day prior.

Thus, at every step of the way, Aerospace is providing independent assessment of the readiness of the launch to proceed.

Watch the video below to learn more about Aerospace's reviews

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Aerospace Starts Pi Day Celebration Early

March 18, 2015

Pie Day celebration participants after eating pies. (Photo: Sonia Henry)

On March 11 at 3:14 p.m. (and 15 seconds) early career employees in D8 celebrated Pi Day three days early with a friendly pie-making (and eating) contest. Amy Jager, an MTS in the Acquisition Support and Information Department, organized the event as a way to help connect some of the early career employees.

"I have been talking with some of the new hires about trying to do more cross-department [and] division events to network and get to know more of their colleagues," said Jager. "I thought Pi Day might be a good occasion to try it out and I figured Aerospace would appreciate a fun, nerdy Pi celebration."

Pi Day is an annual celebration on March 14 of the mathematical constant π (pi), which is the circumference of a circle divided by its diameter. As an irrational number, pi has an infinite number of digits after its decimal point; out to nine decimal places, pi is 3.141592653.

The first publicized observance of Pi Day was in 1988 by the San Francisco Exploratorium, which continues its Pi Day observances. Other organizations have joined in with their own slant on the day. In 2009, the U.S. House of Representatives passed a resolution declaring March 14 of that year National Pi Day and urged schools to "observe the day with appropriate activities that teach students about Pi and engage them about the study of mathematics."

This year's celebration is particularly revered by Pi Day enthusiasts because it falls on 3/14/15, reflecting the more precise approximation of 3.1415. The cathedral of nerddom, the Massachusetts Institute of Technology, went a step further, posting its application decision letters online on March 14 at exactly 9:26 a.m., to carry pi out three more decimal places – 3.1415926.

Ingrid Hallgrimson, left, winner of the Pi Day pie-making contest, with Amy Jager, event organizer. (Photo: Sonia Henry)

Organized mainly by word-of-mouth, attendees at the Aerospace event were invited to sample and vote on home-made pies created by their fellow employees. Eleven of the most pious brought their creations for judging. Ingrid Hallgrimson, a technical administrator in the Acquisition Support and Information Department of the Systems Engineering Division, was selected as the 2015 Pi Day Champion for her Savory Spanakopita pie.

Based on the happy smiles and full stomachs, the event was deemed a success. "I sampled every single pie," explained Eddson Alcid of the Control Analysis Department. "It was probably irrational to eat so much, but they were all so good."

Jager sees Pi Day as a great way for employees to share their love of math, science, and engineering with each other and even the larger community. "I used to work at the Maryland Science Center and each year we would have a Pi Day Celebration for the staff and then a big event for the general public. The event focused on loving math and pie."

Todd Nygren, general manager of the Systems Engineering Division, lauded the event. "Pi is good, the pie was better! I love the initiative of our early career leaders to celebrate what makes us tick. It was an outstanding inaugural event that I plan to win next year."

This article was prepared and submitted to the Orbiter by Marcus George, a project engineer in the Corporate Chief Engineering Office.

Countdown to Launch: Wet Dress Rehearsal

by Laura Johnson
March 16, 2015

Dr. Martin Panevsky (right) and Pierce Martin monitor the telemetry in STARS during the wet dress rehearsal for GPS IIF-9. (Photo: Eric Hamburg)

The Orbiter is publishing a series of articles that follow one launch vehicle through preparation activities to when it lifts its payload to orbit. The payload, GPS IIF-9, is set to launch on March 25 on a Delta IV launch vehicle. This article explains the significance of the so-called wet dress rehearsal.

The day a rocket launches, many tasks must be completed at specific times by both people and machines. To ensure clean performance on the day of launch, a rehearsal is in order.

Aerospace participated in a wet dress rehearsal (WDR) on Feb. 26 for the GPS IIF-9 launch that is coming up on March 25.

“A wet dress rehearsal is basically an all-up system level test,” said Heinz Butner, principal director for Delta IV. “It is as close to the real launch operation as we can make it – it is the test-like-you-fly equivalent of the launch.”

In a WDR, the team steps through the launch process, or countdown, all the way to 10 seconds before liftoff, making sure the timing is right and the rocket hardware and software is responding appropriately at each point. During the WDR, the satellite is not yet attached to the rocket.

Part of the Aerospace team is at the launch site for the WDR, but the majority are in the El Segundo STARS lab, where they can monitor the telemetry coming from the launch site at Cape Canaveral. There are specialists in all the critical areas, including propulsion, avionics, hydraulics, and more.

