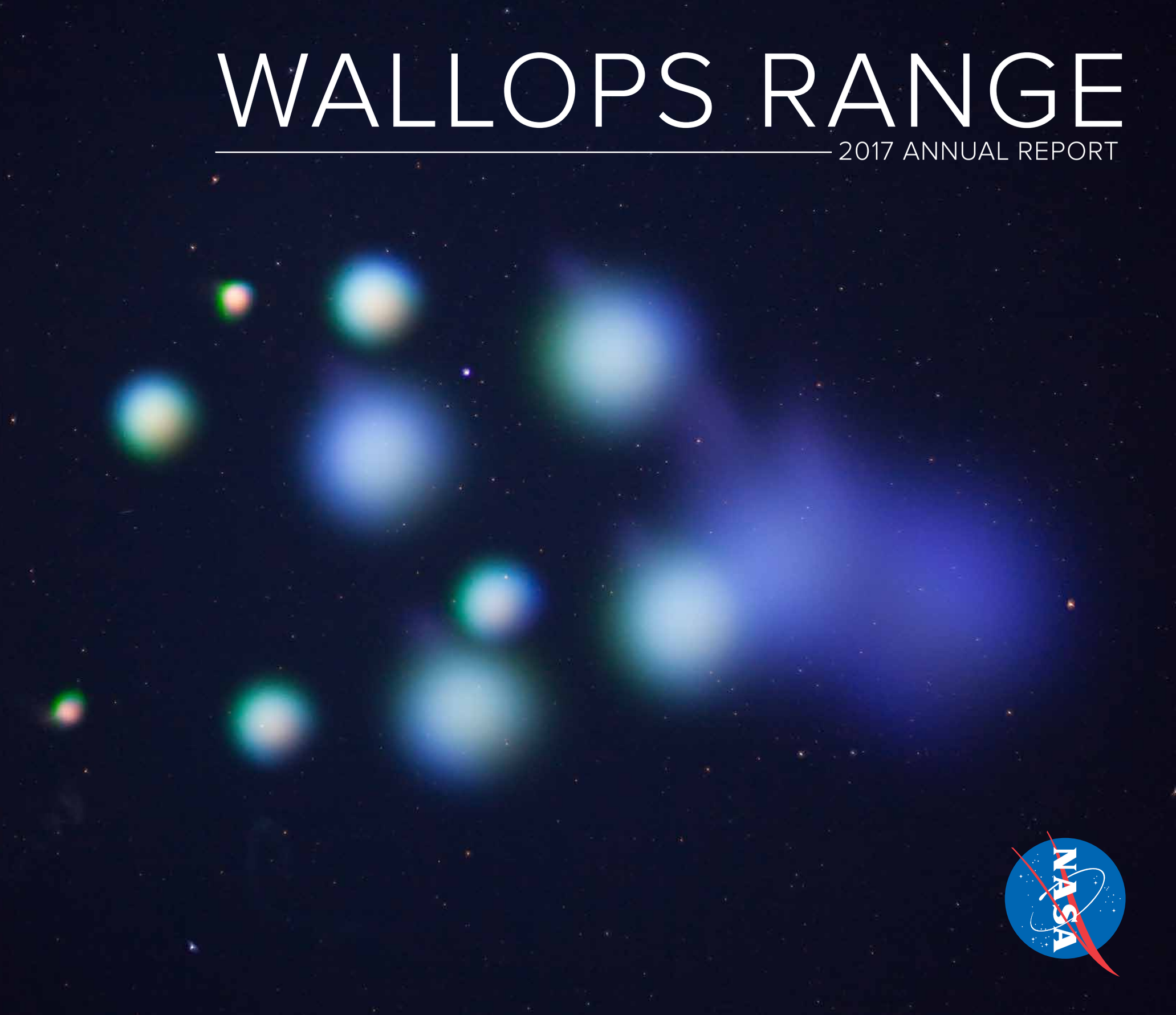
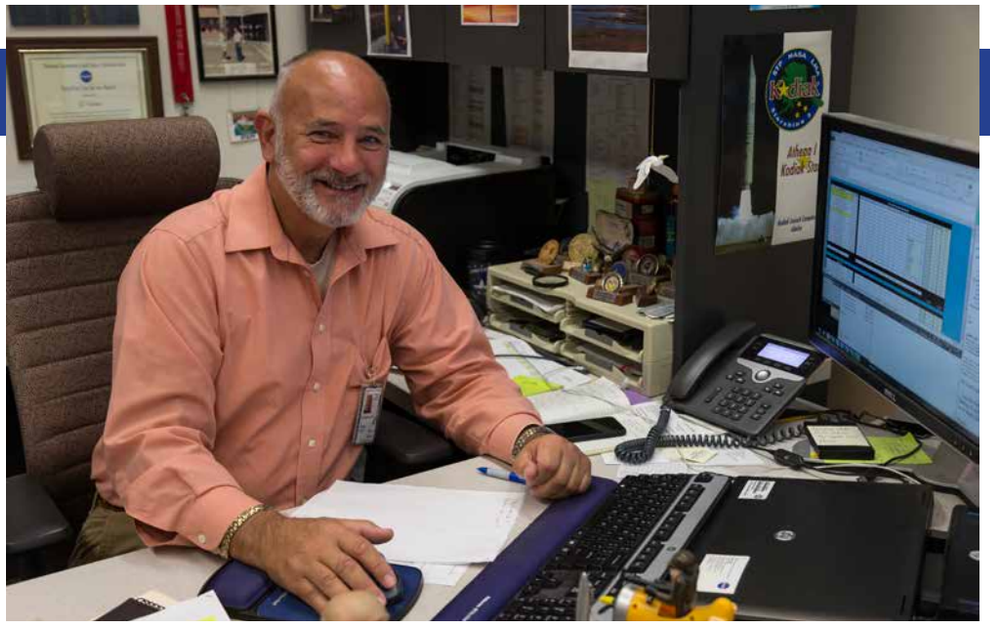
WALLOPS RANGE

2017 ANNUAL REPORT



DEDICATION

Jack Vieira



The year was 1977, Hotel California and Barracuda were climbing the music charts, and the New York Yankees just won the World Series. Clad in his perfect leisure suit, an eager Jack Vieira was ready to embark on a career that would make him a participant in some of America's most outstanding space achievements and become a mentor to students and peers alike.

Jack retired from NASA September 30, 2017, capping nearly four decades of mission operations and project management support with the agency. His tenure includes managing more than 300 missions – an astounding amount by any measure – producing groundbreaking science, enabling space exploration, and equipping American service members with surveillance and reconnaissance. Equally as important, Jack has been a strong advocate of NASA's goal to inspire and educate the scientists, technologists and engineers of tomorrow by volunteering his time and leveraging unique mission involvement for professors, teachers and students.

Of particular note, in Fall 1994, Jack led the NASA Equatorial Sounding Rocket Campaign at the Centro de Lancamento de Alcantara launch range in the northeastern state of Maranhao, Brazil. Jack spent more than 100 days away from his young family to launch 33 sounding and meteorological rockets, a feat that has not been repeated. This unparalleled rocket launch operation was a major example of how strong leadership, combined with impeccable technical skills, ensured mission success.

On the heels of the successful campaign, Jack was assigned to lead the METEO-1 satellite launch onboard the maiden flight of the Conestoga rocket. The rocket would be the first orbital launch from Wallops in more than a decade but ultimately experienced an in-flight anomaly due to a design flaw resulting in mission failure. In 1963, Project Mercury Director Walt Williams said, "Failures are with you always." Jack would utilize the knowledge gained from that mission failure on every mission he worked in the aftermath.

In 1998, Jack led the effort from the north coast of Puerto Rico and the scheduled launch of eleven sounding rockets. Overcoming technical and logistical challenges was difficult enough but the mission faced heavy protest by local citizens. As a mission leader, Jack faced a tug-of-war between a desire to launch or the safety of operations personnel. In deference to the team's safety, Jack made the judicious decision to end the campaign. Closing out this mission required finesse and talent on the part of Jack which many viewed as a greater achievement than had a successful launch campaign occurred.

In the early 2000s, Jack would lead many successful air-launched rocket Pegasus missions that often included launch countdown challenges of many types. On the heels of Pegasus launches, Jack led four straight years of campaigns in the frigid temperatures of Kodiak, Alaska, and from Poker Flat Research Range in Alaska. In Kodiak, he led the Kodiak Star launch, where he had to oversee the development of new launch processes for this first-of-a-kind mission at this site, ensuring team safety in temperatures reaching negative 40 degrees Fahrenheit, and on another occasion successfully launching five sounding rockets in less than five minutes to meet critical science objectives.

Nearly ten years after the failed launch of the Conestoga rocket, Jack was assigned to lead the successful Air Force Minotaur rocket carrying the Missile Defense Agency's Near Field Infrared Experiment (NFIRE) satellite to orbit. Jack's professionalism with the customers and technical skills dealing with complex ground and launch operations was evident in all six successful Minotaur missions that occurred between 2005 and 2013 and readied the Wallops Range to support the ambitious Commercial Resupply Service program and its partnership with Orbital ATK to resupply the International Space Station.

There is no greater respect from ones colleagues than to be sought for ones expertise. For Jack this is evidenced by the requested support of his peers for the current Antares missions. Jack has supported and served on console for every Antares mission which demonstrates his successful leadership.

