Research Range Services

2014 Annual Report

National Aeronautics and Space Administration

Goddard Space Flight Center
Wallops Flight Facility

wallops range

Dedication

Wayne R. Powell

WALLOPS ISLAND — The Wallops Flight Facility community lost a dear friend and colleague this past year with the passing of Wayne R. Powell. Wayne served as the Wallops Technologist and was an integral part of the Wallops institution since 1970.

Wayne is a Salisbury, Md., native born in the Wicomico County city in 1941. After high school, Wayne earned his bachelor's degree in mechanical engineering, and eventually his master's in electrical engineering from Old Dominion University in Norfolk, Va.

Other than Wayne's uncanny technical abilities, he will be most fondly remembered for his sense of humor and good spirit, and as the Assistant Director of Applied Engineering and Technology Steve Nelson put it, his infectious laugh.

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Research Range Services growth key to success

The Research Range Services (RRS) Program started Fiscal Year 2014 with what might be the most challenging Range schedule Wallops Flight Facility has ever witnessed.

The mission set during this timeframe included high visibility operations never before seen at the Wallops Range. RRS' strong technical performance successfully enabled many high-profile missions including support of commercial resupply of the International Space Station (ISS), lunar exploration, and research and development of re-entry vehicles for deep space exploration. This unique mission, known as the Low-Density Supersonic Decelerator (LDSD), is an operation being conducted in Hawaii which will enable further research and development of the country's dream of sending people to Mars.

In all, RRS engineers and technicians supported more than 20 launch events at locations around the world and at our home base of Wallops Flight Facility on the Eastern Shore of Virginia. RRS offered consistently superior support to a myriad of customers including two of NASA's mission directorates, The Department of Defense, other U.S. government agencies, colleges and universities, civilian corporations, and the worldwide scientific community. RRS provides tracking, telemetry, meteorological, optical, command and control, and Range operations services for the Wallops Range, Poker Flat Research Range (PFRR) near Fairbanks, Alaska, and other remote locations, such as Cooper's Island, Bermuda.

Operations and maintenance is only one component of the overall RRS mission. Fiscal Year 2014 saw measurable progress in many engineering efforts offering world-class instrumentation systems sustainment and project management services to underwrite Wallops Range's widely recognized status as a low-cost, flexible, full-service, and customer-friendly launch facility. RRS project managers drove several engineering projects to completion for PFRR's command system, PFRR Redstone radar antenna, the Transportable Command and Telemetry System, Universal Translate, Record and Analyze project, Mobile Optical Tracking System, and the Launcher Surveillance Video project, which gives "eyes" to our launch pad managers. While completing these mission essential engineering activities, RRS continued to ensure the highest quality, adhering to the Capability Maturity Model Integration (CMMI) — Level 2 certified processes in place.

As RRS and Wallops grow together, a new partnership sits on the horizon. The Wallops Range is part of the Mid-Atlantic Aviation Partnership which is led by Virginia Tech University. This partnership was selected by the Federal Aviation Administration as one of six test sites located around the country. Unmanned Aerial Systems (UAS) is a fast-growing industry and the Federal government is focused on developing certification standards, addressing civil and private UAS concerns, and verifying safety and navigation procedures. As part of the infrastructure upgrade for the Wallops Range, a new 3,000-foot runway will be built on the northern-most edge of the Wallops Island during Fiscal Year 2015.

Systems and capabilities under the auspices of the RRS Program include:

• A Range Operations Management System tool which allows effective management and control of launch range configurations, documentation,

maintenance, operations scheduling, asset management, discrepancy reporting, and a new Digital Imaging Database System for all NASA employees to utilize

• A fully equipped, state-of-the-art Range Control Center with a full complement of command and control equipment, as well as an extensive bank of monitors to provide real-time display of all flight events and Range status

• An aeronautical research airport with three runways and a separate runway dedicated to UAS platforms

• Fixed and mobile radar systems for tracking launch vehicles, satellites, and aircraft

• Fixed and mobile telemetry systems to collect state of health, position, and science experiment data

• Fixed and mobile command and control systems to provide event commanding to vehicles in flight

• Fixed and mobile optical systems

• Ground-based and aerial video and photography, professional archiving, printing, and post-production services

• A comprehensive suite of meteorological instrumentation, radars and weather balloons used in collecting atmospheric measurements to provide real-time weather forecasts

• Radar frequency spectrum allocation, monitoring, management, and coordination

• Master station time equipment to synchronize Range activities and data

This Fiscal Year 2014 Annual Report highlights the projects that continued our long track record of successfully, safely, efficiently, and professionally enabling research worldwide. The RRS Program team is both proud of and thrilled with our continued superior performance during this 12-month period, due in no small part to the outstanding working relationship and partnership we enjoy with our customers and partners. Our goal is to make the Wallops Range the most successful, efficient and economical Range facility available. We believe we are excelling toward that end.

Program Management fuels Wallops Range missions

WALLOPS ISLAND — The Research Range Services (RRS) Program 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 all around the globe.

By implementing fundamental project management strategies, we narrow our focus, reach desired goals, and achieve those goals within specific time and cost parameters. The final result is that everyone comes out a winner — which just may be project management's best benefit of all.

Program Management Overview
Directorate: Science Mission Directorate
Division: Heliophysics
Program Executive: Mr. George Albright
Program Manager: Mr. Steven Kremer
Lead Center: Goddard Space Flight Center
Performing Facility: Wallops Flight Facility
Program Type: Research Range Services

RRS project management provides the Wallops Range and its customers with:

• Better efficiency in delivering services by providing a roadmap to project completion

• Improved customer satisfaction by meeting operational schedules

• Improved growth and development within the project team to ensure positive results

• Better flexibility – highly sought after in a launch range environment

• Guarentee of total success in meeting customer requirements through proactive quality assurance, comprehensive operator certification, configuration management, pre-mission testing, proven operating procedures, risk assessment and mitigation, and post-mission support

• Increased quantity – project management allows more time to enable the Range to support multiple projects, and even simultaneous operations

Program Management

Research Range Services personnel, commercial corporations, the Department of Defense, and other organizations all work cohesively within the Range Control Center to ensure the success of every mission.

• Assurance of a "green Range" for all missions through effective, corrective, and preventive maintenance of all Wallops Range facilities and equipment

• State-of-the-art engineering expertise and technology advancements to meet new mission requirements, improve Range safety, reduce operational costs, replace obsolete equipment, and enable more complicated/challenging missions and projects

• Expertise and management skills for oversight of technical performance of contract services, including setting mission priorities, ensuring sufficient staffing levels, identifying and prioritizing engineering upgrades, and overseeing efforts between NASA engineering and contractor personnel.

As part of the Range and Mission Management Office (RMMO), the RRS Program supports NASA project managers and their missions by providing a complex variety of services, such as radar, optical tracking, telemetry downlink, 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 Program employs many highly experienced range services managers (RSM) who work arm-in-arm with their NASA counterparts. In tandem, NASA project managers (PM) and RSMs build, coordinate, and manage cohesive teams that combine the efforts of engineers and technicians in configuring a mobile and fixed Range, effectively providing launch range services around the globe.

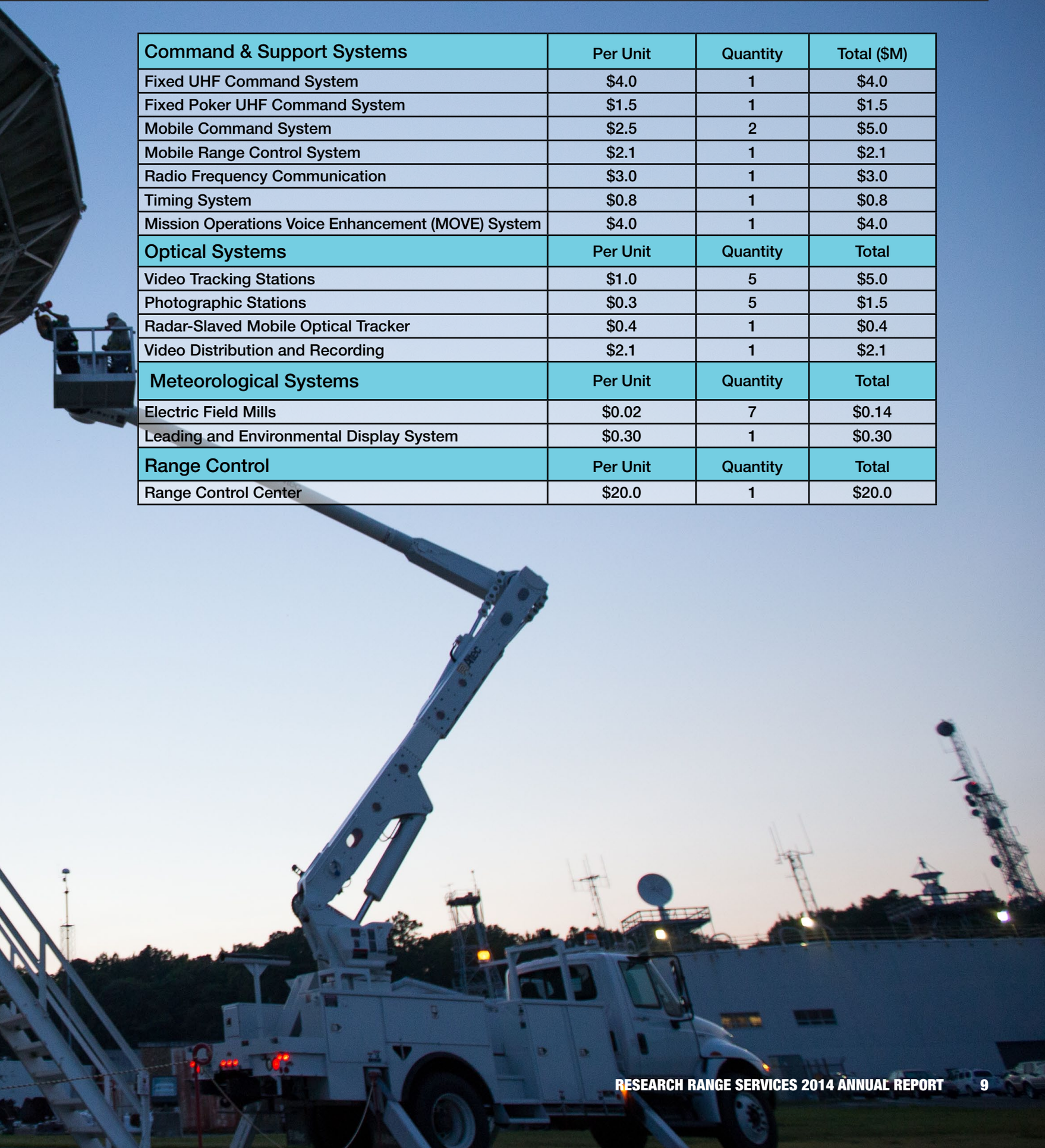
All operations conducted at the Wallops Range and other remote launch ranges, such as Poker Flat Research Range (PFRR) near Fairbanks, Alaska, and Andøya Space Center in Norway, require cutting edge technologies and multimillion dollar systems to support Unmanned Aerial Systems (UAS), sounding rockets, expendable launch vehicles or any other flight platform.