“All those resident experts are there at the WDR, making sure that all their systems are working properly and test out okay,” said Mike Pinnella, a systems director for Delta IV.

The reason this rehearsal is called “wet” is because fuel is actually loaded into the rocket.

“We load all the high pressure helium bottles as well as the cryogenic propellants on first and second stage of the launch vehicle,” Butner said.

Putting these extremely cold propellants (liquid hydrogen and oxygen) in the rocket enables the team to test the thermal protection system, to observe the hardware contracting from the cold, to check for leaks, and observe other effects of the cold fuel.

“The cryogenics take a lot of care and feeding,” Pinnella said.

The WDR for the GPS IIF-9 launch went well, and the team is now continuing to prepare for the real thing.

“This test cleared the way for mating the payload for a launch on 25 March,” said Danny Ortiz, the STARS director for this WDR.

Robert Zeller (left) and Dr. Phuong Than in STARS during the wet dress rehearsal. (Photo: Eric Hamburg)

CEO’s Report: New Board Member, Corporate Officers, Innovation Award Winners

by Lindsay Chaney
March 17, 2015

In her first CEO’s Report to Employees delivered from the new Aerospace Chantilly Campus, Dr. Wanda Austin announced the election of a new board of trustees member, the appointments of two corporate officers, and the winner of the first Aerospace Innovation Award, a new corporate award.

Speaking to a live audience in the Hexagon Auditorium on Tuesday, March 17, and connected to hundreds of other Aerospace employees via VTC and webcast, Austin announced that at last week’s board meeting, retired Air Force Gen. William Shelton was elected to the board. Shelton, who had a 38-year career in the Air Force, most recently was commander, Air Force Space Command, from January 2011 until his retirement last September.

At other points in his career, Shelton served as chief information officer of the Air Force, director of the Air Force headquarters staff, and was a space shuttle controller for the first 18 shuttle missions.

The board also approved two corporate officer changes that will result from the retirement of Ray Johnson on June 30. Randy Kendall, currently vice president of Civil and Commercial Operations (CCO), will succeed Johnson as vice president of Space Launch Operations.

Austin praised Kendall's leadership of the Civil and Commercial business, noting that he has overseen a substantial increase in Aerospace work with NASA and has presided over unprecedented forays into new business areas such as cybersecurity, as well as other areas outside of the space community.

In heading up Space Launch Operations, Kendall returns to an area where he has worked for most of his Aerospace career, which began as a member of the technical staff in 1988. Kendall advanced through a series of space launch management positions and eventually became general manager of the Launch System Division, Space Launch Operations, prior to his Civil and Commercial Operations post.

To lead CCO into the future, the company has brought in Edward Swallow, who previously worked for Northrop Grumman for 12 years, primarily as a business development executive. He has also worked for other companies and consultancies in business development, including areas outside the space community. He will officially start his job at Aerospace on April 6.

Dr. Wanda Austin delivered her first CEO's Report to Employees from the new Chantilly campus on March 17. (Photo: Linda Carroll)

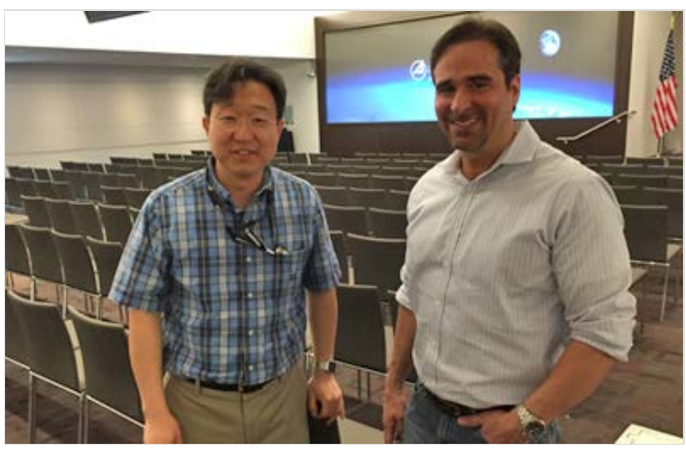
Winner of the new Aerospace Innovation Award is the Plasma Treatment team, which developed new and effective methods for processing advanced composite materials. (Click here for a previous Orbiter article about the team's development of plasma bonding technology.)

Members of the team are Dr. Rafael Zaldivar, department director, Materials Science Department; Dr. James Nokes, principal director, Space Materials Laboratory; and Dr. Hyun Kim, research scientist, Tribology, Surface Science, and Engineering Department.