Jack had the privilege of working on some of the most challenging missions and biggest rockets that Wallops has launched, but he exclaims the most rewarding times have been working with the student sounding rocket missions to close-out his career. Jack has readied the next generation of project managers and future explorers as he concludes his aerospace career.

A lifetime later, Jack retires, leaving his beloved agency better than he found it, providing nearly 40 years of tough but fair leadership, and mentorship for the next generation of eager space cadets, ready to embark in the next 40 years of serving NASA. He will be missed.

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INTRODUCTION

My fellow Range member, partners and customers, it gives me great pleasure to introduce the tremendous achievements of the Range and Mission Management Office, and the Wallops Range as a whole during 2017. This groundbreaking year was full of challenges but our staff members were up to the task each and every time. Please allow me to reflect on some of our highlights, even as we prepare to fulfill the challenge of what promises to be another action-packed year in 2018.

While still maintaining our reputation as the industry standard for assuring safe, low-cost range operations and strong commercial partnerships, 2017 saw an expansion in the launch capabilities provided by Wallops.

A perfect example of this was our mobilization to French Guiana to collect data for NASA Launch Services Program's Cyclone Global Navigation Satellite System (CYGNSS) mission on a Pegasus launch vehicle originating from Cape Canaveral. With less than a year to prepare for the mission, our team was able to establish agreements with a foreign entity, enable timely deployment and clear the path for a successful site build-up in an austere and remote location. Once the site was set up and tested, the Wallops team flawlessly executed the mission and transferred real-time data to waiting customers using innovative new techniques.

Meanwhile, in a completely different time zone and a tad colder climate, the Sounding Rocket Campaign at Poker Flat Research Range in Alaska consisted of five rockets, three of which launched on a single night. Some team members were deployed for nearly two and a half months during the frigid Alaska winter to allow scientists from multiple universities to gather data about Earth's upper atmosphere. Throughout the long campaign, our team worked with scientists as well as local range personnel and other deployed Wallops team members to successfully support testing, launch, and post-launch data collection.

Half a world away in the Marshall Islands on the Kwajalein Atoll, deployed Wallops personnel prepared to launch two sounding rockets for an atmospheric science campaign. Range Research Services personnel utilized new techniques in frequency management and coordinated with an outside agency to secure a GPS-based radiosonde ground station. These innovative ideas reduced mission cost and decreased operational risk.

2017 also saw our range facilities and engineering efforts gain unprecedented momentum. We completed renovation and a successful Operational Readiness Review of the Range Control Center (RCC) just in time to support the Antares OA-8 mission. The completed RCC is now a state-of-the-art facility for leading missions at Wallops. Another crowning achievement is our Bermuda downrange tracking site renovation project. This year we conducted the benchmark signing of a lease agreement between NASA and the Bermuda government that allowed us to begin renovations and operate from a building that will eventually house our more-permanent support site. This effort extends the life of the equipment by removing it from the harsh environment from which we've previously operated and per the agreement ensures a viable NASA capability in Bermuda for supporting launches out of both Wallops and Cape Canaveral through 2026.

The team supported multiple NASA missions all around the globe without any serious injuries or incidents in 2017. Through diligent hazard assessment and proactive activities such as the Wallops Safety Awareness Campaign and the completion of more than 180 monthly safety inspections of Range facilities, our personnel have ensured that the NASA mission is accomplished in a safe and environmentally sound manner.

These projects and missions highlight the innovation, professionalism, commitment, hard work and dedication of our most important asset: Our people. These tremendous individuals fuel our ability to provide our agency and the nation with outstanding return on investment, enabling groundbreaking science and aerospace development in a fast-paced environment. I look forward to another inspiring year of achievements in 2018.

Robert E.Jameson

— Robert E. Jameson

Chief, Wallops Range Office


NASA
WALLOPS
RANGE
NASA WALLOPS FLIGHT FACILITY GSFC
WFF

PORTFOLIO MANAGEMENT

WALLOPS ISLAND – The Range and Mission Management Office (RMMO) is a team of highly-skilled project management professionals who are charged with the responsibility of marrying the skills of scientists, engineers, NASA test directors, resource advisors, airfield managers, technicians and other personnel into one cohesive team whose objective is to conduct operations for data collection from many different flight platforms around the globe.

Working as a team and implementing sound project management strategies, we narrow our focus, reach desired goals and achieve those goals within specific time and cost parameters. As a final result everybody wins – which just may be project management's best benefit of all.

Project Management provides the Wallops Range and its customers with:

STAKEHOLDERS: Building relationships with all our stakeholders is an important part of our overall program management philosophy.

GOVERNANCE: The structure, process and procedure to control operations and changes to performance objectives. This includes metrics to indicate the health and progress of the project.

ASSURANCE: All projects must verify and validate the program, ensuring adherence to standards and alignment with the vision.

MANAGEMENT: Project managers must ensure there are thorough reviews, everyone is held accountable and that management of projects, stakeholders and suppliers are in place.

INTEGRATION: All projects ensure that component parts fit together properly to make the intended whole. Each project must optimize performance across the program value-chain, functionally and technically.

FINANCES: Projects must conform to the budget and track costs.

INFRASTRUCTURE: Project managers are charged with gathering a project team to ensure the Range's infrastructure can support the requirements of any mission.

PLANNING: Project managers must develop the overall plan and manage subsets that include resources, timescales, monitoring and control, lessons learned and other areas.

IMPROVEMENT: Not only do NASA project managers ensure mission success, they also take the time to develop and research new capabilities and systemically apply learning and knowledge to the project.

As part of RMMO, Research Range Services (RRS) supports NASA project managers and their missions by providing a myriad of services such as radar and optical tracking, telemetry down link, meteorological services, command and control, surveillance and recovery, financial analysis and engineering services to allow these missions to take place in a safe, ready environment.

The RRS team consists of many highly-experienced Range Services Managers (RSM) who work arm-in-arm with their NASA counterparts. In tandem, the Project Manager and RSM build, coordinate and manage cohesive teams that combine the efforts of engineers and technicians to configure a mobile and fixed range to provide launch range services around the globe.

From the initial thoughts of a principal investigator through the completion of data analysis, the RMMO PM in coordination with the RRS RSM is the glue that bonds the talents and efforts of the extended team of professionals needed to ensure successful completion of every mission.

All operations conducted at the Wallops Range and other remote launch ranges, such as Poker Flat Research Range, Alaska, Kwajalein, French Guiana and Andøya Space Center in Norway, require state-of-the-art technologies and multi-million dollar systems to support unmanned aerial vehicles, sounding rockets, expendable launch vehicles and many other flight platforms.

In 2017, project managers were responsible for Range instrumentation support for NASA orbital and sub-orbital programs as well as programs for other government and civilian agencies. They assured near 100 percent success for a multitude of programs executed at the Wallops Range while simultaneously managing a remote maintenance campaign at tracking/command sites in Norway and Bermuda.

PORTFOLIO MANAGEMENT OVERVIEW

DIRECTORATE | Science Mission Directorate

DIVISION | Heliophysics

PROGRAM EXECUTIVE | George Albright

PORTFOLIO MANAGER | Robert E. Jameson

LEAD CENTER | Goddard Space Flight Center

PERFORMING FACILITY | Wallops Flight Facility

PORTFOLIO TYPE | Research Range Service

RESEARCH RANGE SERVICES ASSETS: $318.14 MILLION

Telemetry Systems	Per Unit	Quantity	Total ($M)
7.3-Meter Fixed Antenna	$1.5	2	$3.0
7-Meter Mobile Antenna	$1.5	2	$3.0
Mobile Telemetry Van	$1.5	1	$1.5
20-Foot Mobile System	$2.0	1	$2.0
Mobile Super Van	$2.5	1	$2.5
10-Foot Mobile Antenna	$0.5	1	$0.5
8-Foot System	$0.4	2	$0.8
8-Meter Antenna	$2.5	2	$5.0
9-Meter Redstone	$6.0	2	$12.0
9-Meter System	$4.0	1	$4.0
Transportable Command and Telemetry System (TCATS)	$15	2	$30.0
Mobile Integrated Telemetry System	$2.5	1	$2.5
11-Meter Antenna	$2.7	1	$2.7
Atmospheric Radars	**Per Unit**	**Quantity**	**Total**
Space Range Radar (SPANDAR)	$20.0	1	$20.0
Ultra High Frequency (UHF)	$18.0	1	$18.0
Tracking Radars	**Per Unit**	**Quantity**	**Total**
Range Instrumentation Radar – 778	$6.0	4	$24.0
Range Instrumentation Radar – 716	$7.0	2	$14.0
Range Instrumentation Radar – 706	$70.0	1	$70.0
TPQ-39 Radar	$1.5	1	$1.5
19-17 Radar	$1.5	1	$1.5
Multi-Frequency, Longe-Range Tracking Radars MFTR-2100	$10.0	2	$20.0
Surveillance Radars	**Per Unit**	**Quantity**	**Total**
Airport Surveillance Radar (ASR-8)	$10.0	1	$10.0
Sea Surveillance (S- and X-Band, WISSRDS)	$1.0	2	$2.0
Airborne Surveillance Radar (APS-143)	$2.5	1	$2.5
Lightweight Surveillance Target Acquisition Radar	$0.35	4	$1.4
Command & Support Systems	**Per Unit**	**Quantity**	**Total**
Fixed UHF Command System	$4.0	1	$4.0
Fixed Poker UHF Command System	$1.5	1	$1.5
Mobile Command System	$2.5	2	$5.0
Mobile Range Control System	$2.1	1	$2.1
Radio Frequency Communication	$3.0	1	$3.0
Timing System	$0.8	1	$0.8
Mission Operations Voice Enhancement (MOVE) System	$4.0	1	$4.0
Optical Systems	**Per Unit**	**Quantity**	**Total**
Video Tracking Stations	$1.0	5	$5.0
Photographic Stations	$0.3	5	$1.5
Radar-Slaved Mobile Optical Tracker	$0.4	1	$0.4
Video Distribution and Recording	$2.1	1	$2.1
Meteorological Systems	**Per Unit**	**Quantity**	**Total**
Electric Field Mills	$0.02	7	$0.14
Leading and Environmental Display System	$0.30	1	$0.30
Range Control	**Per Unit**	**Quantity**	**Total**
Range Control Center	$20.5	1	$20.0
Mobile Power Systems	**Per Unit**	**Quantity**	**Total**
Mobile Power System	$0.25	4	$1.0