In 2014, PMs were responsible for Range instrumentation support for NASA's orbital and suborbital programs, as well as programs for other government and commercial agencies. They assured near 100 percent success for a multitude of programs executed at the Wallops Range, while simultaneously managing remote campaigns in Alaska and downrange tracking and command sites in North Carolina and Bermuda.

From the initial ideas of a principal investigator through the completion of data analysis, RMMO PMs, in coordination with the RRS RSMs, are the glue that bonds the talents and efforts of an extended team of professionals who are needed to ensure successful completion of every mission.

Research Range Services Assets: $315.54 million			
Telemetry Systems	**Per Unit**	**Quantity**	**Total ($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-Foot Mobile Antenna	$0.4	1	$0.4
8-Meter Antenna	$2.5	2	$5.0
16-Foot System	$0.5	1	$0.5
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	$20.0	1	$20.0
Ultra High Frequency (UHF)	$18.0	1	$18.0
S-band Weather (Tropical Ocean Global Atmosphere)	$5.0	1	$5.0
NASA Polarimetric (NPOL)	$5.0	1	$5.0
Tracking Radars	**Per Unit**	**Quantity**	**Total**
Range Instrumentation Radar – 778C	$6.0	4	$24.0
Range Instrumentation Radar – 716	$7.0	2	$14.0
Range Instrumentation Radar – 706	$70.0	1	$70.0
MPS-39 Radar	$1.5	1	$1.5
19-17 Radar	$1.5	1	$1.5
Weibel Debris 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)	$1.0	1	$1.0
Pathfinder	$0.7	2	$1.4
Active Protective System (APS-39)	$2.5	1	$2.5
L-Star	$0.35	4	$1.4

Command & Support Systems	Per Unit	Quantity	Total ($M)
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	$20.0	1	$20.0



Mobile tracking systems are sent to various locations, including Bermuda and Coquina, N.C.

Mobile Range enables worldwide science research

WALLOPS ISLAND — Throughout the past six decades, the Wallops Range has continually demonstrated flexibility in meeting the aerospace research needs of the United States. Wallops relies on a low-cost, highly adaptable approach to enabling worldwide scientific research for government, commercial industry, and higher education institutions. Being NASA's only owned and operated launch range, Wallops is truly a unique national resource with its ability to operate anywhere in the world to place flight vehicles where science exists.

The key to the success of the Research Range Services (RRS) Program is being mobile. The ability to "pick up and move out" at the drop of a dime to remote locations is the RRS calling card. The RRS team engineers, operates, and maintains more than $30 million in mobile radar, telemetry, command, optical systems, and other assets that can be quickly configured and shipped to locations around the world. In the past couple years, RRS personnel have been able to support scientific research at far-reaching locations, such as Andøya Space Center (ASC) in Norway; Poker Flat Research Range (PFRR) near Fairbanks, Alaska; Hawaii; and Kwajalein Atoll in the South Pacific. In addition to these locations, RRS personnel will soon travel to Woomera, Australia.

Not only does RRS provide launch range services at the Wallops Range, RRS personnel are also located in off-site tracking locations, such as Bermuda and Coquina, N.C.

"It gives us higher confidence in promising Range availability to our customers when they come to Wallops for services," said Steven Kremer, Chief of the Range and Mission Management Office (RMMO).

"In addition, our services offered from Bermuda will benefit other customers who launch from other ranges such as the U.S. Air Force's Eastern Range in Florida."

Creating a routine, mobile launch environment has become the norm for RRS engineers and technicians as they establish and verify instrumentation metrics, adapt range instrumentation to unique customer requirements, assist in performing root cause analyses, implement minor to moderate system upgrades, and perform link analysis calculations. These actions are necessary to ensure adequate radar, telemetry, and command support for a diverse set of challenging, off-site missions.

The RRS mobile reach does not just include setting up for mission support. For the past few years, PFRR has become a "home away from home" for RRS, as several mobile units have been configured in the frozen north. This gives RRS the chance to exercise its deployed engineering capability and install new systems.

This was most recently demonstrated in the installation of a second Redstone 9-meter radar antenna. A team consisting of an RRS engineer and telemetry technicians once again deployed to PFRR for final installation and testing. Despite difficult environmental conditions as the temperature dropped quickly in the Alaskan interior, RRS was able to deploy the correct people, equipment and materials required to complete the installation and deploy a viable system for mission support.

Operationally speaking, the "can-do" attitude of the RRS team has been tested throughout the past few years as near simultaneous missions have been conducted at PFRR, ASC, and at the Wallops Range. For instance, a mobile RRS team recently configured a mobile Range for launch support at ASC, and in just 120 days successfully supported a launch halfway around the world at PFRR. This 120-day window included project management support, engineering testing of all mobile systems at the Wallops Range, logistics to get the systems from one place to another, mobile teams to receive the instrumentation for set up, and the eventual launch support team readying the mobile Range with final combined systems checks.

The RRS Program's vision is to be recognized as the premier provider of integrated test and operational Range services in support of aeronautic, suborbital, and orbital flight, and ground systems projects conducted by the U.S. government, commercial industry, and academic customers anywhere around the globe.

Mobile Power Station

Inside of a mobile telemetry van

Mobile Range systems at Bermuda site

Mobile telemetry station at Alaska

Commercial Space Flight

Cygnus, Antares take flight to the ISS

WALLOPS ISLAND — Following on the heels of the first two successful launches, Research Range Services (RRS) personnel continued to provide superior Range support for the Antares program, launching two more medium-class launch vehicles in 2014.

Named after a red supergiant star in the Milky Way Galaxy and built by Orbital Sciences Corporation, the Antares launch vehicle was developed as part of the Commercial Orbital Transportation Services (COTS) contract for resupplying the International Space Station (ISS). The multi-year effort to achieve space flight culminated with a test flight into short orbit, Antares A-ONE, on April 21, 2013, followed by the first Cygnus spacecraft launch, Antares ORB-D1, loaded with cargo bound for the ISS, on Sept. 18, 2013.

From top left, the Cygnus spacecraft is transported from the V-55 Spacecraft Fueling Facility to the Horizontal Integration Facility where, top right, it is integrated into the Antares rocket. Bottom left, the rocket is then horizontally rolled out to MARS Pad 0A. Bottom right, NASA Project Manager Jeff Reddish coordinates testing during the Antares Mission Dress Rehearsal.

Since those demonstration flights, the Cygnus spacecraft has been a frequent flyer from the shores of the Wallops Range.

Antares Orb-1

Known as Orb-1, this Jan. 9, 2014, launch marked the third successful launch of the Antares program, and the second fully-loaded standard Cygnus cargo module to resupply the ISS. RRS continued to provide the dedicated support of two project managers, along with a ground operations manager and crew, mission engineer, civil engineer, and test engineer, as well as significant time from various Range operators and engineers to meet the continual needs of the program.

As part of what is now a standard package of Antares program support, services provided for the Orb-1 mission included precision tracking radar, telemetry operations, Range timing and communications, radio frequency monitoring, surveillance radar operations, Range air and sea surveillance, NASA communications, weather forecasting, meteorological operations, optical systems, Range scheduling services, and post-production deliverables for pre-launch and launch operations. All requirements were met and all deliverables were completed on schedule.

Although all RRS pre-mission testing and support was completed in preparation for the anticipated launch date of Dec. 19, 2013, a cooling system failure aboard the ISS caused the Orb-1 launch to slip to January. Another launch day was scrubbed due to space weather interference exceeding Antares launch criteria. Once these outside obstructions were resolved, the RRS staff kicked into gear, providing exceptional launch day support and getting the job done while meeting all mission requirements.

A key component of successful Range support is the maintenance and enhancement of the Bermuda downrange tracking station. This station incorporates telemetry, radar, and command, compensating for loss of signal from the Wallops Range during the solid-fueled stage two engine burn.

RRS engineers implemented an upgraded Commercial Data Network (CDN) solution adding a separate carrier, which provided true redundancy in data communications to Wallops. The CDN is the communications backbone for all future missions incorporating Bermuda support and continues to undergo improvements to replace legacy equipment, thereby saving cost and greatly improving quality and reliability. Based on mission trajectory, expected plume attenuation, and loss of signal over the horizon, the Coquina, N.C., tracking site was not used for the Orb-1 mission.

Antares Orb-2

RRS personnel succeeded once again, launching the fourth Antares launch vehicle and the third Cygnus cargo module to the ISS on July 13, 2014. RRS fully met all objectives for the Antares Orb-2 mission, providing all services in the standard package of launch support, with all deliverables completed on schedule.

The Orb-2 Cygnus cargo module was released from the ISS and in a blazing return to the Earth's atmosphere self-destructed as planned on Aug. 17, 2014.

Wallops' downrange tracking station in Bermuda augmented the Range instrumentation, offsetting expected signal losses from Wallops, with support that mirrored the Orb-1 mission.

This mission witnessed the culmination of several obstacles postponing the launch, which was originally slated for May 5, 2014. The first delay moved the anticipated launch date to June and was due to a scheduling conflict with the ISS. Overcoming scheduling and testing conflicts to successfully complete the task at hand, RRS personnel proved in 2014 that executing the Antares mission is just another day at the Range.

Ground Operations personnel prepare to move the Cygnus from the Payload Processing Facility to the Spacecraft Fueling Facility.

Ground Operations team focuses on Antares, Cygnus operations

WALLOPS ISLAND — Soaring to new heights is exactly what the Research Range Services (RRS) Ground Operations (GO) team accomplished during the last fiscal year. A relatively new element to the RRS Program, the GO team provides a wide range of support for Antares launch vehicle and Cygnus spacecraft processing operations.

Ground Operations maintains and operates all NASA Wallops Flight Facility (WFF) processing facilities that support the Antares launch vehicle. These facilities include the Horizontal Integration Facility, the Payload Processing Facility, and the Spacecraft Fueling Facility. In addition to these processing facilities, GO is also responsible for managing a large fleet of mobile systems and ground-support equipment.

Many of the pneumatic, cryogenic, and hypergolic systems used for Antares processing were designed and fabricated by this team. A precision clean laboratory is also being constructed to meet the most stringent standards of the aerospace industry. Operations performed by the GO team are extremely hazardous, which includes high-pressure gases, cryogenic liquid, solid and liquid rocket propellants, and hypergolic fluids, just to name a few.

Some of these systems are so hazardous that they require fully encapsulated suits supplied with breathing air to operate. For example, during spacecraft fueling, Self-Contained Atmospheric Protective Ensemble (SCAPE) suits are required for handling hypergolic fuels.

This team has performed "above and beyond the call of duty" as they say in the military. This team has been recognized as recipients of the prestigious Robert L. Krieger Award and the Robert H. Goddard Award. These honors are due to their 24-hour, seven-days a week support to the Antares mission. This small, but dedicated group packs a powerful punch at the Wallops Range.