The team developed a patented technique to use plasma to prepare a composite surface for bonding. The process produces reliable bonds that reduce the weight and improve the performance of satellite composite structures.

Austin noted that the Innovation Award selection committee – chaired by Dr. Randy Villahermosa, principal director, Research and Program Development Office – received 14 nominations, all outstanding, which made the final selection very difficult. The award criteria states that it "recognizes an individual or team who discovered, fashioned, or developed a new or novel creation that has a noteworthy impact on the company, our customers, or society at large."

There was one launch during the quarter for which Aerospace was accountable – the Jan. 20 launch of the Mobile User Objective System 3 (MUOS-3) aboard an Atlas V from Cape Canaveral. Space vehicle checkout is complete and the spacecraft is undergoing payload calibration, Austin reported.


Dr. Hyun Kim, left, and Dr. Rafael Zaldivar, were winners of the new Aerospace Innovation Award. Team member Dr. James Nokes is not pictured. (Photo: John Langer)

Before the end of the fiscal year on Sept. 30, there will be eight more launches for which Aerospace is accountable, including three GPS launches, another MUOS launch, and a Wideband Global SATCOM launch.

"I know that I can count on all of you to rise to the occasion and meet the demands of this challenging schedule," Austin said, "as we pursue our goal of achieving 100% mission success by focusing on one launch at a time."

The following questions and answers, edited somewhat for space and conciseness, were answered at the end of the CEO's Report.

Question: The AERP2 guide shows an example with yearly wage increases averaging 3.5 percent over a 25-year career. Since Aerospace has adopted the "lump sum in lieu of merit increase" model, can the AERP2 guidebook be updated to reflect a more accurate example of projected retirement benefits?

Answer: The Benefits Department will look at the assumptions used in examples to see if they continue to make sense. Meanwhile, employees can use various online tools to estimate their own specific retirement benefits, including the retirement calculator at www.aeroretirement.com.

Question: Earlier in the fiscal year, it was mentioned that the Aerospace board of trustees discussed the goal of increasing internal investment. What does this mean for us now, in FY16, and in the future?

Answer: A significant portion of the corporation's internal investment is put toward research and development (R&D), civil and commercial business development, and facilities and equipment. The board of trustees identified the need to invest internally to grow the work from our existing customers and to expand into new areas. Seven areas were specifically identified as targets for future growth: cybersecurity, space security, remote sensing and data exploitation, agile platforms, unmanned and autonomous systems, energy, and transportation. Strategic planning is currently underway, through multiple corporate strategic initiative projects, to coordinate internal investment in these areas.

In terms of funding levels, the investment for R&D has remained healthy over the past few years and has actually increased

slightly since FY13. In the same period, there has been a significant increase in funding for business development to engage new customers and opportunities. The corporation also continues to enhance our facilities, such as the recently completed Propulsion Research Facility and the technical computing equipment installed in the new Chantilly building.

Watch a video of the complete CEO's Report below

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Ideas Flow at First Aerospace Innovation Challenge

by Kimberly Locke
March 13, 2015

Addressing some of the nation's toughest technical challenges is at the core of what Aerospace does. So it was no surprise that when some of its technical staff agreed to participate in the corporation's first Innovation Challenge, a host of cutting-edge solutions to that challenge emerged.

Chris Dunbar, center, discusses approaches to the UAS challenge with members of team A. (Photo: Walter Sturrock)

The spirited competition, held March 6, involved three teams (teams A, B, and C) that were presented with a challenging scenario several weeks ahead of time: to develop concepts for navigating and exploring the Karez tunnels of Afghanistan using an unmanned and autonomous system (UAS), and report the findings. The event, held at the corporate offices in El Segundo, was part of the UAS Corporate Strategic Initiative Project and was hosted by the Research and Program Development Offices (RPDO).

The purpose of the challenge was to focus on a real-world design reference mission to highlight the technical capabilities of the Aerospace teams in the area of UAS. Exploring ways to successfully and safely survey and navigate through the Karez tunnels is a situation based on an actual need of the U.S. Army. These underground tunnels, which are more than 1,000 years old, are an elaborate network extending for miles. The tunnels are used for bringing drinking and irrigation water from the mountains to the areas below but have also been linked to the smuggling of drugs and arms and for hiding insurgents. The ultimate goal was to find a system that could be used to gain credibility in the UAS community as well as to show proof of capability for new businesses and proposals.