OPERATIONAL MISSIONS AND ACCOMPLISHMENTS

ASPIRE

WALLOPS ISLAND – Research Range Services (RRS) continued its role as a vital part of the MARS 2020 mission on October 4, 2017, when the Advanced Supersonic Parachute Inflation Research Experiment (ASPIRE) launched from the Wallops Range, carrying with it a parachute test system used to develop improved full-scale parachutes for atmospheric re-entry to Mars.

One of the greatest technical challenges in executing the NASA 2020 mission to MARS is trying to determine how to slow down a payload upon atmospheric re-entry given the limits of current parachute technology. As a critical part of the Mars 2020 mission, the ASPIRE project is performing a series of high-altitude sounding rocket tests in order to assess a parachute's ability to survive the loads and stresses associated with supersonic inflation.

The RRS team provided a full suite of instrumentation, surveillance, engineering, and project management support. Radar and telemetry assets were able to successfully track the vehicle, as well as receive and record data from the payload. Photo and optical provided coverage of the build-up and fly-out of the vehicle. The surveillance team monitored restricted areas and reported their status to Wallops Range Safety to help ensure the safety of the public during the launch. While all of these support aspects can be demanding, it was the recovery of the payload and parachute that truly challenged the RRS team.

As part of the minimum success criteria, the sounding rocket's experiment section needed to be recovered after splash-down to collect the recorded data and video which will eventually be used in flight reconstruction and evaluation of the parachute's performance.

In order to achieve comprehensive success criteria, the RRS team was also required to recover the parachute so it could be examined for inflation related damage. While recovery of payloads and parachutes has been accomplished on numerous past missions, the size, shape, and weight of the ASPIRE experiment section and parachute made this recovery unprecedented. Further complicating the recovery was the need to recover the parachute quickly and without damage. This difficult recovery was performed seamlessly, meeting both minimum and comprehensive success criteria and providing the ASPIRE experiment team with critical data needed to push humankind to Mars.

The RRS team was tasked with a challenging mission outside of our regular operation parameters, but teamwork, innovative recovery procedures and solid operational performance once again resulted in a successful mission.

MISSION FACTS

LAUNCH VEHICLE
Black Brant IX

WALLOPS ID
NRW-5789

LOCATION
Pad 2 - 50K Launcher

LAUNCH DATE
October 4, 2017

ANTARES OA-8

WALLOPS ISLAND – Research Range Services (RRS) played a vital role in the day-to-day operations of the International Space Station (ISS) on November 12, 2017, when an Antares rocket lit up the morning sky from the Wallops Range, carrying with it much needed supplies for the astronauts on board the ISS.

One of the crowning achievements of space exploration and international cooperation is the ISS, a joint venture between five global space agencies. The ISS has been in operation since 1998 and has been continually manned by crews of up to six astronauts. Crucial to its continued operations is the regular, dependable resupply of the station. Wallops continued its support of this critical mission of ferrying cargo to the ISS with the build-up, check-out and launch of Orbital ATK's Antares rocket for the OA-8 mission.

The November 12, 2017, mission was the result of nearly nine months of on-station support from numerous Wallops Flight Facility functional area and their contractors. The team expertly worked to march through the vehicle processing and testing, ensuring a smooth campaign.

A potential drop in downrange antenna coverage was discovered during link analysis. RRS personnel immediately deployed to the downrange operations site to assess and test mitigation plans. After a complete survey of the command system, all cabling was rerouted and replaced with lower loss-rated cable; the result was a command link margin that was within expected thresholds.

The vehicle was moved to Pad 0A on November 9, 2017, for final checkout and tests. Final launch pad checks, range systems checks, and launch readiness reviews were conducted during the first ten days of November. On November 11, the Wallops team processed a near flawless countdown and were primed for launch until surveillance officers detected an aircraft in the hazard area minutes before T-0. This prompted an abort and 24-hour recycle. The Wallops team returned to station late that evening to open a second count. This time, weather, range, safety and vehicle all worked perfectly and the OA-8 launched November 12, 2017, at 7:19 a.m. EST.

The Cygnus spacecraft, named the S.S. Gene Cernan, docked with the ISS approximately 48 hours later, successfully completing yet another Wallops space support mission. RRS now looks to support another Antares launch scheduled for May 2018 at the time of this printing.

MISSION FACTS

LAUNCH VEHICLE
Antares

WALLOPS ID
CRW-5805

LOCATION
Pad 0A

LAUNCH DATE
November 12, 2017

ALASKA CAMPAIGN

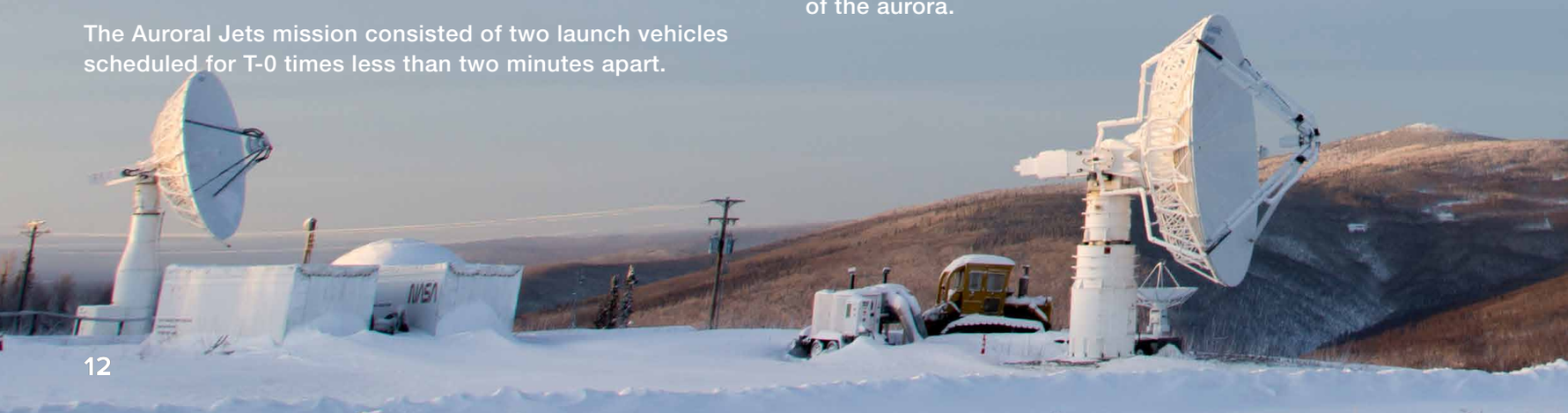
FAIRBANKS, Alaska – Continuing the tradition for more than forty years, the Wallops Research Range Services (RRS) team returned to Poker Flat Research Range (PFRR) to support another exciting NASA scientific campaign. The 2017 campaign consisted of three separate missions, including five launches. For some members of the team, support of this mission involved a nearly two-and-a-half month deployment, spanning from late December through mid-March in the freezing temperatures of Fairbanks, Alaska. The team traveled to PFRR just after Christmas to begin setting up the support equipment and preparing for pre-mission testing. After ringing in the New Year, the testing efforts ramped up as the January 19, 2017, launch window opening drew ever closer.

This campaign was effectively broken up into two major segments. The first effort involved launching the PolarNox mission in the mid-late January timeframe. This was complicated by the fact that if it did not launch early in the window, PolarNox would begin affecting the pre-mission testing schedule of the two remaining missions, which were scheduled to launch later in February. As can often be the case on scientific flights, the launch continued to slip later and later into its window due to vehicle issues and bad atmospheric conditions. Finally, in the early morning hours of January 27, 2017, the PolarNox experiment roared into the arctic sky. This mission was unique in that it represented the first use of the Wallops Range's permanent command uplink system installed at PFRR. This command system enabled investigators to make adjustments to payload events or attitude during data collection periods to ensure measurements and data collection. Fortunately, the PolarNox mission launched just before the scheduling conflicts became a more serious challenge. After the successful launch and data collection for PolarNox, the team turned its attention towards the next two launches. Several members of the RRS team switched out between these two campaigns due to its extended duration. Thanks to the training and experience of the team, these changeovers were performed seamlessly and work continued in the set-up of the two remaining launches.