Telemetry technicians Les Gifford, left, and Steve West prepare their station to track a launch.

Radar and telemetry tracking help Atlas V, Falcon 9 missions

VEHICLE	MISSION	LAUNCH DATE
Atlas V	NROL-67	April 10, 2014
Falcon 9	CRS-3	April 28, 2014
Atlas V	NROL-33	May 22, 2014
Falcon 9	Orbcomm	July 14, 2014
Atlas V	GPS 2F-7	Aug. 1, 2014

WALLOPS ISLAND — Most launches supported by the Research Range Services (RRS) Program are at range facilities that are operated and maintained by RRS; however, there are expendable launch vehicles that fly from Cape Canaveral Air Force Station and Kennedy Space Center in Florida, that require radar and telemetry tracking support. The Wallops Range is part of a chain of shore- and sea-based tracking sites which provide a green light for a launch to take place during the countdown, as well as downrange tracking support as the rocket heads east.

Headquartered at the 45th Space Wing at Patrick Air Force Base, the Eastern Range (ER) supports missile and rocket launches from Florida's eastern coast.

RRS supported five launches from the ER without delay or issue. In a unique situation late last March, RRS received a request from the ER to provide a mobile tracking asset at the Cape in order to temporarily replace a failed prime tracking asset. This was an urgent request as the ER was down and unable to support any launch opportunities until the issue was resolved. RRS wasted no time assembling a team of management, operations personnel, and engineers tasked with establishing a thorough support plan. Within days of receiving the request notification, a complete plan for packing, shipping, installing and testing one of Wallops' mobile radars was provided to the ER. Ultimately the ER did not require the support, but Wallops was at the ready to meet the unique support requests.

This year, RRS aided SpaceX in their commercial resupply of the International Space Station (ISS) by providing ascent and orbit support for the Falcon 9 launch vehicle and the Dragon spacecraft through downrange tracking support from Bermuda. RRS' expansion in support strengthened the relationship with SpaceX, and is a direct reflection of the quality of service that RRS has been able to provide mission after mission. The Wallops Range will also support the Falcon 9 SpaceX CRS-5 launch scheduled for December.

Human Exploration and Operations Mission Directorate

RRS helps lead new Mars mission decelerator technology

PACIFIC MISSILE RANGE FACILITY, Hawaii — The NASA Curiosity Rover is a car-sized robotic vehicle weighing approximately 2,000 pounds that is currently exploring the surface of Mars. This incredible human achievement underlies a limitation in decelerator technology used to successfully land Curiosity on the alien planet.

The NASA Low-Density Supersonic Decelerator (LDSD) project aims to develop successful advancement in deceleration technology using a 30.5-meter Supersonic Ringsail (SSRS) parachute and a 6-meter Supersonic Inflatable Aerodynamic Decelerator (SIAD). This advancement will allow NASA to deploy larger mass objects with greater accuracy on future Mars missions. These technologies are necessary to realize any future human mission to Mars.

The Research Range Services (RRS) Program provided project management, surveillance, and recovery operations during the successful execution of the first Supersonic Flight Dynamics Test (SFDT) on June 28, 2014, off the western coast of the Island of Kauai, Hawaii, within the U.S. Navy's Pacific Missile Range Facility (PMRF). This first mission served as a proof of concept for the test setup and, as a bonus, gathered valuable data on the technologies being developed.

RRS personnel deployed to PMRF for a three-and-a-half month period, covering multiple launch slips to provide support spanning multiple disciplines within the project, including mission operations, training, surveillance, communications services, and flight hardware recovery. Additionally, RRS staffed the mission leadership positions of test conductor and recovery director, providing crucial launch day support. In a mission-critical role, RRS recovered the LDSD test vehicle, all on-board mission critical data, and the balloon carcass, meeting environmental requirements.

Leading up to this landmark SFDT, intensive pre-mission planning resulted in a detailed recovery plan coordinating RRS and Navy surveillance and recovery assets. RRS successfully executed recovery operations, overcoming significant challenges caused by eleventh-hour changes. RRS resolved these gaps by securing additional recovery assets of two commercial vessels, and ensuring satellite phone ground-to-ship communications with surveillance and recovery assets.

Other noteworthy support provided by RRS included mission operations on-console training for NASA Jet Propulsion Laboratory, NASA Balloon Programs Office, NASA Columbia Scientific Balloon Facility, NASA Applied Engineering and Technology Directorate, and the U.S. Navy Range Safety Organization. This training established a foundation for inter-agency coordination, matured countdown procedures, and solidified go/no-go criteria.

Looking ahead, the 2015 launch campaign will be in March 2015, with two follow-on SFDTs, billed as the flights for record, in the Summer of 2015.

The ISS-CREAM module is tested and assembled at the Wallops Range in F-7.

CREAM to conduct cosmic ray research

WALLOPS ISLAND — While Research Range Services (RRS) is most known for its support of rockets and other Wallops Range missions, there is another side not as well-known: Special projects, such as ISS-CREAM.

ISS-CREAM started out as a long-duration balloon (LDB) project with a goal of extending direct measurements of cosmic-ray composition to the highest energies practical with balloon flights in Antarctica. Six successful LDB flights of the CREAM payload within six years accumulated about 160 days of data, the longest known exposure for a single balloon project.

Using the proven science concept, ISS-CREAM has now taken the next step: Residing on NASA's share of the Japanese Experiment Module Exposed Facility (JEM-EF) of the International Space Station (ISS). Its goal is to precisely measure energy spectra of individual nuclei over the proton-to-ion elemental range from 10^{10} eV to ~10^{15} eV, and will address the long-standing fundamental science questions: 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? and What is the origin of the "knee" in the cosmic ray all-particle energy spectrum? These questions have been difficult to answer because no space mission capable of measuring the low fluxes of particles at energies approaching the cosmic ray "knee" around $3x10^{15}$ eV has yet been flown. The ISS-CREAM mission would be the first experiment to have the statistics needed to pursue them effectively.

The ISS-CREAM project consists of a collaboration of both U.S. universities (University of Maryland, Penn State and Northern Kentucky University) and foreign universities (Sungkyunkwan University and Kyungpook National University from South Korea) in addition to multiple NASA facilities (HQ, GSFC, JSC, MSFC, KSC) and other collaborative efforts from the Japanese Aerospace Exploration Agency (JAXA) and Laboratoire de Physique Subatomique et de Cosmologie (LPSC) in France.

By working closely with the Johnson Space Center (JSC) ISS Program Payloads Office, Wallops Flight Facility (WFF) is managing, with contractor and civil servant support from the Applied Technology and Engineering Directorate (AETD) and the RRS Program, the integration and test of the payload to meet the Dragon Lab / Space-X launch vehicle and JEM-EF mission requirements. At completion of system-level qualification to be performed at Goddard Space Flight Center (GSFC), the instrument payload will be integrated at the Kennedy Space Center into SpaceX's Dragon trunk for launch sometime next year.

Science Mission Directorate

Range services personnel success shines through vehicle malfunction

WALLOPS ISLAND — Most missions at Wallops Flight Facility (WFF) are launched to deliver a specific payload, and in most instances there are no anomalies or issues causing failed missions; however, there are vehicles that do not perform to expectations. This was the case for the SubTEC-6 mission on July 2, 2014, as a two-stage Terrier MK12-Improved Malemute sounding rocket was launched from the Wallops Range ARC Launcher, ending prematurely only 19 seconds after liftoff.

This mission, although a failure from a vehicle performance standpoint, was a Range success for Research Range Services (RRS) personnel as it demonstrated Range planning, from a risk assessment and surveillance standpoint, as the vehicle harmlessly fell into the Atlantic Ocean one-mile downrange. Other RRS instrumentation and personnel functioned perfectly during the launch event. The sounding rocket's second stage sent the vehicle into a spin causing a brief loss of radar and telemetry coverage. Immediately after the anomaly, the vehicle separated into multiple pieces. Rising to the occasion, each supporting radar was able to track a different portion of the vehicle/payload to impact. This information was invaluable to the Wallops Safety Office, as it allowed them to determine that all pieces landed safely within the pre-coordinated and cleared hazard area.

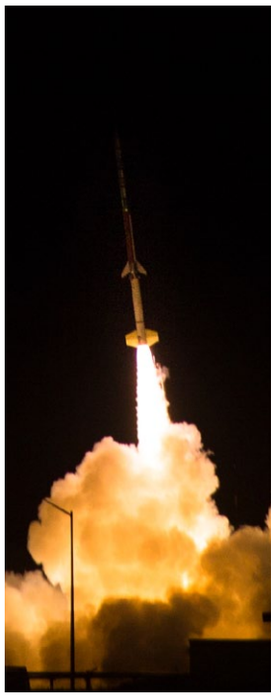
Prior to launch, the size of the hazard area caused the RRS surveillance team many challenges, because the hazard area encompassed a large section of a popular commercial fishing area. In between five launch attempts, the RRS surveillance team made specific changes to the surveillance plan in order to ensure the team cleared the hazard area to provide a clear launch opportunity.

The mission was conducted to provide a low-cost, reusable platform for development of new sounding rocket technologies and low-cost flight opportunities to Sounding Rocket Program Office partners. This mission was the first flight of the new payload design that was based off of the RockSat-X payload.