Members of the judging panel, left to right: Randy Villahermosa, Andre Doumitt, and Jennifer Gautier. (Photo: Walter Sturrock)

"We're looking for a concept design that leverages our existing capabilities and technologies as well as those available off-the-shelf," Dr. Randy Villahermosa, principal director, RPDO, Technology and Laboratory Operations, Engineering and Technology Group (ETG), told competitors prior to teams breaking off to different rooms to work on the challenge. "We are also looking for an alternative, streamlined design that optimizes existing and future technologies. This is a great way to tap into our experience base in a quick manner, a crowd-source solution if you will," he added.

On the day of competition, the original challenge was modified. Participants were given the option to either develop a UAS to autonomously navigate a burning multi-story structure, determine if individuals were trapped inside, and report back their location; or, develop a counter-UAS to detect, characterize, and/or respond to a UAS. This latter scenario carried with it the restrictions put in place by the Federal Aviation Administration and Federal Communications Commission for all airborne craft. These restrictions prohibit, for example, any jamming of the system, or disarming it with any type of explosives.

Chris Dunbar, principal director, Guidance and Control Subdivision, Vehicle Systems Division (VSD), ETG, and a member of team A, thanked the competitors for participating, noting this was in addition to the work they already support. Calling this effort a "time to shine," Dunbar acknowledged all participants, including those joining in via videoteleconference from Chantilly, and praised the inter-divisional esprit de corps.

These cross-functional, multi-generational teams of technical experts had approximately two hours to work on their challenge of choice before presenting their solutions to a panel of in-house technical experts. Snacks and beverages were provided throughout the event to help keep participants' energy high and the creativity flowing.

Team A chose the first proposed scenario, navigating through a burning structure, determining if there was anyone inside, and communicating those findings. Team B and team C in Chantilly opted for the second scenario of developing a counter-UAS to detect, characterize, and/or respond to a UAS. The team presenters were Amiel Fernandez, senior project engineer, U.S. Government On-site Office, Electronic Programs Division, National Systems Group, team A; Dr. Evan Ulrich, member of the technical staff, Embedded System Applications, VSD, team B; and Mike Martino, engineering specialist, Advanced Sensor Engineering Department, Electronics and Sensors Division, ETG, team C.

Panelists were John Langer, principal scientist, and Villahermosa, both of Technology and Laboratory Operations; Dr. Dave

Bearden, general manager, Civil and Commercial Programs Division; Andre Doumitt, contractor, Business Development, Civil and Commercial Development; Gina Galasso, principal engineer, Civil and Commercial Programs Division; Dr. Jennifer Gautier, systems director, Commercial Applications, Civil and Commercial Programs Division; and David McQuiggan, principal director, Civil and Commercial Development, also of Civil and Commercial.

Out of this competition came the delivery of three end products, one from each team. Although team A was singled out for its approach to working the challenge, teams B and C were also lauded for their efforts and all three teams' concepts will be further explored by the corporation. Team A's Naoki Oishi, an associate member of the technical staff, Mechanisms, Mechanical Systems Department, VSD, was nominated by his colleagues as its most valuable player. For that recognition, Oishi was presented with an iPad mini at the conclusion of the challenge.

During a break, Evan Ulrich of team B, left, explains some of the features on his unmanned aerial vehicle to other Innovation Challenge participants. (Photo: Walter Sturrock)

Event team planning members were Dunbar, Katharine Losoncy and Scot Osburn, VSD; and Dr. Allyson Yarbrough, Electronics and Sensors Division.

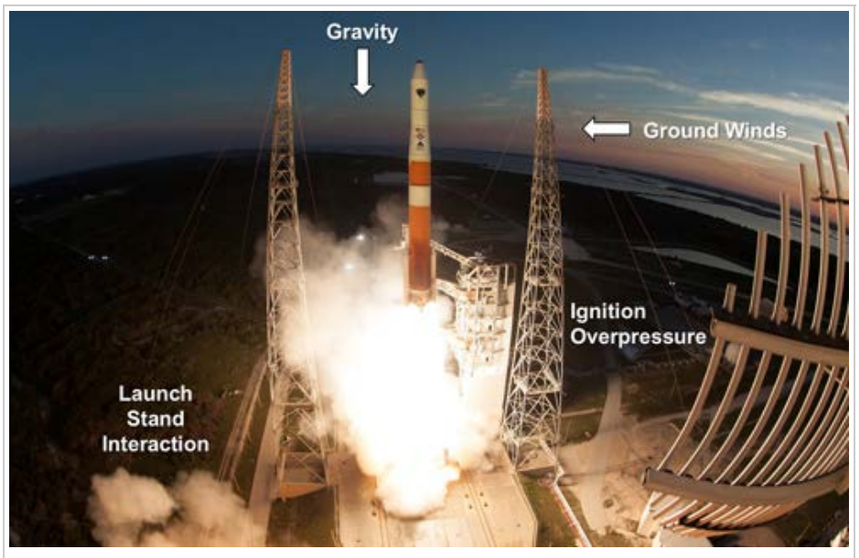
"This is our first challenge," said Dr. Terence Yeoh, Research and Development Portfolio manager, RPDO, ETG. "And given its success, I would say there will be many more to come."