The Auroral Jets mission consisted of two launch vehicles scheduled for T-0 times less than two minutes apart. The ISINGLASS mission also consisted of two launch vehicles, but scheduled for launch on two different nights. Once the setup and pre-mission testing was complete, the team was ready for the opening of the launch window on February 13, 2017. After several days, the first of the ISINGLASS missions launched on February 22, 2017, leaving three flights to go. As the end of the available window crept closer, the team began to wonder if they were due for a repeat of the 2014 campaign, where a second window was required to successfully execute the mission.

On March 1, 2017, the team reported to the range as usual. Typically for these missions, the auroral conditions the scientists required do not occur until the early morning hours of the launch window. As the pre-launch checkouts began, the Principal Investigator (PI) of the Auroral Jets mission warned the team that indications suggested promising science would be arriving very early in the launch window that night. The PI of the ISINGLASS mission also stated that science was looking promising for their vehicle as well. As the final pre-launch tests were close to being completed, the Auroral Jets PI announced over the communication nets that he wanted to proceed with the final launch count. A few minutes later, the first of the Auroral Jets mission lifted off. There was no relaxing for the team, however, because less than two minutes later, the second rocket launched. Rockets in these salvo configurations can present tracking challenges, but the RRS team was able to successfully track both rockets. The night's activities were not over yet. Just two hours later, the PI for the ISINGLASS mission announced that science conditions had developed for their mission. So for the third time that night, the team conducted countdown operations to T-0 as the third rocket carried its experiment into the aurora.

This campaign presented many challenges – the number of launches, the length of the deployment, the challenging weather conditions when the temperatures would rise and the roads became icy. Despite these challenges, the hard work and dedication of the RRS team allowed for the successful support of NASA's scientific investigations of the aurora.



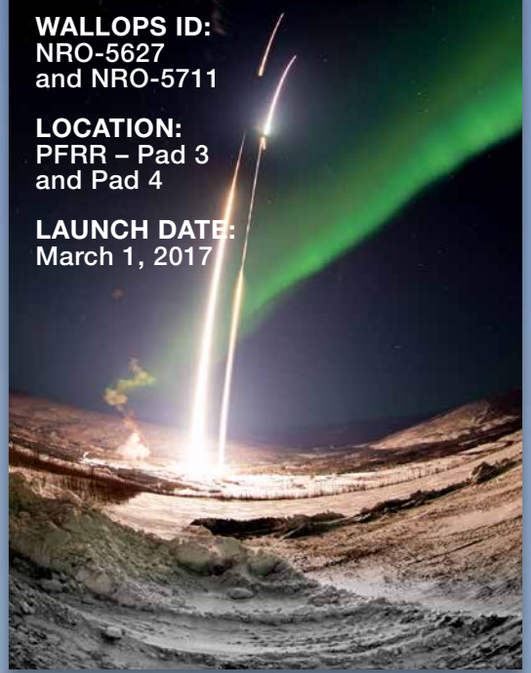
AURORAL JETS FACTS

LAUNCH VEHICLE:
Black Brant IX

WALLOPS ID:
NRO-5627
and NRO-5711

LOCATION:
PFRR – Pad 3
and Pad 4

LAUNCH DATE:
March 1, 2017



The Auroral Jets mission was an experiment to understand neutral 'jet' winds within the auroral arcs.

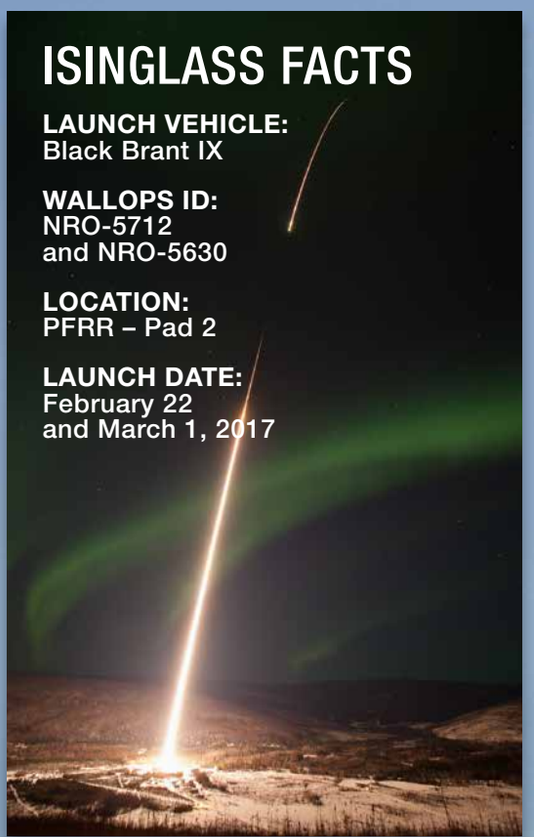
ISINGLASS FACTS

LAUNCH VEHICLE:
Black Brant IX

WALLOPS ID:
NRO-5712
and NRO-5630

LOCATION:
PFRR – Pad 2

LAUNCH DATE:
February 22
and March 1, 2017



The ISINGLASS mission launched two identical payloads through two different types of aurora to understand how the electrodynamic process structure of the aurora is created by solar winds in the upper atmosphere.

POLARNOX FACTS

LAUNCH VEHICLE:
Black Brant IX

WALLOPS ID:
NRO-5628

LOCATION:
PFRR - Pad 3

LAUNCH DATE:
January 27, 2017

The PolarNOX mission payload was used to measure the abundance and altitude of peak nitric oxide in the aurora and how it effects the ozone layer.

SUB-TEC 7

WALLOPS ISLAND — The skies over the Wallops Range illuminated and a rumble was felt as a Black Brant IX suborbital sounding rocket carrying multiple experiments launched on May 16, 2017, carrying the 1,200 pound Suborbital Technology Experiment Carrier (Sub-TEC) payload.

Sub-TEC carried multiple payload experiments, with the primary purpose being to demonstrate the NASA Sounding Rocket Operation Contract (NSROC) Forward Ogive Recovery System (N-FORSe) and the Water Recovery Shutter Door. The new recovery system will enable telescope payloads to be launched from sites with water impact areas, such as Kwajalein and Wallops Island. The secondary objective was to provide a flight opportunity for 23 Sounding Rocket Program Office (SRPO)/NSROC development components and subsystems.

Though the rocket launched successfully, unfortunately the parachute did not deploy nominally during its descent. Once the rocket splashed down, it was located by the surveillance aircraft who directed the recovery team to collect the payload. On return to the dock, the team noticed that the payload had sustained damage and the aft section had broken off. Despite this, the Wallops Range team captured all the valuable telemetry readings to improve the performance of future mission and provided valuable information to the engineering team.

This was the seventh mission in the Sub-TEC series. The Sub-TEC missions are intended to demonstrate multiple technologies, improve SRPO capabilities, and support range development initiatives. Sub-TEC missions are intended to be low-cost, and use as much existing payload hardware as possible, and provide for water recovery.

MISSION FACTS

LAUNCH VEHICLE
Black Brant IX

WALLOPS ID
NRW-5725

LOCATION
Pad 2 — 50K Launcher

LAUNCH DATE
May 16, 2017

HALL

WALLOPS ISLAND — On its ninth attempt, a suborbital sounding rocket successfully launched from NASA's Wallops Flight Facility off the Eastern Shore of Virginia. Ten colorful chemical clouds illuminated the early morning sky on June 29, 2017, at 4:25 a.m. EST, due to detonated ampules that were ejected during flight from the two-stage Terrier MK12 — Improved Malemute rocket. Scientists released the chemical clouds, or vapor tracers, in the ionosphere to study particle motion in the upper atmosphere and to test if the chemical ampules would eject and detonate fully.

Critical Range support elements for this mission included launch weather forecasting and tracking. Ground cameras located at Wallops Island, Virginia, and Duck, North Carolina, both needed clear sky conditions in order to properly track vapor tracers in the atmosphere. The Range Weather Office communicated daily throughout the entire month of June with the management team to determine which days provided acceptable weather conditions for launch. Less than a week before the final T-0, the camera was removed at the Duck, North Carolina, location due to continuous visibility issues. NASA's Beechcraft B200 Super King Air aircraft, equipped with optical coverage, was used in its place and helped yield a "green" range.

Principal Investigators (PI) from Clemson University planned on operating the camera aboard the aircraft and the ground camera at Wallops Range, but due to the extended launch window, the research team from Clemson University had to abandon their optical services. The PI then asked the Wallops optical team to operate their cameras days before the last launch attempt. The Wallop Range optical team received training in time to gather the most critical data of the chemical clouds for this mission. Range optical support services additionally provided long range tracking, high-speed imagery capture, and still photography for this mission.

This test successfully demonstrated the ejection and detonation of the chemical ampules, a new technology that will be used on upcoming science missions occurring in Norway to study the aurora. The launch also tested and proved functional a multi-canister ejection system. As opposed to deploying the ampules from the main payload, scientists can now gather information on a larger scale with the new system.

Red, green, and blue puffs in the sky could be seen from New York to South Carolina, and as far west as points throughout Virginia, Maryland, and Pennsylvania. The vapor tracers were composed of barium, strontium, and cupric oxide and released 96-124 miles high in Earth's atmosphere. The clouds posed no hazard to the area near the launch and Wallop's Range team completed the mission with flying colors.