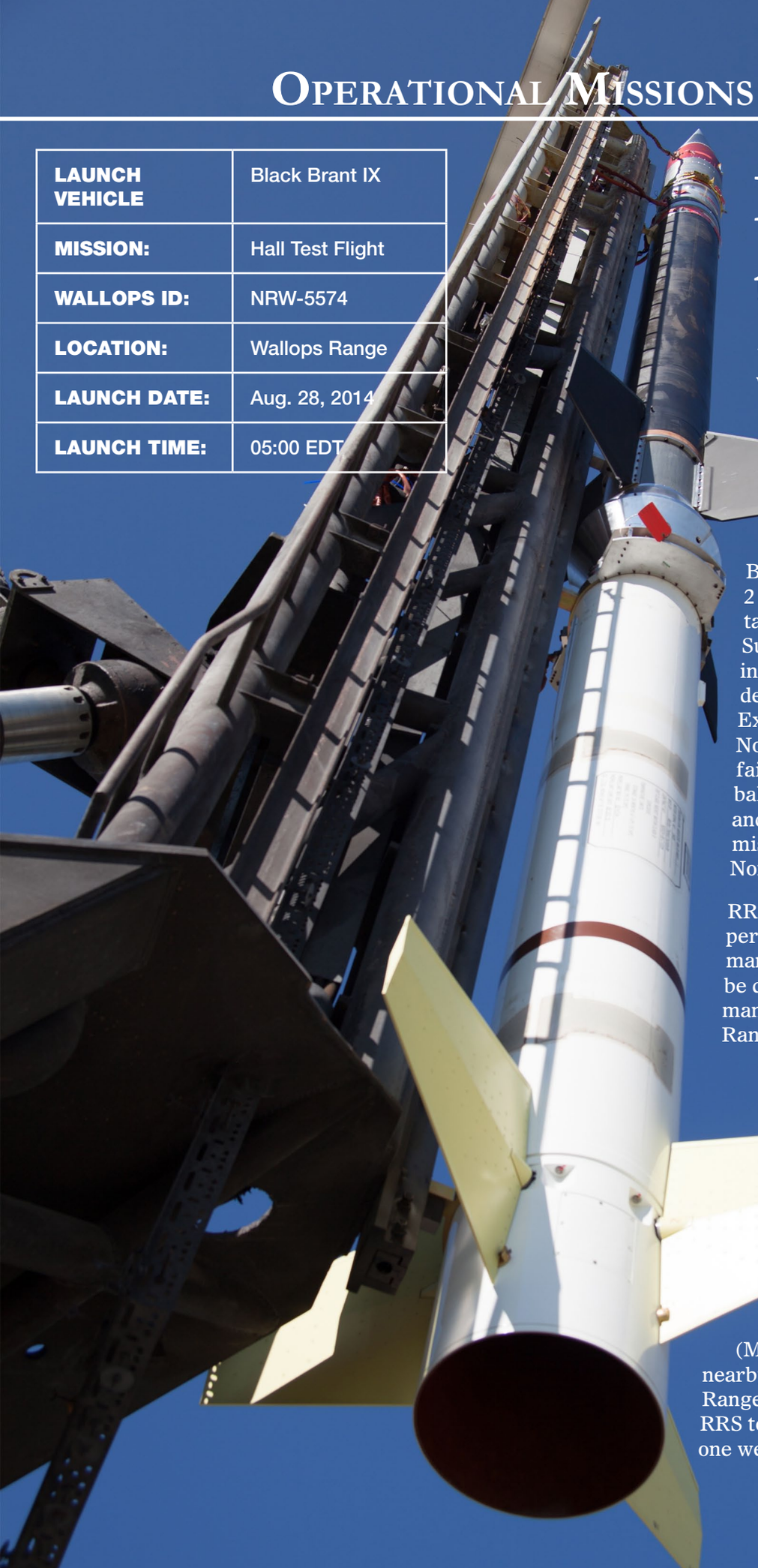
Due to the critical qualifying experiments aboard SubTEC-6, a follow-up sounding rocket was successfully launched in late August. This mission, known as the Hall Test Flight, performed successfully Aug. 28, 2014.

Jordan West, RRS survillence coordinator, keeps an eye on the hazard area for any foulers.

LAUNCH VEHICLE	Terrier MK12 — Improved Malemute
MISSION:	SubTEC-6
WALLOPS ID:	NRW-5492
LOCATION:	Wallops Range
LAUNCH DATE:	July 2, 2014
LAUNCH TIME:	04:35 a.m. EDT



The Terrier MK12-Improved Malemute sounding rocket exits the launch rail.



LAUNCH VEHICLE	Black Brant IX
MISSION:	Hall Test Flight
WALLOPS ID:	NRW-5574
LOCATION:	Wallops Range
LAUNCH DATE:	Aug. 28, 2014
LAUNCH TIME:	05:00 EDT

Science Mission Directorate

Hall flight rises to the challenge

WALLOPS ISLAND — The Hall Test Flight mission was a fast turn-around sounding rocket campaign quickly put together by NASA's Sounding Rockets Program Office (SPRO) due to the failure of a previous mission at the Wallops Range.

Research Range Services (RRS) personnel supported the launch of the Black Brant IX vehicle from the MRL launcher on Pad 2 on Aug. 28, 2014. This test flight was a measure taken in response to the in-flight failure of the SubTEC-6 mission. The SubTEC-6 mission was intended to prove a technology needed for the newly designed and highly complex Conde /Cusp-Region Experiment (C-REX) payload slated to launch from Norway in the winter of 2014. With the SubTEC-6 failure, the Conde mission was left hanging in the balance. Wallops as a whole was challenged to step up and respond with this extremely quick turn-around mission in order to mitigate risk for the upcoming Norway campaign.

RRS responded to the five week development period by implementing an extreme project management approach, which enabled activities to be done in parallel. RRS personnel provided project management which coordinated the support of Range instrumentation, including telemetry, timing, radio frequency monitoring, precision radar tracking, surveillance radar, Range data processing and display, air and sea surveillance, communications, meteorological operations, and optical systems.

To add to the complexity of the mission, the Range was a happening place as a second vehicle, Missile Defense Agency (MDA) Shark No. 3, was preparing to launch from a nearby pad. Hall successfully weaved its way into the Range schedule, and the hard work and dedication of the RRS team paid off, with two successful launches within one week of each other.

RRS team endures Alaskan Winter for GREECE mission

LAUNCH VEHICLE	Terrier MK70 — Black Brant MK3
MISSION:	GREECE
WALLOPS ID:	NRO-5397
LOCATION:	Alaska
LAUNCH DATE:	March 3, 2014
LAUNCH TIME:	06:09 EST

POKER FLAT RESEARCH RANGE, Alaska — For the sixth straight year, the RRS program travelled deep into the Alaskan interior in order to support a launch from the Poker Flat Research Range (PFRR) just outside Fairbanks, Alaska. A Terrier Mk70-Black Brant Mk3 rocket illuminated the night sky March 3, 2014, as it tore through the atmosphere carrying the Ground-to-Rocket Electrodynamics Electrons Correlative Experiment (GREECE) payload on its scientific mission to study the aurora borealis.

Although the missions at PFRR can be very similar with respect to the overall mission concept and support, each year has a unique set of challenges and triumphs and this year was no different. The initial set up was relatively easy compared to the previous year, and although the team encountered some issues with the instrumentation, the issues were generally small or resolved quickly.

The set up was relatively quiet – too quiet. The real fun began once the launch window opened. Normally, the RRS team has to deal with the harsh, Alaskan winters when supporting these campaigns. This year, the team faced a few chilly days, but the bigger problem was the warm weather that moved in. While the Wallops Range was gripped by the bitter polar vortex, Fairbanks was enjoying a veritable heat wave with temperatures even getting above freezing! This actually caused more problems than it solved as all the roads and surrounding areas melted and then re-froze, coating everything in a solid sheet of ice. After much debate, it was decided to forego the first day of the launch window in the interest of personnel safety since even the locals struggled getting around. Once the weather stabilized and the roads were salted, the team made their way out to the range and began supporting the count. Hopes were high as the launch window opened, given that the scientific conditions were relatively easy to obtain, so the team counted. And counted. And counted. Night after night the team supported the launch count, and as good launch conditions remained elusive, it became apparent that a second launch window was a very real possibility. The last night of the first launch window came and went without the correct conditions, so most of the team packed up to return home, leaving a few brave (volunteer) souls to monitor the systems during the time between the two windows.

Roughly one week later, the RRS team again boarded flights bound for Fairbanks and arrived to perform a quick-check of the systems and begin the count again. This one proceeded much the same as the first one, with elusive launch conditions once again ruling the day. Some excitement was had with gremlins in one of the instrumentation systems, but with close coordination among all of the agencies involved, the count was able to continue. At long last, the launch conditions required for this mission finally manifested themselves and after several very tense moments, the rocket soared into the sky, much to the happiness and relief of the entire team. It just so happened that that afternoon, prior to showing up on console, several team members from both

Above: The RRS team at Poker Flat Research Range for the GREECE mission.

Top right: Research Range Services Manager Lauren Neely observes Engineer Joe Sherwood at the Poker Flat Research Range.

Bottom right: NSROC Technicians Clay Merscham and Frank Waters perform tests on the Terrier Mk70-Black Brant Mk3 sounding rocket on the rail.

Wallops and PFRR were able to attend a memorial service for a member of the PFRR team who had passed away between the first and second launch windows. It seemed a fitting tribute to finally launch the rocket after that service, almost as a memorial to the departed team member who provided so much help to both PFRR and the Wallops Range crew in the past. This mission brought new meaning to the phrase "it's a marathon, not a sprint", but the professionalism and perseverance of everyone involved resulted in a successful launch into a beautiful aurora.

UAS flight tests a rising trend at the Wallops Airfield

WALLOPS ISLAND — The Research Range Services (RRS) Program saw a significant uptick in Unmanned Aerial System (UAS) flights in 2014. Three notable success stories were the return of NASA's Global Hawk (GH) mission, known as Hurricane and Severe Storm Sentinel (HS3), continued support of the Airborne Subscale Transport Aircraft Research (AirSTAR) program, and a new mission, the U.S. Coast Guard (USCG) Scan Eagle Demo.

Hurricane and Severe Storm Sentinel (HS3)

For the third consecutive year, RRS hosted the GH UAS to conduct hurricane research in the Atlantic Ocean. The HS3 mission is a five-year NASA Airborne Science mission, specifically targeted to enhance understanding of hurricane intensity changes in the ocean basin. The mission involves three years of Global Hawk science flights from the Wallops Range occurring during peak hurricane seasons. Flight operations in 2014 occurred between Aug. 25, 2014, and Sept. 28, 2014, with the GH aircraft performing 10 science flights, tracking three named storms, logging a total of 236 science hours, and dropping a mission record-breaking 649 sondes.

Operations were conducted out of the Global Hawk Operations Center-East (GHOC-E), the construction of which earned RRS a place as recipient of a 2014 NASA Robert H. Goddard Honor Award.

"…This team has gone well above and beyond normal duties by concurrently completing not just one, but two large successful joint projects combined as the NASA Goddard Flight Research Center WFF GHOC-E UAS hurricane research and construction team project." – Goddard Honor Award.

Support from RRS is as follows:

• The Weather Office provided forecast briefings each day of the science period covering weather at the Wallops location and all divert airports.

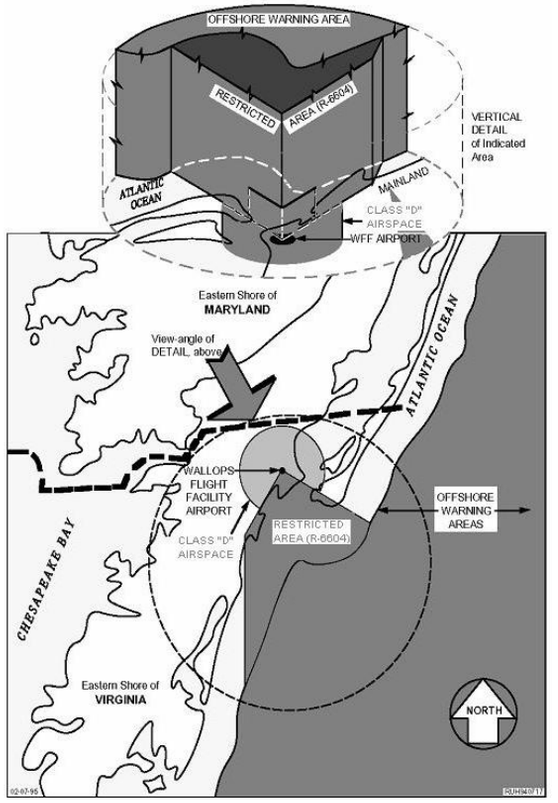
• Air tower controllers coordinated with the Wallops Flight Facility wildlife biologists to reduce the risk of bird strikes.