Editor's note: Due to the nature of this challenge, each team's solution is proprietary and those specifics cannot be included in this article.

Countdown to Launch: Take a Load Off

by Laura Johnson
March 09, 2015

The Orbiter is publishing a series of articles that follow one launch through its preparation to when it lifts its payload to orbit. The payload, GPS IIF-9, is set to launch March 25 on a Delta IV launch vehicle. This article showcases the analysis work that Aerospace does to support a launch.



At each point during the launch and ascent, a variety of loads are affecting the vehicle. (Photo: United Launch Alliance, LLC)

Aerospace performs a significant amount of analysis work for each launch that it supports, including the upcoming GPS IIF-9 mission. Analyses are done in the areas of loads, structures, environments, mechanisms, fluids, guidance and control, trajectory, software, propulsion, and more.

To provide a complete description of all this analysis work would take books. To just give a taste of what this work looks like, however, this article will focus on Aerospace's loads analysis work, which at this point is complete for GPS IIF-9.

A loads analysis is basically an assessment of the stresses, or "loads" that the launch vehicle and satellite structure will have to endure during launch and ascent.

The goal is to make sure the structure and other hardware are strong enough that nothing will break, but not any heavier than necessary. Determining that balance turns out to be an incredibly complicated question.

Aerospace experts hold a peer review meeting to discuss loads for GPS IIF-9. (Photo: Lester Chung)

During launch, there are many things that can cause the launch vehicle/spacecraft system to vibrate and deform, or even break.

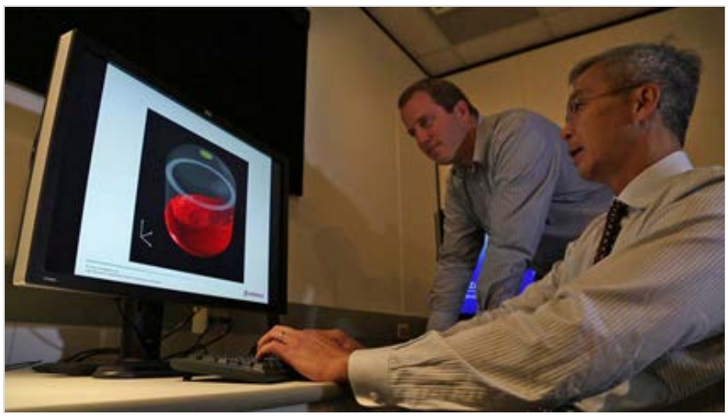
For example, when the vehicle is merely sitting on the pad, it is already exposed to various loads. Gravity is pulling down and deforming the system, and winds cause the vehicle to bend and oscillate. When the engines ignite, this causes more vibrations. When the vehicle lifts off, pressure waves go down, hit the flame bucket under the vehicle and come back at different times, causing more stresses on the vehicle.

"What you have to do is run analyses to actually predict what the loads are due to all these forces; from these you compute stresses in all critical areas of the launch vehicle and its payload," said Dr. Alvar Kabe, principal director of the Structural Mechanics Subdivision.

And this is just for the beginning of the launch. The loads

change at different points during the flight. For example, when various parts of the vehicle are jettisoned, the mass of the whole structure changes. When the engines ignite and shut down, loads are produced. There are differences depending on whether the vehicle is flying in the atmosphere or not.

Thus, there are about a dozen different events for which the loads must be calculated, including liftoff, various times of atmospheric flight, solid rocket motor jettison, main engine cutoff, stage separation, and more. Each of these events has its own set of factors, including wind, turbulence, shock waves, the autopilot, propellant levels, etc. The models used to predict loads and stresses have millions of equations.