MISSION FACTS

LAUNCH VEHICLE
Terrier MK12 — Improved Malemute

WALLOPS ID
NRW-5724

LOCATION
Pad 2 — ARC Launcher

LAUNCH DATE
June 29, 2017

KWAJALEIN CAMPAIGN

KWAJALEIN ATOLL, Marshall Islands – The 2017 NASA Sounding Rocket Equatorial Campaign, a Geospace Mission, was supported by Research Range Services (RRS) personnel and conducted from the Kwajalein Atoll in the Marshall Islands in early September 2017. This campaign involved two rockets designed to discover details about the formation of a phenomenon called Equatorial Spread F (ESF).

The RRS program boasts a mobile range that consists of radar, telemetry, command and control and communications systems. At a moment's notice, these systems can be gathered and shipped to any launch location in the world. This past year, the RRS mobile range was dispatched to the southern North Pacific to collect Geospace data in that part of the world.

A series of two sounding rockets were launched on September 9, 2017, about 5 minutes apart during this launch campaign. Both rockets supported the NASA Waves and Instabilities from a Neutral Dynamo or WINDY mission.

RRS personnel provided mission planning, logistics and scheduling support during pre-mission activities and during the execution phase. Other support provided included a mobile telemetry readout capability, RF communications, meteorological operations, photography and a video surveillance system, and project management support for the WINDY mission. RRS personnel worked in conjunction with the existing Reagan Test Site (RTS) personnel and tracking instrumentation on both Roi Namur and Kwajalein Atolls. Thus saving wear-and-tear and a significant amount of funds on other RRS instrumentation normally required for a remote campaign deployment.

The first rocket, a Black Brant IX sounding rocket, was successfully launched at 7:43 a.m. EDT, and flew to approximately 254 miles altitude and released its trimethyl aluminum (TMA) and lithium, forming vapors to allow scientists to measure the winds and energetic particles that are in motion in the upper atmosphere.

The first rocket was followed five minutes later by a Terrier-Improved Malemute sounding rocket, which carried instrumentation to gather information on the trimethyl aluminum (TMA) and lithium behavior at that altitude and region of the earth. The instrumentation aboard the second rocket was configured to measure densities and electric and magnetic fields in the ionospheric disturbance but did not obtain useful data.

The remote deployment return to Kwajalein by RRS personnel and instrumentation highlights the special capabilities of the RRS program, and fills a gap in science gathering that no other NASA facility can offer. NASA Wallops personnel were last deployed to Kwajalein in spring 2013 for a successful support of four science missions. In the near future, the Wallops Range has scheduled a deployment for spring 2018 to support two NASA telescope missions.

Data from these missions, in conjunction with data from numerous missions during the years, are helping scientists better understand space weather and how it impacts our lives here on earth.

MISSION FACTS

LAUNCH VEHICLE
Terrier MK12 —Improved Malemute and Black Brant IX

WALLOPS ID
NRO-5790 and NRO-5791

LOCATION
Roi Namur

LAUNCH DATE
September 9, 2017

ISS-CREAM

INTERNATIONAL SPACE STATION — The International Space Station – Cosmic Rays Energetics and Mass (ISS-CREAM) mission was successfully integrated in the SpaceX Dragon Capsule and launched onboard the Falcon 9 for the CRS-12 mission from Kennedy Space Center on August 14, 2017.

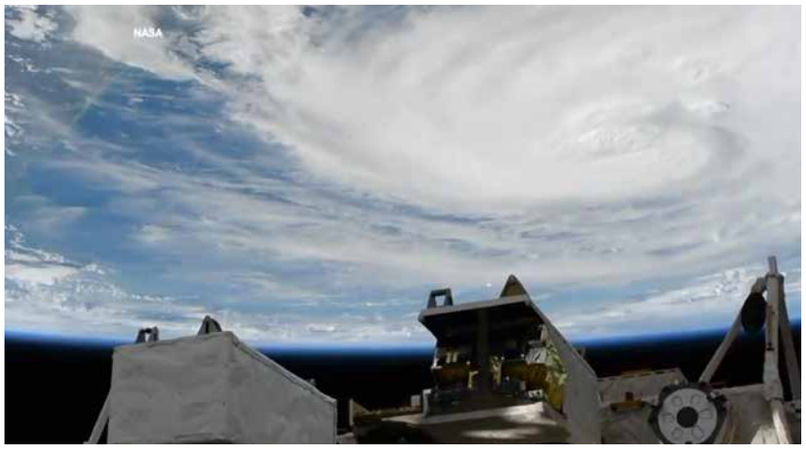
The ISS-CREAM mission took the next step and currently resides on NASA's share of the Japanese Experiment Module Exposed Facility (JEMEF) of the ISS for a minimum of three years. Its goal is to precisely measure energy spectra of individual nuclei over the proton-to-ion elemental range from 1010 electron volt (eV) to approximately 1015 eV, and will address the long-standing fundamental science questions such as:

- Do supernovae really supply the bulk of cosmic rays?
- What is the history of cosmic rays in the galaxy?
- Can the energy spectra of cosmic rays result from a single mechanism?
- What is the origin of the "knee" in the cosmic ray all particle energy spectrum?

These questions have been difficult to answer because no other space mission capable of measuring the low fluxes of particles at energies approaching the cosmic ray "knee" around 3x1015 eV has yet to be flown. The ISS-CREAM mission will be the first experiment to have the data set needed to pursue these questions effectively.

The Applied Technology and Engineering Directorate and the Research Range Services program at Wallops Flight Facility (WFF) were responsible for managing the system-level integration and environmental test program. In addition, the WFF team oversaw the technical and programmatic aspects of the mission, and also provided thermal and mechanical engineering.

The ISS-CREAM project consists of a collaboration of the University of Maryland, Penn State University, and Northern Kentucky University), as well as foreign universities such as Sungkyunkwan University and Kyungpook National University from South Korea. Multiple NASA facilities are also engaged, such as NASA Headquarters, Goddard, Johnson, Marshall and Kennedy space centers, and other collaborative efforts from the Japanese Aerospace Exploration Agency (JAXA) and Laboratoire de Physique Subatomique et de Cosmologie (LPSC) in France.



The ISS-CREAM seen attached to the International Space Station.

The ISS-CREAM seen before being loaded for flight on the Falcon 9.

UAS PROJECTS

NETTED SENSOR DEMONSTRATION

WALLOPS ISLAND – The Naval Warfare Development Command (NWDC) Fleet Experimentation Program (FLEX) turned to Wallops to conduct a Netted Sensors demonstration in August 2017. During the week of August 7, three flights of two Unmanned Tactical Aerial Platform (UTAP) Unmanned Aerial Vehicles (UAVs) were planned. The mission objectives were to control the UAVs via a tablet from a Northrop Grumman CRJ-700, sense a variety of aerial and ground targets of interest, and communicate through an expansive Tactical Targeting Network Technology (TTNT) network.

The Research Range Services (RRS) and Wallops Safety Office provided support in the form of ground safety support, surveillance, weather reports and range service management. Setup and pre-flight checkouts were conducted in W-65.

The UTAPS were launched from Pad 2 and took less than one minute to pass through R-6604 restricted airspace. Once through R-6604, handover was successfully given to the CRJ-700 project for operations, termination and recovery in W386 airspace. The UTAPs were recovered by helicopter and returned to the south UAV runway. They were then loaded onto a truck and transported to Wallops main base to be prepped for the next flight.

Unfortunately due to weather, an issue encountered with the UTAPs; Only one flight was conducted, but it was deemed successful. The customer stated, “We thought Wallops was a great location to work out of.”

A helicopter carries the UTAP back to Wallops Island after its flight.

UAS PROJECTS CONTINUED

COBRA

WALLOPS ISLAND – The Navy completed the first phase of its initial operational test and evaluation on the AN/DVS-1 Coastal Battlefield Reconnaissance and Analysis (COBRA) airborne mine detection system April 19, 2017, through June 1, 2017, and is awaiting Littoral Combat Ship availability to complete the remaining testing.

COBRA is a sensor payload that operates onboard the MQ-8B Fire Scout and can detect beach zone mines in the daytime to help plan amphibious landings. An eventual block upgrade would add nighttime and surf zone detection capabilities.

COBRA wrapped up its Initial Operational Test and Evaluation Phase 1 at Wallops Flight Facility this summer, and the Navy declared initial operational capability on July 31, 2017. Using air vehicle operators and mission payload operators from Air Test and Evaluation Squadron (VX) 1, maintainers from Helicopter Sea Combat Squadron (HSC) 21 and operators from USS Independence (LCS-2) and the LCS Squadron (LCSRON) 1, the LCS program proved to the operational test and evaluation force that COBRA can effectively and reliably meet its mission requirements.

Research Range Services successfully provided program management support, meteorological and weather services, radar operations, optical support, airspace management, frequency management and ground communications services.

The Navy FireScout UAV is seen in the D-1 Hangar at Wallops Flight Facility.

Data from COBRA will be sent to the amphibious landing force through the Joint Direct Attack Munition (JDAM) Assault Breaching System (JABS), which could either direct a JDAM air assault on a beach to clear mines or could feed the location of mines to the precision navigation and lane marking systems on the amphibious vehicles coming ashore. COBRA can also feed the data through the LCS to other components of the mine countermeasures mission package, including to systems that can neutralize the mines COBRA located.