• Airfield personnel coordinated to de-rig the arresting gear on Runway 04-22 before each scheduled GH departure and approach.

Airborne Subscale Transport Aircraft Research (AirSTAR)

NASA's Langley Research Center's remotely-piloted Airborne Subscale Transport Aircraft Research (AirSTAR) program includes a battery of test scenarios performed at the Wallops Range. Several remotely-controlled scalable aircraft models are tested in various flight and system configurations. In 2014, RRS hosted AirSTAR for initial testing operations, and behind-the-scenes generated an innovative solution to interface Radio Frequency (RF) communications in the AirSTAR Mobile Operations System (MOS) control unit with the Range Land Mobile Radio (LMR) system, paving the way for solid RF communications in future mission support.

At time of publication, RRS personnel are poised for further support slated for late Fall 2014.



U.S. Coast Guard Scan Eagle

A first for the Wallops Range, RRS supported the USCG Scan Eagle UAS Demo Feb. 10-20, 2014. With the purpose of increasing the U.S. Coast Guard's air surveillance capability, the Scan Eagle UAS Demo mission sought to test the vehicle's payload sensor capabilities in a maritime environment, without the physical and scheduling limitations of actually being on a USCG vessel at sea. The project required a quick turn-around in support, and RRS rose to the challenge, overcoming scheduling hurdles to enable the Scan Eagle UAS to accumulate more than 47 hours of flight time during eight testing days, spanning weekends and holidays.

RRS provided support in the following areas:

• Weather forecasting, earning praise from the customer: "The in situ pilots were especially impressed with the accuracy of the daily weather reports. They commented that the weather reports were the best they've ever received." – Alfred Fordan, RRS project manager

• Air traffic management and air field support

• Radio Frequency monitoring and communications

• Photography and project management

The USCG Scan Eagle UAS demo flight was conducted on the UAS runway.

The USCG Scan Eagle UAS flies above the Wallops Range.

ORS-3 takes 29 CubeSats into Earth's orbit

WALLOPS ISLAND — As Thanksgiving drew near in 2013, the Research Range Services (RRS) team had much to be thankful for. After a long and challenging journey, the Operationally Responsive Space-3 (ORS-3) mission was launched into the night sky on Nov. 20, 2013, carrying the STP-SAT-3 payload, along with a near record-breaking 29 CubeSat sub-payloads.

The road to this successful launch took many twists and turns, both during the planning phase and during the launch itself. In September 2013, rumors of government sequestration began swirling around the water-cooler, but no one was sure if it would actually happen or not, so the team continued to prepare for the launch in the hope that things would be worked out.

On October 1, 2013, the rumor became a reality and the RRS team was told to stand down on all but critical operations, which, unfortunately, did not include ORS-3. All work to support the mission was suspended until sequestration was resolved, at which point the RRS team coordinated with the Range user and other agencies to determine the best path forward to launch the rocket.

With sequestration behind the team and a new launch date established, the RRS team ran into another challenge in competing for support assets with the Eastern Range. Two other missions that shared instrumentation with ORS-3 were competing for similar launch windows. After much negotiation with our partners on the Eastern Range, a priority

LAUNCH VEHICLE	Minotaur I
MISSION:	ORS-3
WALLOPS ID:	DRW-5299
LOCATION:	Wallops Range
LAUNCH DATE:	Nov. 19, 2013
LAUNCH TIME:	08:15 p.m. EST

order with several contingency options was established. Luckily, the priority mission at the time was able to launch on its first attempt, which gave the "green light" for ORS-3 to press forward with its schedule and the team soon found itself on console and counting down to zero.

The fun, however, did not end once the team arrived on console! As the count progressed, several gremlins worked their way into the deployed systems, keeping RRS personnel on their toes throughout the night. Communication and coordination were critical to ensuring troubleshooting was completed in a timely manner and all parties maintained good situational awareness. The greatest challenge occurred when a part broke on one of the systems at the downrange sites in such a way that it could not support the launch. This piece of instrumentation was mission critical – we could not fly without it – and after some troubleshooting, the team realized that there were no on-site replacement spares. The RRS team back at Wallops coordinated with Range Safety to re-purpose one of the surveillance planes and turn it into a transport aircraft. An RRS engineer boarded the plane with spare parts, flew down to the deployed site in Coquina, N.C., dropped off the parts, and immediately returned to Wallops. The team had managed to repair the system while the engineer was en route, but it was determined that the extra spares would benefit the deployed team in case of another failure.

Once the system was repaired, a new launch time was coordinated and the team was able to successfully support a spectacular launch from Pad 0B. This mission would not have been possible without the dedication and flexibility of the entire RRS team. Despite the many challenges both during the planning phase and during the launch count itself, the team was able to work together to bring about a successful conclusion to months of hard work.

RRS team receives Agency Award for Firefly CubeSat support

WALLOPS ISLAND — It comes as no surprise that the Research Range Services (RRS) Program had another highly successful year supporting the CubeSat mission set. Although new to the Firefly mission, RRS has continued to play a major role in the success of the CubeSat platform.

RRS Atmospheric Sciences Research Facility (ASRF) staff spent the early part of the fiscal year preparing for Firefly support. Work included the installation of unique ground station equipment and testing of the UHF system. Ensuring the UHF Radar was operational was paramount, as it is the sole system responsible for communications with Firefly.

The Firefly CubeSat, sponsored by the National Science Foundation and led by NASA's Goddard Space Flight Center in Greenbelt, Md., was launched aboard the ORS-3 vehicle, along with 28 other CubeSats, on Nov. 19, 2013. The RRS team worked diligently during the next seven weeks in attempts of locating Firefly among the cluster of 29 CubeSats. The team's unwavering support led to locating the CubeSat Jan. 6, 2014. Since the location of the Firefly, RRS has continued to provide daily tracking support.

In April 2014, the team's creative solutions and excellent customer service led them to win the 2014 NASA Agency Honor Award. The award is only given to groups that go above and beyond any and all expectations. The RRS CubeSat ground station support team quickly resolved a number of issues in both a unique and innovative manner. They created software workarounds, electrical rewiring, and a rejection filter system.

This year RRS had the opportunity to continue support on multiple CubeSat proposal efforts. This will expand RRS' role in future CubeSat missions at the Wallops Range, which will also further utilize the UHF radar as its sole communication source.

Carrier deck landing flights a highlight at the Wallops Airfield

910 Flight Hours **14,802** passes **47** passses per hour

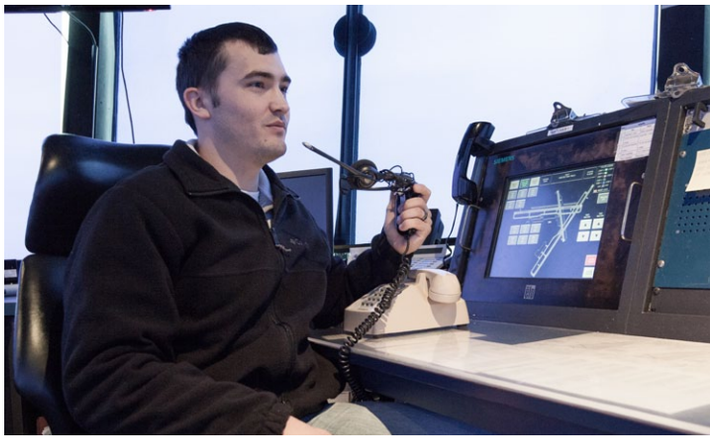
WALLOPS ISLAND — To those familiar with it, it's the sweet sound of airplanes playing a friendly game of tag. The sound in question is that of the E-2 Hawkeye and C-2 Greyhound aircraft performing nearly 15,000 flight passes on the Research Range Services (RRS) airfield. The Field Carrier Landing Practice (FCLP) project has made its way to the Wallops Range and the sound of success could not be any sweeter!

The Navy has begun conducting operations at the Wallops Airfield, and in doing so, RRS personnel have taken on the responsibility of providing support services to help achieve the Navy's goals. One of the many goals was the development of simulated carrier deck runways and the maintenance, development and installation of the necessary power, and communications and tie down/parking interfaces for mission-specific systems. These included the Improved Fresnel Lens Optical Landing System (IFLOLS), Manually Operated Visual Landing Aid (MOVLAS), and the Landing Signals Officer (LSO) Shack ground support equipment.

The second goal RRS achieved was stepping up the air traffic control class D services and airspace management. This included after-hours support as needed, access to R-6604 airspace, fueling services, and ground mobile radio communications. RRS personnel also coordinated services, such as scheduling, Range support, logistics, ground support, and equipment maintenance support. The RRS Program has successfully completed the installation and checkout of the simulated carrier deck runways as well as the concrete pad staging locations, with power and communications interface modules. The IFLOLS, MOVLAS, and LSO Shack ground support equipment have passed functional checkout using these interface modules.

So, the next time you hear the sound of the aircraft flying overhead, look up and wave (or salute) just to say thank you to these men and women … thank you for your service and thank you for visiting NASA's

A C-2 Greyhound aircraft lands on a simulated carrier deck painted on the Wallops Airfield runway. The equipment in the right corner is the Improved Fresnel Lens Optical Landing System.



Wallops Aircraft Controller Greg Hickman observes the E-2 and C-2 aircraft flights from the Wallops Airfield.

DEPARTMENT	SQUADRONS
U.S. Navy	VAW, 120, 122, 123, 124, 125, 126 and VRC-40

Wallops continues Pax River air support

A helicopter lands to pick up a comrade during simulated search and rescue operations.

Helicopters fly over the Wallops Airfield while performing search and rescue operations.

WALLOPS ISLAND — Patuxent Naval Air Station, simply known as Pax River, in southern Maryland is a mainstay customer of the Research Range Services (RRS) Program. RRS personnel have been providing support for test and development of Naval Air Warfare Center Aircraft Division (NAWCAD) aircraft since 1996.

Service requirements continued through this past fiscal year with RRS staff supporting six days per week on average. Requirements are mainly for Navy test flights of the F-35 Joint Strike Fighter. These flights consisted of "bent-pipe" telemetry flows, relaying telemetry from the aircraft back to Pax River.

Air traffic management support is also provided for all MH-60 and search and rescue (SAR) helicopter airfield activities. Demonstrating flexibility and stewardship, RRS staff supported additional aircraft, such as the F-18 Hornet and P-8, in order to meet ever-changing customer needs. For the second year in a row, RRS supported Expendable Decoy Drop Operations with the F-35 aircraft.

The Pax River F-35 Integrated Task Force (ITF) utilized air traffic management, telemetry, frequency monitoring, optical and communications support for this unique mission.