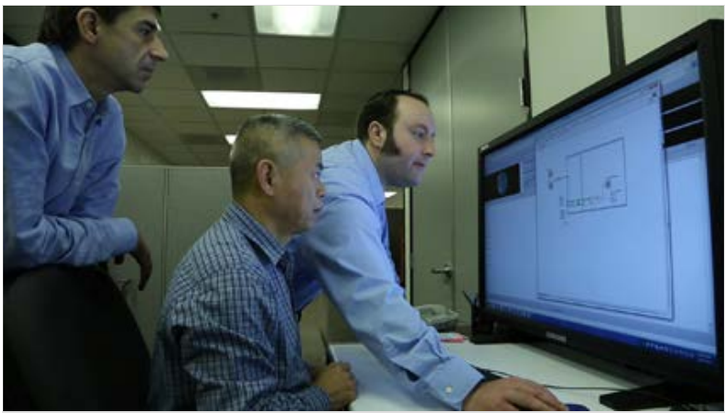


Slosh Analysis: Dr. Phuong Than (right) and Dr. Ethan Barbour discuss a slosh video as part of Aerospace's slosh analysis, which predicts propellant movement in the tank during flight. (Photo: Lester Chung)

Once the loads are calculated, it must be determined if each part on the launch vehicle and spacecraft will hold up under these stresses. This means assessing, for example, joints, bolts, and structure such as tanks, thrust structure, inter-stages, adapters, and the payload fairing.

A complex spacecraft might have as many as 20,000 items that need to be considered. In the case of the GPS IIF-9 spacecraft, there are approximately 3,000 items that need to be analyzed to ensure it can withstand launch and flight.

Even for re-flight missions like GPS IIF, significant analysis work might need to be re-assessed and redone if there are changes that impact the loads.



Software Analysis: A team builds a hardware-in-the-loop simulator to independently verify and validate launch vehicle flight software. (Photo: Lester Chung)

Both the launch vehicle and spacecraft contractor evaluate the loads. Aerospace uses its own in-house-developed tools and methodologies to independently calculate the loads for evaluation, thus providing independent verification and validation in this area.

The launch vehicle vibration response has an impact on the spacecraft loads, and vice versa. Aerospace works with both, and helps facilitate the collaboration necessary to accurately calculate loads for the entire assembly.

According to Kabe, there are not many entities that can perform loads analysis. It is a special skill set and one that Aerospace has honed for many years.

"If someone had to develop from scratch all of the loads analysis methodologies and tools that this company has and uses, it could take as much as 30 man-years of work," Kabe said.

And yet the loads analysis is just one facet of the analysis work that Aerospace does to support a launch. Other experts analyze other areas, all with the goal of successfully launching the spacecraft into orbit.

Enjoy the video below, showing some of Aerospace's analysis work.

[Video Removed]

Countdown to Launch: Raising the Rocket

March 11, 2015

The Orbiter is publishing a series of articles that follow one launch vehicle through preparation activities to when it lifts its payload to orbit. The payload, GPS IIF-9, is set to launch on March 25 on a Delta IV launch vehicle. This article and the accompanying video describe the process of raising the Delta IV to a vertical position on the launch pad.

The Delta IV rocket is raised to vertical on Jan. 28. (Photo: United Launch Alliance, LLC)

Delta IV launch vehicles, such as the one that will boost the GPS IIF-9 satellite to orbit on March 25, are assembled horizontally and transferred to the launch pad, where they are raised into a vertical position and prepared for launch.

The Delta IV for the GPS IIF-9 mission was raised on Jan. 28. and has been waiting at Space Launch Complex 37 at Cape Canaveral Air Force Station since then. The GPS satellite was placed on top of the

rocket on March 10, a process referred to as payload mating.

The short video below, courtesy of United Launch Alliance, LLC, shows the Delta IV being lifted to a vertical position, an operation that in real time takes about 10 minutes.

[Video Removed]

COUNTDOWN TO LAUNCH

Patent and Trademark Office Reps Tour Aerospace

by Kimberly Locke
March 05, 2015

Dr. Richard Welle, left, aided by Jerry Fuller, second from left, explained Aerospace's CubeSat work to a delegation from the U.S. Patent and Trademark Office on Wednesday, March 4. Several Aerospace employees also attended the briefing. (Photo: Eric Hamburg)

A group of examiners from the U.S. Patent and Trademark Office (PTO) paid an inaugural visit to the Aerospace offices in El Segundo on Wednesday, March 4, where they received a briefing about the corporation followed by tours of some of its laboratories.

In connection with their industrial outreach efforts, the purpose of the visit was for the PTO examiners and other representatives to gain a better understanding of some of the aerospace-related technologies being worked on at Aerospace, namely aerospace propulsion, altitude control, gas turbines, and testing.