AEROSTAR

WALLOPS ISLAND – Research Range Services (RRS) provided support and services during a six-day period in November 2016, to the Navy AeroStar program. A single Navy AeroStar Unmanned Aerial System (UAS) successfully flew three flights (one maintenance and two operational) November 5-6, 2016, aided by the professional and dedicated RRS personnel who helped the flights occur safely and smoothly. A final flight was canceled due to dangerous cross winds on the runway.

The Navy AeroStar Project takes off from the Wallops Airfield.

By providing the research airfield and airspace and its accompanying services, the Navy received the level of quality they have come to expect to close out this last phase of the Navy's mission for the year.

The Navy's AeroStar UAS is a fixed-wing aircraft with twin-tail booms used for research, development, test and evaluation, and science/technology missions.

The purpose of the project was to perform target data acquisition in support of naval operations. The air vehicle was planned to maneuver within the Wallops Range's restricted airspace and was intended to present certain air vehicle aspects while data was collected. The flight events were scheduled using RRS facilities, which are capable of accommodating the UAS and its support equipment while providing resources, project management services, and Wallops Range Safety Office support necessary to complete the proposed project. RRS personnel supported this project by providing a variety of Range services, to include communications, scheduling, project management, safety, HAZMAT material storage, weather forecasting, electric power supply, frequency management, equipment storage facilitation, optical, and critical air tower operations.

During its short time at the Wallops Range in November, the NASA project team was able to accomplish all support tasks associated with the mission. This project provided the perfect blend of contractor, military, and NASA synergy which provides a successful test atmosphere. The UAS Principal Investigator

GULFSTREAM WATER INGESTION TEST

WALLOPS ISLAND – Gulfstream returned to the Wallops Range to conduct another water ingestion test, this time for their Gulfstream G500 in July 2017. These water ingestion test are required by U.S. Federal Aviation Administration to ensure that the aircraft engines are still able to perform during a sudden intake of water kicked up as landing gear touches down on a rain-soaked runway.

The Wallops Range supported these tests with a 200-foot-long trough filled with 7,000 gallons of water, which stands about one inch deep. High-speed camera and photography support were also provided during each of the series of runs made through the trough. This support provides a slowed-down visual of the run, giving the customer detail of where water runs over and into the aircraft engines that would otherwise not be seen with the naked eye.

RRS faced the challenge of stretching their optical support while simultaneously supporting the Gulfstream testing and also the Hall sounding rocket mission, which had begun to slip closer to the week of the test. Part of the optical team split off to prepare setting up for the water ingestion test while the rest of the team continued to support the Hall mission.

The Gulfstream G500 sits within the water trough on the Wallops airfield.

Each series of tests increased speed from 70 mph up to 140 mph to determine at what speed the aircraft engines took on the most amount of water. Once that was determined, the G500 ran through the water at that speed but with different throttle and flap settings, said Scott Martin, senior experimental test pilot for Gulfstream.

RRS was scheduled to support the test throughout the whole week, but the customer received all the results they needed within the first few days.

AIRBORNE SCIENCE SUPPORT

WALLOPS ISLAND – In addition to the support of rockets and other range missions, Research Range Services (RRS) provides project management support to aircraft-based research missions funded through the Airborne Sciences Program in the Science Mission Directorate.

The RRS project manager (PM) coordinates the activities of the aircraft maintenance and operations contractor, the various science team members, Wallops Flight Facility (WFF) aircraft office Departments, WFF Applied Engineering and Technology Directorate (AETD) team members, and other WFF support organizations to ensure all campaign objectives are met. A primary function is developing plans and documentation for the campaign and nurturing the collective team through the airworthiness certification process culminating in a final flight release. Airborne science instruments vary in form and function — some are mounted in racks inside the fuselage, while others are mounted to or protrude from the aerodynamic surfaces. These instruments can change the airflow around the aircraft and it is critical to flight safety and mission success that the final compliment of instruments have been analyzed and tested in flight configuration.

Aircraft Office missions are conducted on one of the Wallops-owned aircraft or on a contracted aircraft. Campaigns are conducted at locations across America and throughout the world.

OPERATION ICEBRIDGE

THULE, Greenland – In fall 2017, after being down for 18 months getting new wings installed, the WFF P-3 Orion aircraft was once again ready to support the Operation IceBridge mission. NASA's Operation IceBridge was conceived to bridge the gap between ICESat missions by capturing images of Earth's polar ice and studying changes in thickness of sea ice, glaciers, and ice sheets, in the polar regions. The team used a combination of radar, laser, and optical imaging to map land and sea ice over Greenland, the Arctic Ocean, the continent of Antarctica, and its surrounding waters. Highly specialized instruments were installed on, and in the P-3, to enable visual, spectral, and radar imaging of the ice over which the P-3 flies. Large radar antenna arrays from the Center for Remote Sensing of Ice Sheets (CReSIS) at Kansas University are hung under the wings and along the underbelly of the aircraft. Specially designed downward looking ports for the lasers on the Airborne Topographic Mapper (ATM) instruments are installed. Instrument racks for GPS/Navigation, data handling and processing take up the majority of the P-3 interior.

The team left for deployment March 7, 2017, with 63 possible flight plans prioritized to allow the team to respond to real-time weather conditions and avoid missing flight opportunities. The primary deployment site was from Thule Air Base in Greenland, with short term deployments out of Fairbanks (Alaska), Svalbard (Norway), and Kangerlussuaq (Greenland). During the entire deployment duration, which was just under ten weeks, the team flew 40 of the 63 flight plans tallying 332 flight hours. The successful campaign concluded on May 13, 2017, after producing volumes of data and stunning images, like the one included here showing an iceberg calving.

The P-3 lands in Greenland for the IceBridge mission.

The glaciers in Greenland seen from the P-3 aircraft.

AIRBORNE SCIENCE SUPPORT CONTINUED

ORACLES CAMPAIGN

SÃO TOMÉ, Central Africa – After completion of the Operation IceBridge Arctic Campaign, the P-3 aircraft was cleared of instruments and reloaded with an entirely new complement of research tools. This time the campaign was focused on studying key processes that determine the climate impacts of African biomass burning aerosols. The ORACLES experiment provides multi-year airborne observations of the key parameters that drive aerosol-cloud interactions in the South East Atlantic, an area with some of the largest inter-model differences in aerosol forcing assessments on the planet. In 2016, the team was deployed to Walvis Bay, Namibia. This year's campaign operations were out of São Tomé. The new location had improved scientific value in that the transit time for each flight to reach the aerosol plume (scientific area of interest) was only 25 percent of the time it took from Walvis Bay. Operating out of a new site has many challenges, especially when the site is as remote as this one. Logistics were particularly challenging and the RRS Project Manager worked closely with the Earth Science Project Office out of Ames Research Center to ensure critical spare parts would be available during the deployment.

ORACLES instruments include various probes for sampling cloud particles and aerosols from the flight environment. The cloud probes are hung on pylons under the wings. A redesign of one of the pylons was completed to support this campaign in order for the science team to determine if moving the probe forward of the wing's leading edge would change the quality of data collected. The operations engineer from the WFF AETD managed this effort, responding to manufacturing delays and defects and preserving the project schedule.

The P-3 aircraft was stationed out of São Tomé.

With all the instruments on board, the aircraft and instrument performance were tested for deployment readiness during one airworthiness test flight and two projects test flights. Everything passed the tests and last minute maintenance issues were cleared. The aircraft and team left for São Tomé on August 1, 2017.

After a rocky start with delays along the transit route, the team reached São Tomé, took some time to rest, and made the first purely science-driven flight on August 7, 2017. The team struggled with mechanical issues throughout the campaign. Still, they were able to achieve 152.7 flight hours of the approved 179.5. The missions included a joint flight with the CLARIFY team from Great Britain in Ascension studying similar cloud/aerosol interactions. They flew numerous high-priority flight lines, including collection of semi-LaGrangian data following the same particles during several days' migration.

The team was happy to be home on September 4, 2017. Project scientists and team members agreed it was a difficult yet successful campaign.

ACT AMERICA CAMPAIGN

WALLOPS ISLAND – RRS provided program management support to the Atmospheric Carbon and Transport-America (ACT-America) campaign. This campaign consists of five, six-week flight campaigns spread across four seasons and three years, which started in May 2016 and will end in summer 2019.

The ACT-America mission advances science's ability to predict and manage future climate change by enabling policy-relevant quantification of the contemporary carbon cycle. This mission enabled and demonstrated a new generation of atmospheric inversion systems for quantifying regional carbon dioxide (CO2) and methane (CH4) sources and sinks. These inversion systems are the first-ever with the precision, accuracy, and resolution needed to evaluate and improve terrestrial carbon cycle models at continental scales and monitor carbon fluxes to support climate-change mitigation efforts.

A C-130 flew out of Wallops Flight Facility to support the ACT-America Campaign around the mid-Atlantic region.

To accomplish this, ACT-America mission will conduct five campaigns total, with each campaign covering three regions during each of the four seasons. Using the C-130 and Langley's B-200, science flights are based out of WFF for the mid-Atlantic region, Lincoln, Nebraska, for the Midwest region, and Shreveport, Louisiana, for the southern region. Three successful campaigns have been conducted, with the fourth starting in May 2018.