Range assists in national defense support for MDA

LAUNCH VEHICLE	Both missions Terrier-Lynx
MISSION:	MDA Shark 03
WALLOPS ID:	DRW-5504
LOCATION:	Wallops Range
LAUNCH DATE:	Aug. 23, 2014
LAUNCH TIME:	09:13 p.m. EST

WALLOPS ISLAND — Mission preparedness is a staple of the Department of Defense (DoD) and the Research Range Services (RRS) program is at the ready to assist the DoD when the need arises. For the past few years, the Missile Defense Agency (MDA) has partnered with the Wallops Range to conduct sounding rocket missions in support of national defense – Fiscal Year 2014 was no different.

The purpose of the MDA Shark missions was to engage an off board missile defense sensor against the target rocket's payload. The RRS team provided ground instrumentation, communication, surveillance, optical, meteorological and ground ops support for the mission. The MDA Shark 2014 mission was to launch two separate Terrier-Lynx vehicles about two weeks apart from the Wallops Range, which provided a ballistic tracking vehicle for off-board tracking systems and instrumentation data collection.

The first vehicle, Shark No. 3, had its first launch attempt on Aug, 12, 2014; however, inclement weather put a halt the mission, and another mission date was scrubbed due to an issue with the vehicle. As the old saying goes the "third time was the charm" as the MDA launch vehicle took flight Aug. 23, 2014.

The MDA Shark No. 4 created quite a stir as well. Initially scheduled for Sept. 20, 2014, mother nature proved again to be too much to overcome. Unfortunately the wind, rain, and cold weather lasted for the rest of the day … and the rest of the week causing a delay until October 2014.

The end customer was the Naval Surface Warfare Center Port Hueneme Division Detachment out of White Sands Missile Range, N.M., who served as MDA's empowered mission integrator.

Salvo launch simulates missile raid operations

LAUNCH VEHICLE	Three Terrier-Improved Orions
MISSION:	MDA FTX-18 RAID
WALLOPS ID:	DRW-5462, DRW-5463, DRW-5464
LOCATION:	Wallops Range
LAUNCH DATE:	Jan. 15, 2014
LAUNCH TIME:	05:09 a.m. EST

WALLOPS ISLAND — One of the more challenging and unique missions the Research Range Services (RRS) Program faces is a sounding rocket salvo – multiple vehicles being launched in close succession. In early 2014, the U.S. Navy Aegis Ballistic Missile Defense (BMD) Program, the Sea-Based Missile Defense (SMD) element of the Missile Defense Agency (MDA), challenged RRS personnel with such an operation. The mission was to launch a salvo of three sounding rockets to simulate engagement of a missile raid against U.S. Navy ships. Three U.S. Navy Aegis Readiness Assessment Vehicles (ARAV Type-A) Terrier-Improved Orion vehicles served as simulated missiles tracked by the Navy.

The first launch attempt was conducted on Jan. 14, 2014, but was scrubbed at T-30 minutes as the weather was not optimum for launch; however, the second launch attempt proved successful. The Terrier-Improved Orion vehicles were launched on Jan. 15, 2014, from the MRL Launcher, the HAD Launcher, and the ARC Launcher in succession in the early morning hours before sunrise. A fourth vehicle was on standby as a hot back-up on the 50K launcher on Pad 1 in the event one of the first three vehicles did not launch.

RRS personnel provided telemetry services from vehicle turn on to horizon loss of sight for each of the three rockets. Fixed and mobile assets were utilized for tracking, receiving, relaying, recording, and readout capabilities. Also, four radar sites were in a primary configuration with one spare unit on standby. Additionally, optical systems recorded high-speed video data to capture motor ignition, umbilical release and vehicle egress from the rail. Visible optical tracking provided data through flight until loss of sight. Launch System Integrations services were provided along with surveillance services.

Supporting this salvo operation required a significant amount of RRS services and personnel while simultaneously supporting launch operations at Poker Flat Research Range near Fairbanks, Alaska. The successful launch of MDA Raid undoubtedly started the 2014 year off with a bang.

RRS works to inspire the next generation's career goals

WALLOPS ISLAND — The Research Range Services (RRS) Program continued its stewardship of aspiring engineers, technicians, scientists, and students in other professional fields who are on a path to obtain a degree in one of the STEM core subjects – science, technology, engineering, or math. The goal for RRS in this effort is to provide an ideal work experience for those considering a career in the space industry and may someday seek to call NASA home.

This year, RRS provided career-enriching experiences for 15 students from various universities and high schools from around the country.

A unique collaboration highlighted the 2014 intern program. RRS teamed with the U.S. Navy Pacific Missile Range Facility (PMRF) and NASA's Hawaii Space Grant Consortium, giving three University of Hawaii students the opportunity to support a high-tech project as a participant of the RRS team. This initiative allowed these students, who are permanent residents on the Island of Kauai, to support the Low-Density Supersonic Decelerators (LDSD) project at PMRF.

RRS also reaches out to a number of educational systems and other youth group to provide tours of the Wallops Range and the ever-popular Range Control Center. Students are afforded the rare opportunity to sit in an actual launch control environment as if they are part of a launch.

List of Schools who visited RRS during 2014:

- University of Maryland Eastern Shore, Princess Anne, Md.
- Salisbury University, Salisbury, Md.
- Worcester Technical High School, Newark, Md.

Universities attended by RRS interns

- Wor-Wic Community College, Salisbury, Md.
- Parkside High School, Salisbury, Md.
- Princess Anne Middle School, Princess Anne, Md.
- Broadwater Academy, Exmore, Va.
- Arcadia High School, Oak Hall, Va.
- Boy Scout Troop 1, Dover, Del.
- Colonel Richardson High School, Denton, Md.
- Moravian Academy, Bethlehem, Pa.
- Howard County Public School System in Maryland
- Stephen Decatur JROTC, Berlin, Md.
- Portsmouth Public Schools, Portsmouth, Va.
- Shore Christian Academy, Exmor, Va.

The RockOn! VII student team poses in front of the Terrier Mk12-Improved Orion.

RockOn! VII

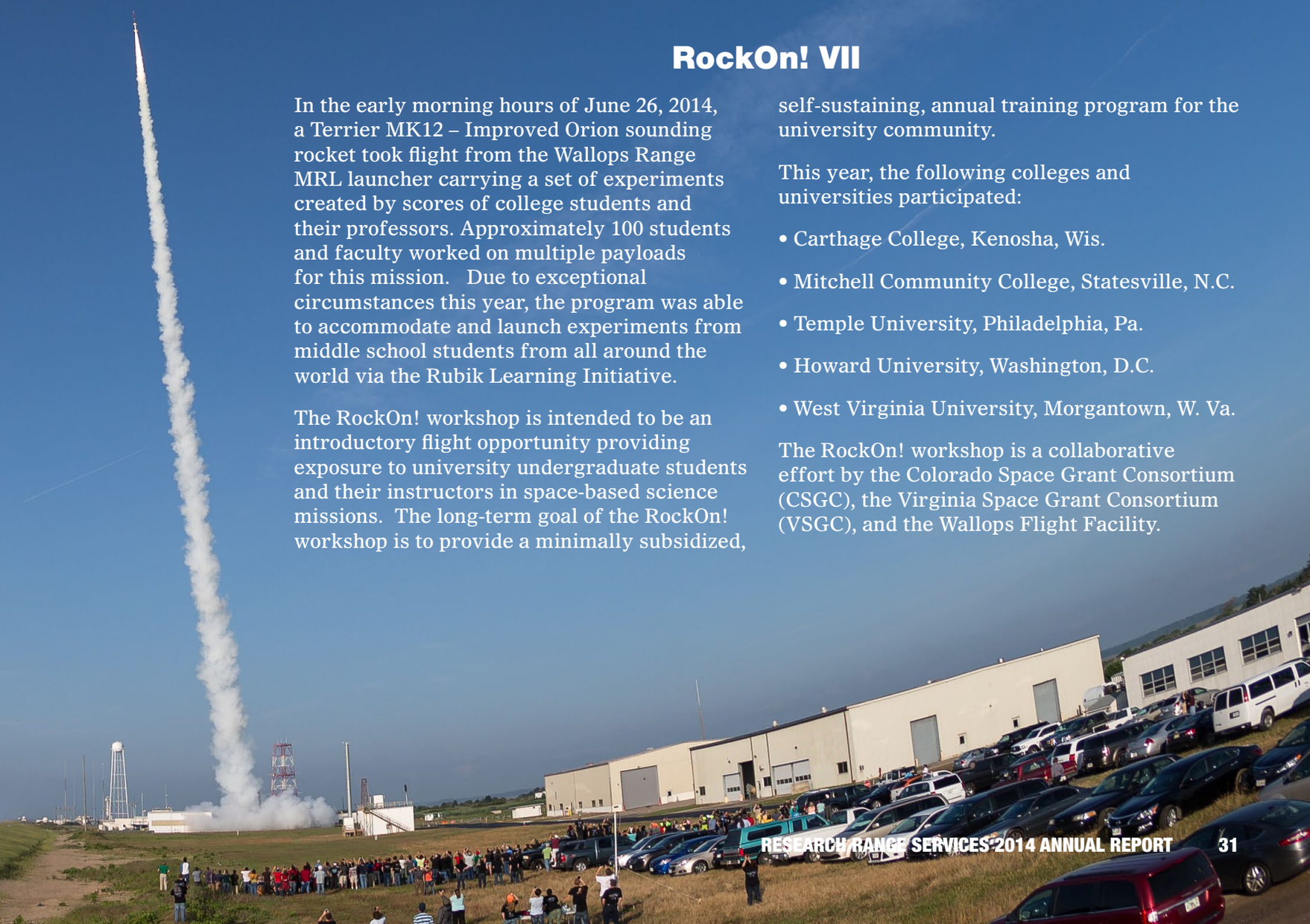
In the early morning hours of June 26, 2014, a Terrier MK12 – Improved Orion sounding rocket took flight from the Wallops Range MRL launcher carrying a set of experiments created by scores of college students and their professors. Approximately 100 students and faculty worked on multiple payloads for this mission. Due to exceptional circumstances this year, the program was able to accommodate and launch experiments from middle school students from all around the world via the Rubik Learning Initiative.

The RockOn! workshop is intended to be an introductory flight opportunity providing exposure to university undergraduate students and their instructors in space-based science missions. The long-term goal of the RockOn! workshop is to provide a minimally subsidized, self-sustaining, annual training program for the university community.

This year, the following colleges and universities participated:

- Carthage College, Kenosha, Wis.
- Mitchell Community College, Statesville, N.C.
- Temple University, Philadelphia, Pa.
- Howard University, Washington, D.C.
- West Virginia University, Morgantown, W. Va.

The RockOn! workshop is a collaborative effort by the Colorado Space Grant Consortium (CSGC), the Virginia Space Grant Consortium (VSGC), and the Wallops Flight Facility.