“This visit provided us the opportunity to showcase our expertise and capabilities and to explain how some of the innovations we develop work so the PTO examiners can better understand the patent applications we file,” said Kien Le, senior counsel, Office of the General Counsel and Secretary. Le organized the visit and accompanied the PTO representatives during their time at Aerospace.

Following a briefing about the corporation by Dr. Rami Razouk, senior vice president, Engineering and Technology Group, the visitors were given a quick tour of the STARS (Spacelift Telemetry Acquisition and Reporting System) lab led by John Binkley, Systems director, STARS, Launch Enterprise Engineering, Launch Systems Division.

There were additional tours of the new Propulsion Research Facility led by Tom Curtiss, director, Space Materials Lab, Technology and Laboratory Operations (TLO), and the CubeSat lab, given by Dr. Richard Welle, director, and Jerry Fuller, research specialist, both of the Microsatellite Systems Department, Space Materials Lab, TLO.

Countdown to Launch: Shipping the Satellite

by Lindsay Chaney
March 04, 2015

The 10th GPS IIF satellite is unloaded at Cape Canaveral Air Force Station. (Photo: The Boeing Co.)

The Orbiter is publishing a series of articles that follow one launch through its preparation to when it lifts its payload to orbit. The payload, GPS IIF-9, is set to launch March 25 on a Delta IV launch vehicle. This article traces the history of the GPS IIF program and the satellite that will fly the GPS IIF-9 mission.

On the evening of Dec. 8, a flatbed trailer big-rig pulled out of the Boeing Satellite Development Center on Imperial Highway in El Segundo. The rush hour traffic on Imperial Highway had died down, making it easier to travel the short distance from the world’s largest satellite factory to a runway at Los Angeles International Airport. There, a C-17 military transport jet was waiting to take on the truck’s cargo – a crated Global Positioning System satellite.

Aerospace employees supported the convoy to LAX, which took about 30 minutes and also involved the California Highway Patrol, a wide-load escort service, the Air Force, and Boeing. It took more than three hours to transfer the containerized satellite onto the C-17.

The overnight flight ended at 5:30 the next morning at the Cape Canaveral Air Force Station in Florida, where Aerospace employees were on hand to do a receiving inspection and other tests of the satellite.

This particular GPS satellite was the 10th in a lot of 12 built by Boeing for the U.S. Air Force.

Boeing first won the GPS IIF contract in 1996, which included options for up to 33 satellites. As time progressed and the existing on-orbit satellites were continuing to function much longer than expected, the need for rapid replenishment of the GPS constellation decreased. New capability requirements were also added for the IIF satellites, resulting in contract revision discussions in 2000 that eventually settled on delivery of just 12 satellites.

Aerospace was involved with the IIF program from the beginning, helping the Air Force set out the requirements for the satellite, selecting the contractor to build the satellites, then working with the contractor, Boeing, to help with testing and to solve any problems that arise.

“Aerospace provides an invaluable service by acting as independent validators, and they are involved in the GPS IIF program every step of the way, from factory to orbit,” said Munzir Badawi, Boeing’s GPS IIF program director. “We strive for an open and constructive relationship with them, and value their insight and experience.”

The first GPS IIF-1 launched May 27, 2010; GPS IIF-8 launched Oct. 29, 2014, and GPS IIF-9 is scheduled to launch on March 25 this year. The last IIF is scheduled for launch in January 2016.

Boeing workers prepare the GPS IIF satellite for packaging. (Photo: The Boeing Co.)

Among the upgrades and new features on the block IIF satellites are:
• Improvements in the atomic clocks
• New civilian L5 signal for commercial aviation and search and rescue
• Improved military signal and variable power for better resistance to jamming
• 12-year design vs. 7.5-year previously
• On-orbit reprogrammable processor for software uploads.

Although the space vehicle (SV) numbers generally correspond to the mission numbers, this is not always the case. The GPS IIF-9 mission will launch satellite SV-10 because of some delays in preparing an upgraded transmitter unit on SV-9, which will now be used for the final GPS IIF-12 mission. The decision to swap SV-10 for SV-9 was made in 2014.

Construction on SV-10 began in May 2012. When finished, it was stored at the Boeing satellite factory until the week of November 17, when it was packaged and secured to the transporter before the Thanksgiving holiday. It was finally shipped to the Cape on Dec. 8.