EPOCH

ARMSTRONG FLIGHT RESEARCH CENTER – The EPOCH project concluded its month-long airborne science campaign at Armstrong Flight Research Center at the end of August 2017. The primary science goal of the project was to advance understanding of hurricane genesis and rapid intensification by analyzing observational data obtained by overflying developing storms. The project used the Global Hawk aircraft due to its ability to fly more than 24 hour continuously, as well as its capability to reach storms in all three basins — East Pacific, the Gulf of Mexico, and the Atlantic. This project was led by NASA, but received substantial contributions from National Oceanic and Atmospheric Administration (NOAA).

The Global Hawk aircraft carried three primary instruments: the ER-2 X-band radar (EXRAD), the High Altitude Monolithic Microwave Integrated Circuit Sounding Radiometer (HAMSR), and the Advanced Vertical Atmospheric Profiling System (AVAPS). EXRAD is a high-power airborne Doppler radar developed by the Goddard Space Flight Center. It has flown in three prior field campaigns in the nose of an ER-2, but had never been integrated or flown on the Global Hawk before. HAMSR is a microwave atmospheric sounder designed and built by the Jet Propulsion Laboratory. AVAPS, developed by the National Center for Atmospheric Research, is a dropsonde delivery system designed for the Global Hawk aircraft. It can hold up to 90 dropsondes per flight. These sondes provide high-resolution vertical measurements of temperature, pressure, relative humidity, wind speed and direction in real-time.

The flight campaign began at the start of August and conducted three flights. The first occurred on August 8-9, 2017, and was able to capture intensification of Tropical Storm Franklin in the Gulf of Mexico. For the first time, dropsonde data were assimilated in real-time into NOAA's Global Forecast System. The second flight occurred on August 23-24, 2017, and captured intensification of Tropical Storm Harvey to a hurricane. This storm had record-breaking impacts to coastal Texas and Louisiana due to the extensive flooding. The final flight occurred on August 30-31, 2017, in the East Pacific and captured the genesis of Tropical Storm Lidia.

The Global Hawk is outfitted at Armstrong Flight Research Center.

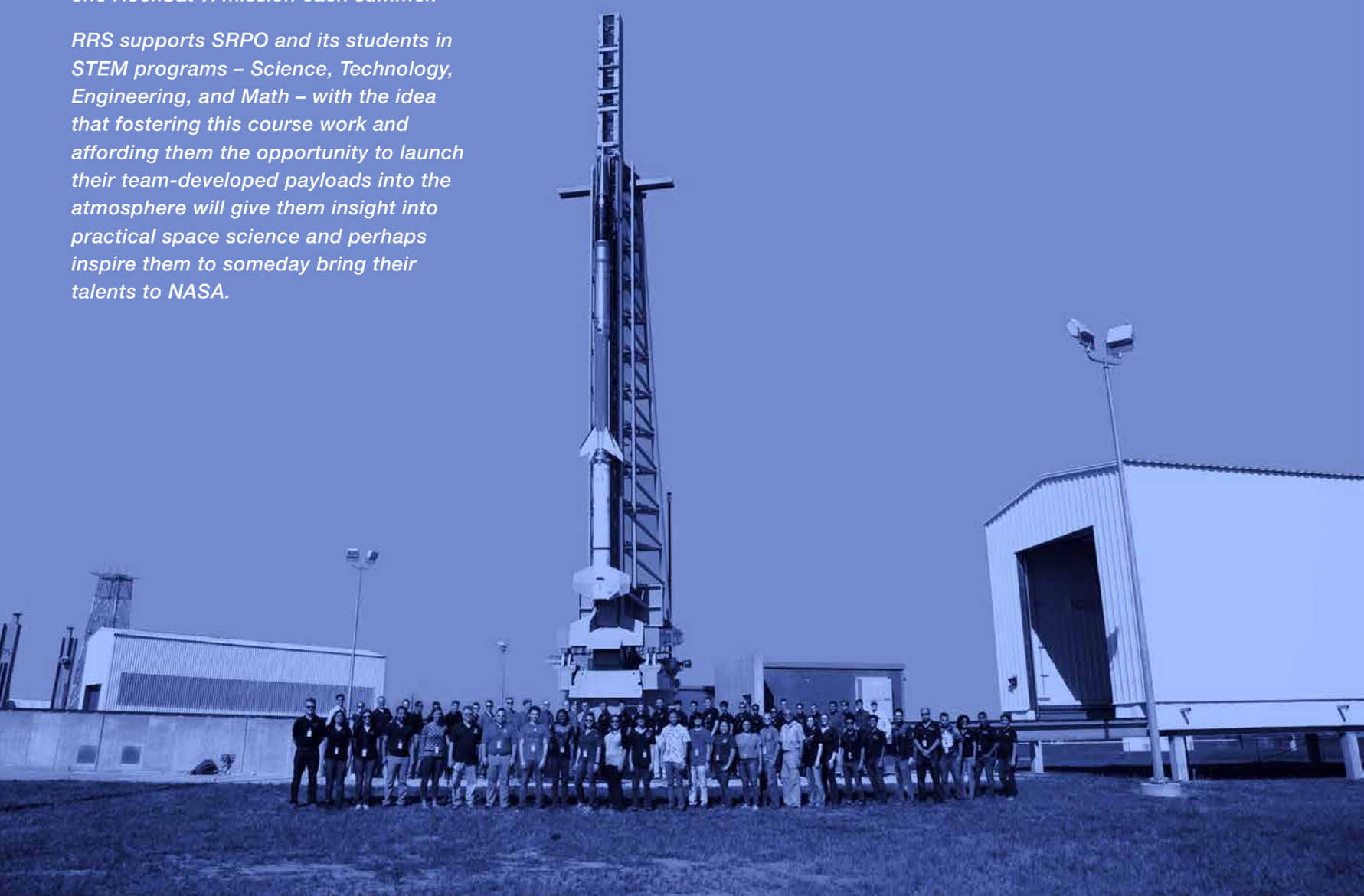
Technicians prepare for flight operations.

Technicians work on instrumentation for the mission.

EDUCATION AND PUBLIC OUTREACH

Every year, Research Range Services (RRS) supports the NASA Sounding Rockets Program Office (SRPO) Education and Public Outreach by providing Range services to multiple student launches. These student-driven missions introduce students to the world of NASA rocketry. Usually, the annual missions consist of one RockOn! and one RockSat-X mission each summer.

RRS supports SRPO and its students in STEM programs – Science, Technology, Engineering, and Math – with the idea that fostering this course work and affording them the opportunity to launch their team-developed payloads into the atmosphere will give them insight into practical space science and perhaps inspire them to someday bring their talents to NASA.



ROCKON!

WALLOPS ISLAND — The RockOn! 2017 mission successfully launched aboard a two-stage Terrier MK12 – Improved Orion sounding rocket from the Wallops Range on June 22, 2017. The rocket carried more than 30 student experiments on its payload from the RockOn/ RockSat-C program.

The Research Range Services (RRS) team supported the mission with multiple services, including radar, command and control, optical tracking, surveillance, payload recovery, and many other services the help enable the launch of a sounding rocket.

The mission was a continuation of the annual RockOn! Sounding Rocket Workshop which represents the collaborative effort of the Colorado Space Grant Consortium, the Virginia Space Grant Consortium, and Wallops Flight Facility (WFF). It marked the tenth mission through the RockOn! Program and the ninth for RockSat-C.

Approximately 130 college and university students participated in the launch from Wallops. In addition, Cubes-in-Space, a nationwide program for middle school students, flew more than 80 small cubes with experiments on this mission.

List of Universities:

- University of Colorado
- University of Puerto Rico
- Virginia Tech
- University of Kentucky
- Capitol Technology University
- University of Maryland
- Oregon State University
- University of Hawaii Community Colleges at the Honolulu, Kauai, and Windward Campuses

Additional Universities:

- West Virginia University
- Marshall University
- West Virginia State University
- West Virginia Tech
- Fairmont State

MISSION FACTS

LAUNCH VEHICLE
Terrier MK12 — Improved Orion

WALLOPS ID
NRW-5765

LOCATION
Pad 2 — MRL Launcher

LAUNCH DATE
June 22, 2017

ROCKSAT-X

WALLOPS ISLAND – The RockSat-X mission again provided an opportunity for students from multiple universities and colleges to spread their exploratory wings. On August 13, 2017, a Terrier Mk12-Improved Malemute launched into the early morning sky carrying student payloads from the University of Kentucky, Capitol Technology University, University of Hawaii Community Colleges, University of Puerto Rico, West Virginia University, Oregon State University, University of Colorado, and Virginia Tech.

Range resources successfully tracked the vehicle and received data until the planned ocean impact, at which point the recovery vessel began its search. Although the visual spotter was somewhat hampered by low-cloud cover, additional recovery aids included with the payload more than made up for the problems caused by the clouds. The payload was successfully recovered and safely transferred back to port, and then back to WFF where the students were able to finalize the collection of their data.

With a clean launch and a relatively quiet count, the mission provided a great opportunity for the next generation of rocket scientists and engineers to gain experience and learn the skills required to continue exploring our world and the galaxy beyond.