Engineering sustains fixed and mobile Range assets

TCATS

The Transportable Command and Telemetry System (TCATS) added more than $21 million in mobile Range assets to the Research Range Services (RRS) inventory including two Mobile Operations Centers (MOC), four antenna systems, two tool vehicles, two tow vehicles, safety simulator, as well as spares for the system. The vehicles are providing much needed support to the Wallops Range supporting various operational missions, including transportation of the mobile optical camera station during inclement weather preparations. The Engineering Group led the effort of getting one complete TCATS system out of a mothballed state back to the operational state of the system when it was used at Patrick Air Force Base. engineering developed a list of tasks and scheduled the support needed that made the completion this effort possible. A Telemetry Acceptance Test Procedure was developed by Engineering to test out the Telemetry capabilities of TCATS for use on the Range. Engineering was also instrumental in getting a complete inventory list compiled, accounting for all spares received when TCATS was shipped to Wallops.

One of the two TCATS vehicles that provide support for the Range.

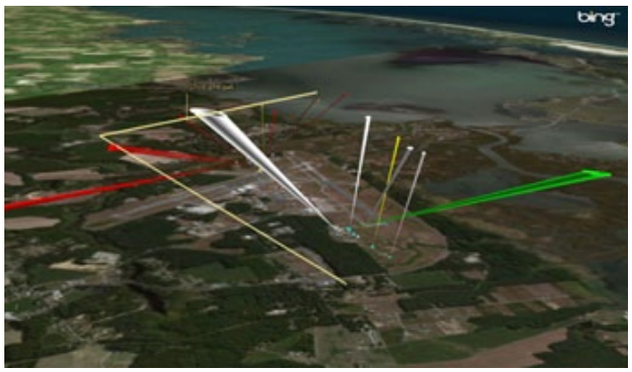
The RRS engineering group performed a gap analysis of the system, based on upcoming mission requirements and availability of other systems. The analysis determined that the current capability of TCATS would not meet the needs of these upcoming missions. TCATS is currently being re-designed, modernized and reconfigured to provide Telemetry, Command Uplink and Readout requirements needed during the Woomera, Australia, Sounding Rocket Campaign coming in 2016.

Radar 2 Repacking and Refurbish

Due to obsolescence and condition issues with Radar 2, RRS decided to repackage the system in a new expandable shipping container. To increase loop gain and improve the tracking capability of the radar system, a 12-foot pedestal will be integrated into the system in 2015. By using excessed equipment from the U.S. Air Force and Kennedy Space Center, the project should be completed in one year for under $100,000. To date, the first two phases of the project are nearly complete. This includes the refurbishment of the shipping container and the relocation, setup and testing of the Radar 2 equipment with the original 8-foot NIKE pedestal. As soon as the 19.17 pedestal undergoes the overhaul scheduled for late 2014, the new pedestal will be integrated and complete system testing will be conducted.

3D STK RFI Assessment Tool Concept

RRS identified a potential opportunity to gain some efficiency in radio frequency interference (RFI) analysis turnaround time, accuracy, 3D Mission Planning Graphics, and a real-time 3D graphical display capability of the Range and National Oceanic and Atmospheric Administration RF sources. The RRS team put together a high level concept and value added package for a potential tool that could accomplish this. A RRS project manager and the Range Chief considered this package and agreed that this should be looked at in more detail and a Stakeholder Concept Demonstration task was created. In addition, a WFF Main Base Low Flying Aircraft Concept Demonstration Simulation Video has been created in the Satellite Tool Kit (STK) mission planning software application.



Radio frequency sources at Wallops Range and UAS flight paths

Surveillance Radar Project L-STAR

Recently, RRS obtained four TPQ-49 Lightweight Surveillance Target Acquisition Radars, known as L-STARs. After obtaining these systems, it was decided that two of them would travel to Poker Flat Research Range (PFRR) near Fairbanks, Alaska, to replace the existing Portable Surveillance Target Acquisition Radar (P-STAR) system currently in place. This P-STAR system is used during launch campaigns to ensure that the airspace required for a launch is clear of any aircraft. The L-STAR system will provide upgraded capability and reliability over the current P-STAR system.

The team has been working with the manufacturer to ensure that the new L-STAR system is capable of surviving the harsh Alaskan winters, as well as fulfilling the requirements of supporting air surveillance during a launch campaign. As the project progresses, the team will travel to the manufacturer's site to receive training on both operations and maintenance of the system. This summer, the team will travel to PFRR to install and test the system in its operational environment with the intent of certifying it for operations in time for the PFRR 2016 campaign.

Air-to-Ground Radio System (AGRS)

The Air-to-Ground Radio System (AGRS) project was created as a mitigation strategy for one of the highest risks on the RRS Risk Register – the inability to procure spares as the current system has gone through a technical refresh and the refreshed system is not backward compatible. This directly impacts air-to-ground communications, range safety, and the ability to support multiple operations on the same day.

The AGRS RRS team has completed

- A Concept of Operations
- Requirements Development
- FAA Requirement Based Back-Up Power Trade Study
- Form-Fit-Function Market Trade Study
- Net-Centric Connectivity Trade Study
- System and Subsystem Drawings (Block Diagrams, Rack Elevations, Cable Interconnects)
- Supportability Assessment
- Request for Proposal (RF) Open Competition
- 4 Bidder Source Selection Evaluation
- Risk-Based Implementation Scenarios

The project team has also nearly completed the design review package, developed a risk-based staggered implementation approach to allow for flexibility in material funding sources, and is 80 percent complete with the System Bill of Materials.

Mobile Optical Tracking System

The Mobile Optical Tracking System (MOTS), now known as Camera Station M1, was a bit of an engineering marvel as RRS engineers and technicians were able to take an existing telemetry tracking pedestal, ingest Radar ELTAS data and produce an optical video deliverable. The M1 system is able to collect high definition video data, record that data to a digital recording system while packaging that video stream for distribution to the RRS Range Control Center (RCC).

Since its inclusion in the optical inventory it has quickly become the group's top tracking system. The project was completed in August 2014 after all hard requirements were met and all panel board member's questions were satisfied.

Furthermore, the system is capable of being used in an unmanned configuration allowing RRS optical technicians to place the tracking trailer in hazardous areas increasing video coverage of a launch event. The system is a model for video tracking systems and is being discussed as a roadmap to create similar optical systems.

The inside of the manned operator station of Camera Station M1.

Wallops Video Project Phase 2, Launcher Shelter Surveillance

Launch Pad Managers (LPM) at the Wallops Range were running into surveillance difficulties during sounding rocket integration activities. To combat this issue, RRS developed and funded a strategy to develop a unique, dedicated surveillance system within the three sounding rocket shelters.

In total, nine pan-tilt-zoom internet protocol cameras were installed in and around the ARC, MRL and 50K launchers on the Wallops Range. This system provides dedicated cameras for proper surveillance to the LPMs as well as a recording system capable of ingesting all cameras simultaneously. This gives the LPM and NASA Safety the ability to investigate any anomalies that may occur.

Nine surveillance cameras were added to the sounding rocket launcher shelters.

Flight Termination System (FTS)

The Flight Termination System (FTS) project is a formalization of the effort started in 2009 to replace the legacy command ground system with a turn-key solution capable of all three command modulation types:

- Standard IRIG
- High Alphabet
- Enhanced

A system prototype is in development and once completed it will allow for the RRS team to conduct testing without interfering with our safety and command missions. As an example of sound management techniques, the team is actively working to align the design of the replacement system with the future goals of the Range Command time domain multiplexers (TDM) Upgrade project.

This alignment will help to manage costs, eliminate rework, and provide for easier integration of new systems. Working closely with our safety counterparts the team obtained funding and is in the process of developing a hazard analysis with a fault tree, once complete this will become a benchmark for other projects to follow and will bring a much needed enhance capability to our safety systems.

RADAC

After several scheduling delays due to limited resources, the Range Data and Acquisition Computer (RADAC) team was able to finalize the plan for the final sprint to the finish line. The RADAC system is used to ingest data during a launch from various tracking sources around the Wallops Range. It then processes and displays this data for both RRS personnel and Range Safety to help them determine whether or not the vehicle is flying on course. Data from the RADAC is also used as a slaving source to help steer equipment in the correct direction during a vehicle flyout. The purpose of this project is to upgrade the existing RADAC to a system based on the LINUX operating system. The current system is rapidly approaching obsolescence, so the RADAC upgrade will help ensure functionality and sparing for several more years, among other advantages.

The team is currently in the process of updating the final test procedures and is scheduled to begin testing in 2015. They are also working hard to finalize project documentation and ensure everything is in order to get the system approved for operations. Once complete, the old RADAC will be phased out, and the Linux RADAC will move out of engineering test mode and become a fully operational system.

Universal Translate, Record and Analyze Project (ULTRA)

The Universal Translate, Record and Analyze (ULTRA) Project was initiated as a result of the outgrowth of Code 589's Selectable Internet Protocol Slaving (SIPS) system. The SIPS was required to use only Ethernet data sources, but needed access to data that was only available in synchronous serial format. A commercial system was eventually developed to what is known as ULTRA. The RRS team used ULTRA on an engineering test basis and brought the system through the engineering and certification process to become a completed Applied Engineering and Technology Directorate (AETD) project. ULTRA replaced the failing ASCII Time Code generator at Poker Flat Research Range, near Fairbanks, Alaska, and another aging Wallops Range system known as the External Generic inGester (EGG). ULTRA could easily be configured to convert a wind-weighted nominal trajectory to synchronous serial minimum delay data format – to replace the radar auxiliary processing system, or to convert Ethernet launch trajectory acquisition system (LTAS) to LTAS (synchronous serial) to provide slaving for the WFF 9-meter.

ULTRA consists of a set of hardware and software building blocks (options). The hardware building blocks are set and include 4 serial ports, 2 Ethernet ports, an IRIG-B port, and a pseudo-IRIG port. The software building blocks include the data flow option, serial input/output option (SIO), data recording option, and IRIG-B and Pseudo-IRIG options. Mission configurations are built using these building blocks while the main purpose of the ULTRA is to convert data from one format to another in real time, as required by a mission.

Redstone Radar

After years of planning and work, the 9-meter No. 2 (Redstone-2) is now in the final stretch of operational certification. During last year's winter PFRR maintenance trip, the RRS team was able to make huge gains toward completing antenna assembly and testing, but a faulty component stopped testing in its tracks. The component was returned to the Wallops Range for troubleshooting while the antenna itself, like many things in Alaska, remained dormant throughout the winter. The team returned the following summer to re-install the component and completed the required testing. Unfortunately, the problem ran deeper than anyone knew, and despite everyone's best efforts, the feed had to once again return to the "lower forty-eight".

This time, however, the feed was returned to the manufacturer to try and determine the issue. The timeline was getting tight for completion of this project because the 9-meter No. 2 antennas was on the list to support the upcoming PFRR 2015 launch campaign and it was already mid-summer by the time the component was returned to the manufacturer. Luckily, in working with other groups on base, the RRS team was able to locate another version of the required component. This "spare" component was also returned to the manufacturer who said it needed some work, but was actually in better condition than the component that was originally up at PFRR.