All the GPS IIF satellites were built in the Boeing Satellite Development Center, a complex that spans between Nash Street and Selby Street and Imperial Highway to Maple Avenue in El Segundo. With more than one million square feet of floor space, it is the world’s largest satellite factory.

The factory boasts a storied history, having been constructed in 1948 as a production facility for Nash Motors, makers of the Nash Rambler. Cars came off the assembly line at the end of the original building that opened onto Nash Street. The reclusive Howard Hughes bought the property in 1955 for $3 million, eventually forming a division of Hughes Aircraft to build satellites, starting in 1961. Boeing bought Hughes Space and Communications in 2000 and currently builds both commercial and military satellites in the El Segundo plant.

See video on satellite preparation below.

[Video Removed]

March 2015 Anniversaries

by Carolyn Weyant
March 01, 2015

5 YEARS

Engineering and Technology Group: Thomas Turflinger, Robyn Wilkes

National Systems Group: Kimberly Crothers, Bradley Hirasuna

Operations and Support Group: Darryl Thone

Space Systems Group: Joseph Provenzano

10 YEARS

Civil and Commercial Operations: Suzanne Boucek

Engineering and Technology Group: Yontha Ath, Howard Cohen, Lorrie Davis, Michael Engler, Jason Hsu

National Systems Group: Bradley Ayres, Cathy Leamnson

Operations and Support Group: Howard Dotson, Christine Higuchi

Space Systems Group: Donald Putnick, John Shirakawa

Systems Planning, Engineering, and Quality: Marco Bacaloni

15 YEARS

Engineering and Technology Group: Kerry Buckland, Charles Jackson, Michael Kramer, Naomi Rose, Jonathan Taylor

National Intelligence Operations: Michael Healy

National Systems Group: Julie Goetz, Dean Sedgwick, Kevin Zehner

Operations and Support Group: Caryn Medrano, Reginald Parsons

Space Systems Group: Vannaroth Nuth, Vale Sather, David Woon

20 YEARS

Engineering and Technology Group: Calvin Truong

National Systems Group: Wayne Scheller

Operations and Support Group: Jill Greenlaw

Systems Planning, Engineering, and Quality: David Evans

25 YEARS

Operations and Support Group: Eric Hamburg

30 YEARS

Engineering and Technology Group: Jack Kreng, Donald Sather, Timothy Webb

35 YEARS

Engineering and Technology Group: Vickie Guillen, Sandra Jackson, Louis Sacks, Kenneth Winters

Operations and Support Group: Timothy Fernandes

Space Systems Group: Edmund Vierzba, Myra Watts

40 YEARS

Engineering and Technology Group: Peter Tsukamoto

Operations and Support Group: Hester Covington

March 2015 Obituaries

by Carolyn Weyant
March 01, 2015

Sincere sympathy is extended to the families of:

James Brown, member of the technical staff, hired Jan. 9, 1961, retired Nov. 1, 1969, died Feb. 19.
Robert Caldwell, member of the administrative staff, hired Jan. 14, 1963, retired July 1, 1993, died Feb. 4.
Dennis Charland, member of the administrative staff, hired Aug. 30, 1965, retired Oct. 1, 2000, died Dec. 12, 2014.
Richard Cherry, member of the technical staff, hired July 9, 1990, retired June 1, 2002, died Feb. 22.
Noel Eberz, member of the technical staff, hired Oct. 5, 1970, retired May 1, 1996, died Feb. 5.
Robert Ferro, senior engineering specialist, hired July 1, 1991, died Feb. 3.
Philip Morris, engineering specialist, hired June 24, 1976, retired Oct. 1, 1993, died Feb. 18.
Denny Pidhayny, member of the technical staff, hired Jan. 9, 1961, retired June 1, 2012, died Dec. 1, 2014.
Gerald Rellick, research scientist, hired May 10, 1976, retired April 1, 2000, died Feb. 17.
Theora Steward, administrative secretary, hired Sept. 30, 1991, retired June 1, 2014, died Feb. 1.

To notify Aerospace of a death and have it included in the Orbiter, please contact Cynthia Johnson in Human Resources at 310-336-5806.

March 2015 Notes

by Carolyn Weyant
March 01, 2015

Notes of appreciation to fellow employees and Aerospace for thoughtfulness and sympathy have been received from:

Pat Jefferson, on the recent passing of her brother, Willie Wolfe.

Lydia Moos, on the recent passing of her brother, Rizal Ibanez.

To submit a note of appreciation to Aerospace, please contact Valerie Jackson in Human Resources at 310-336-0891.