MISSION FACTS

LAUNCH VEHICLE
Terrier MK12 — Improved Malemute

WALLOPS ID
NRW-5788

LOCATION
Pad 2 — ARC Launcher

LAUNCH DATE
August 13, 2017

RCC TOURS

WALLOPS ISLAND – Due to Range Control Center (RCC) Upgrade this year, only 14 groups toured the Wallops RCC. The groups ranged from local community groups and schools from all around the Delmarva area. Some of the organizations that visited were:

- Chincoteague Bay Field Station
- University of Delaware
- Ocean Pines Community Center
- Assateague State Park
- Worcester Technical High School
- UVA Creative Writing Class
- Arcadia High School
- Ocean Pines Community Center
- Worcester Preparatory School Admin
- Civil Air Patrol
- Ocean Pines Community Center
- Southwest Virginia Teachers
- The Salisbury School
- Harrington Senior Center

ENGINEERING PROJECTS

BERMUDA DOWN RANGE TRACKING SITE

BERMUDA – RRS personnel made great strides in 2017 for the Bermuda site enhancement project, a major engineering effort that consolidated all mobile range assets for command and control, telemetry, and radar into one environmentally-protected operations center at Cooper's Island, Bermuda. The project involved designing and renovating the old NASA operations and administration building, and provided a new operations center, technician work areas and offices. The newly renovated building also contained command system antennas while telemetry and radar assets will be housed in environmental structures that will protect the instrumentation from harsh shore conditions.

The project team built on previous years' work designing the radar, telemetry, command, power, network and communication systems developed through numerous design meetings, round tables and technical interchange meetings. The designs and drawings matured into complete plans that were presented at final Design Reviews and configuration control boards for approval. To ensure complete requirements coverage, all 700-plus system and building requirements were inputted into a requirements matrix that mapped every requirement to both the supporting documents/drawings and associated testing strategy. These approved plans were used to complete the refurbishment of the operational control racks, antenna systems and radar remote system. During summer 2017, each system completed final testing at Wallops and now awaits shipment to Bermuda for installation once the building is complete.

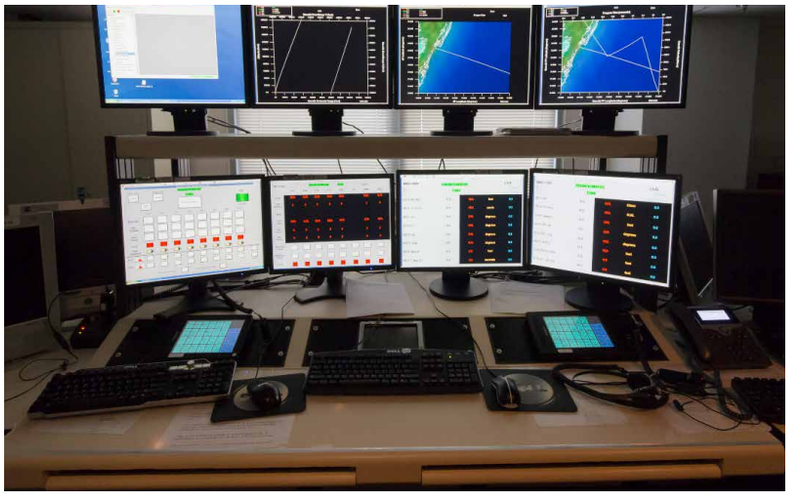
Speaking of the building, the final facility, telemetry pad, and radar tower designs were completed and delivered to the Bermuda permitting office. Approval to proceed with the building renovations was given by the Bermuda permits office in September and work began immediately. Sub-contractors for construction, HVAC, electricians, fire suppression and roofing were procured and demolition tasks commenced in October 2017.

As of this writing, renovations are continuing and RRS hopes to have the facility ready for operations rack installation in February 2018, and have the project complete by April 2018 and ready to support Antares OA-9.

RADAC

WALLOPS ISLAND – The Range Data Acquisition Computer (RADAC) receives inputs from various tracking sources around the Wallops Range, processes the data, and sends out a graphics system used by the Wallops Range Safety officers to monitor a vehicle while in flight. Research Range Service (RRS) personnel have been working to upgrade the current system with a new Linux operating system.

This year, the team successfully completed all testing and analysis on the RADAC system. The system completed its final Operational Readiness Review in April and was transitioned over to the operations group. After the transition, the team began work on an implementation and test procedure to replace a second RADAC system with the newly certified version. This involved developing procedures that can now be used any time a new system needs to be brought online. This installation was successfully completed in October 2017, which allowed the team to close out the project. The newly installed systems were able to successfully support both sounding rocket missions and the OA-8 Antares mission. It was a long road to the finish line, but the hard work and dedication of the RRS team ultimately won the day.



The Range Data Acquisition Computer is located in the Range Control Center.

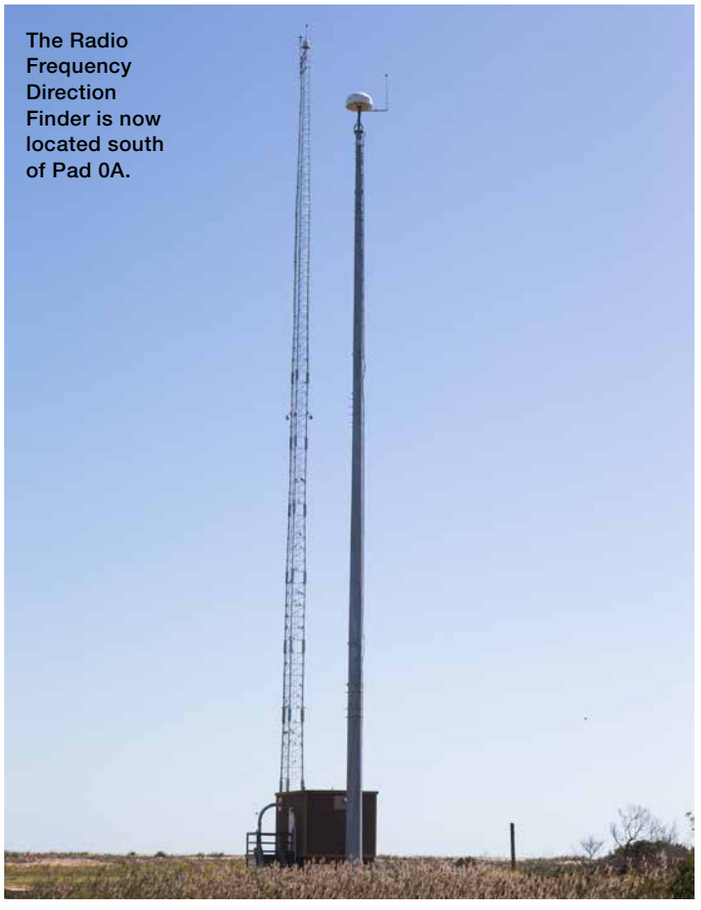
RADIO FREQUENCY DIRECTION FINDER

WALLOPS ISLAND – A successful transition to operations of the critical Radio Frequency Direction Finding and Emissions Control system was completed October 2017.

RRS engineers were busy developing a much needed engineering asset to the Wallops Range.

These critical systems enable radio frequency direction finding from 20 MHz to 3 GHz and spectrum monitoring and surveillance in the 20 MHz to 18 GHz ranges, respectively. RRS engineers added a feature that enabled remote operations, allowing control and troubleshooting of both systems from a single server in Radio Frequency Communications. Both systems were critical during the Antares OA-8 mission, and provided vital data while monitoring radio frequency power levels to ensure no potential damage to the vehicle's critical hardware.

These operational systems will provide much needed emission control monitoring and radio frequency interference mitigation for all WFF customers.



The Radio Frequency Direction Finder is now located south of Pad 0A.

RCC UPGRADE

WALLOPS ISLAND – The focal point for all Wallops Range operations is the Range Control Center (RCC). Located on Wallops Flight Facility's (WFF) Main Base, the RCC is the command, control, and communications hub for launch activities at WFF. Real-time mission and safety-critical data feeds are provided by radar, telemetry, timing, weather systems, and cameras to provide RCC range and launch operators with the necessary information to ensure public safety and success of the mission. An extensive audio and data communications system connects the various locations of the range with both voice and data. Video and graphical systems process data to display launch vehicle and other mission data in the RCC for situational awareness and real-time decision making. Safety-critical functions, such as flight termination commands, originate from operators depending on display and control systems in the RCC.

The Range Control Center before upgrade.

The first floor provides space for computer, communications, and instrumentation support equipment. The second, or main floor, includes the main control room and special rooms for Wallops Range Safety Office, surveillance and recovery, and data acquisition and processing. The two-story high RCC main room originally contained ten obsolete large-screen video displays and outdated operator consoles with low-resolution monitors.

Throughout the last year, engineers and technicians worked diligently to upgrade significant technological enhancements and addressed obsolescence and enhanced performance for this vitally important asset. These updates included:

- Operator and test director console furniture, which provides improved human factors and additional workspace for users
- Multiple high-resolution monitors per user
- Scalable high-resolution video wall system, which provides up to 12 unique video displays
- Software-based server and client video over Internet protocol distribution
- Improved video recording and playback capability
- Critical facility modifications to support video wall, HVAC and power enhancements

The upgrade was completed in October 2017. The first mission the new RCC supported was the Antares OA-8 mission, which launched November 12, 2017.

The Range Control Center after upgrade.

National Aeronautics
and Space Administration

Goddard Space Flight Center
Wallops Flight Facility
34200 Fulton Street
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www.nasa.gov

WALLOPS

RANGE