RRS personnel work on putting the final touches on the Redstone antenna at PFRR.

The decision was made to focus all efforts on the "spare" to get that up and running, and then focus on the original component if there was time. The spare component was completed ahead of schedule and shipped up to the waiting arms of our permanent-party RRS member. This permanent-party RRS technician is a relatively new development in the RRS architecture which proved extremely useful for this project since he was able to install the component prior to the arrival of the test team from Wallops. Due to the component's repair and the in-station RRS technician, the balance of the RRS team was able to travel up to Poker earlier in the year before the bitter winter cold really moved in. Once they arrived, the RRS team was able to successfully complete the required testing just as the fiscal year rolled over. Although some challenges were encountered and there is still some remaining work, the prognosis is promising for this antenna to abandon its dormant state and be awake and kicking for the upcoming winter support.

SureTrak

The RRS SureTrak project team has made great progress during the past year towards the testing required to obtain safety certification of the SureTrak system and bring it into operational use. The system itself is used during a launch count to determine whether or not a pre-determined Safety area in the Atlantic Ocean is clear of all ships. This area is blocked off to protect personal safety during a staging event (when a spent stage drops off the rocket as it flies out) or in the event of a catastrophic explosion when rockets parts could potentially hit a boat if it was in the area.

The SureTrak system tracks these vessels and allows RRS personnel to know where they are, where they are headed, and, if they are in the area, how long it will take them to clear out. It is also capable of determining the risk of the person being in that area by determining the probability of being struck by falling debris. This past year, the team has completed testing on two out of three locally developed modules and is very close to completing testing on the final module. An updated operating system is due out very soon, so the team will perform regression testing to ensure that the updated system does not contain any hidden "gotchas" when interacting with the locally-developed modules. In the coming year, the team is hoping to finish regression testing and be well on its way to finishing system level testing. Once the system is online, it will help better ensure that those sailing the earthly expanse remain safe as we sail into the heavenly expanse.

Medium Gain Antenna Project

Early this past year, RRS personnel were provided the funding required to purchase a new 6-meter antenna that will replace the current 7.3 No. 2 Medium Gain Antenna. This newer system will provide the Wallops Range a higher gain and a newer, more reliable tracking antenna across the L-band and S-band frequency range as compared to the 7.3 MG No. 2. The original plan was to remove the 7.3 MG No. 2 and install the new 6-meter antenna on the existing concrete pad. After consultation with Wallops facilities engineers, it was determined that, given the age of the current pad and the differences in the way the two antennas were constructed, the existing pad would not be a good option over the long term. The team is currently working with Wallops facilities personnel and others on the base to conduct an analysis of the different options for antenna placement (including building a new pad). Once this analysis is complete, the team will press forward with the final design, installation, and testing of the antenna.

7.3 No. 2 Medium Gain Antenna

Mobile Command Antenna Control Unit Upgrade

The Mobile Command Antenna Control Unit (ACU) Upgrade project represents a new way of doing business with respect to safety critical projects brought to RRS. The purpose of this project is to replace the current controllers in the Mobile Range Control System-2 (MRCS-2), as well as replace the current slaving system in use by that controller. Both of these objectives will be accomplished by installing an ACU in the MRCS-2 system. The ACU has already demonstrated its capability on several systems around the Wallops Range, but this particular version of the ACU is different because it directly supports Range Safety's capability to protect public safety in the event of a launch mishap.

Because of this "safety critical" designation, several more testing requirements are levied on the system, including the development of a fault tree which basically shows ways in which the system could possibly fail. In the past, RRS has taken care of developing fault trees on its own, but for this project, RRS decided to bring in a firm who specializes in this type of safety analysis. This firm will partner with RRS and the ACU vendor to study ways the system could possibly fail, and then develop tests and fixes to prevent those failures.

Command TDM Upgrade

The RRS staff continued to make strides in the engineering effort to upgrade the Wallops Range Safety Critical Command System. The focus has remained on upgrading the method of transmitting command tones and receiving transmission verifications, TDM, due to equipment obsolescence issues.

The project team continues to work closely with Range Safety, Applied Engineering and Technology Directorate (AETD) and Wallops Range chief engineer to ensure this safety critical system is meeting all stakeholder expectations. During the last year, the project engineer has worked diligently to fully document the current system configuration to ensure the upgrade would have no negative impacts on the existing system. In an effort to help manage Range cost and align long-term goals, the team was able to design and procure a system that utilized a network backbone which could be used for future tri-mode flight termination system upgrades.

Major Engineering Projects

The project was originally slated to be complete however; the scope of the project grew over the last year to include additional testing and the development of fault tree analysis (FTA). The FTA prove to be a major undertaking which RRS staff expertly developed working closely with Range Safety capturing all faults and delivering the first product of its kind. The results of the analysis are being put to good use as the team continues to work on fully developing all required test procedure. This project demonstrates how having a good management process which properly identifies all the required stakeholders can methodically be completed to ensure the reliability and confidence that is required on a safety critical system.

SPANDAR & UHF Radar ACU Upgrade

RRS engineering took on the unenviable task of updating the antenna control units (ACU) for both the SPANDAR and UHF radars, the two largest and oldest in the Wallops Range inventory. This year the RRS engineering staff completed the design, implementation, and testing of the new UHF ACU. This effort included numerous obstacles which RRS was able to overcome without issue. The first major hurdle, outdated documentation, was overcome by diligent work performed by the engineering and operations staff documenting the current system interface. This work would later ensure a smooth installation of the new ACU. The second major obstacle was the ongoing daily CubeSat tracking support which the UHF system and RRS personnel were responsible for. The team started planning months in advance with the UHF customers to ensure minimal mission impact. Due to the planning and early engineering efforts the team was able to complete the installation and testing in under a week and only required ~3 down days for which tracking support could not be supported. The upgrade will provide more reliable and accurate tracking for CubeSats for years to come.

The SPANDAR ACU upgrade project is in the earlier stages of planning. RRS plans to mirror the highly successfully approach that was used on the UHF radar to ensure yet another successful system upgrade.

UHF Radar

SPANDAR Radar

The Way Forward

WALLOPS ISLAND — Every year it seems that the Research Range Services (RRS) Program outdoes itself from the prior year as it continues its operations and maintenance of NASA's only owned and operated launch range. We're blessed to be a focal point of the nation's launch activities during this era of science collection and space exploration.

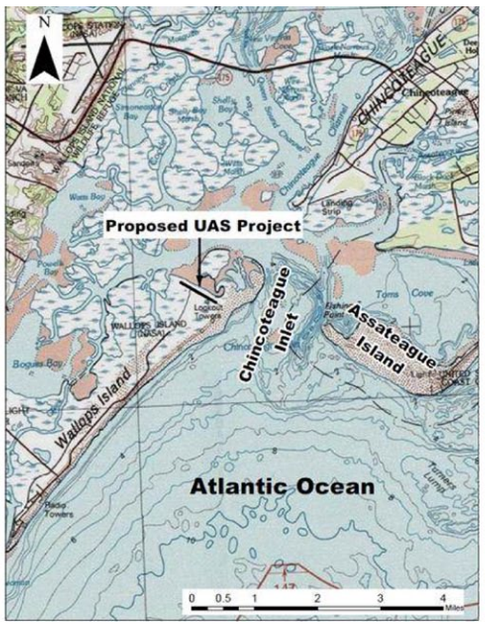
Fiscal Year 2015 looks to further enhance the professional reputation of the RRS Program as more fascinating missions are planned, and RRS prepares to play a major part in the newly formed Mid-Atlantic Aviation Partnership to support the nation's Unmanned Aerial Systems (UAS) integration into national airspace.

NASA Wallops Ready to Support UAS Test Site activities

The Federal Aviation Administration announced in late 2014 the selection of six test sites that will work toward integrating UAS in the National Airspace System.

The Research Range Services Program and the rest of NASA's Wallops Flight Facility is a supporting partner to one of the six sites selected, Virginia Polytechnic Institute and State University, more commonly known as Virginia Tech. The greater core team involves academia, government, industry, economic development organizations, and research parks connected under one umbrella organization known as the Mid-Atlantic Aviation Partnership, or MAAP.

"The safe and efficient integration of unmanned aerial systems into the National Airspace System is an important national goal, and we at NASA Wallops stand poised and ready to support related testing in the Mid-Atlantic Region," said Wallops Director Bill Wrobel.



The new proposed 3,000 foot UAV runway will be constructed on the northern-most edge of Wallops Island in 2015.

"Wallops' location, instrumentation capabilities, restricted airspace, established safety program and past experience in flying unmanned aerials systems make it a valuable member of the team supporting this great endeavor."

Later in 2015, a 3,000 foot-long runway will be constructed on the northern-most edge of Wallops Island which will be able to accommodate most unmanned systems. Current federal civil aviation regulations are based on a pilot being in the aircraft. Few regulations exist that specifically address UAS. To allow seamless operation of civil unmanned aircraft, technologies and procedures need to be developed, validated and employed by the FAA. NASA and the Wallops Range will contribute data needed to help define requirements, regulations and other issues.

Future Missions

Alaska Sounding Rocket Campaign

The upcoming launch campaign at the Poker Flat Research Range (PFRR) is shaping up to be one of the most challenging campaigns in recent history. This year, the team will launch a total of five rockets: One stand-alone rocket and two sets of two "salvo" where two rockets will launch within 60 seconds of each other and then the second set will launch approximately 30 minutes after that.

The stand-alone mission introduces a much higher level of complexity than is normally supported at PFRR in that it has seven payloads that the team will need to track, some of which are flying perpendicularly away from the others. The RRS team will deployed a small "away team" in late 2014 to finalize some remaining work in the telemetry and fiber set up, as well as support vehicle personnel in pre-mission testing.

The full team will deploy in early January to finalize equipment setup and support any remaining tests.

Once the launch window opens, the real fun begins as the team will have to be ready to support whichever mission's "science" is most active that particular night. That could mean setting up for one mission and having to switch to another. Careful planning and coordination with be critical to this year's success, but with a trained and knowledgeable team, we are looking forward to an exciting campaign that will help us to better understand our world.

Low-Density Supersonic Decelerator — Phase 2

For decades, NASA has been at the forefront of the nation's space exploration and the Low-Density, Supersonic Decelerator (LDSD) mission continues that challenge. LDSD started this past spring at the Pacific Missile Range Facility in Hawaii and will continue in the spring of 2015. The purpose of the Supersonic Flight Dynamics Test 1 (SFDT No. 1), which was conducted this past June, was to verify the design and functionality of the flight hardware. SFDT No. 1 also served as a pathfinder for maturing the mission concept of operations ahead of the SFDTs for record in 2015.

All mission success criteria set for SFDT No. 1 were met with the added bonus of validating the design of a Robotic Class of Supersonic Inflatable Aerodynamic Decelerator, denoted SIAD-R, for potential future Mars missions. The goal of SFDT No. 2 and SFDT No. 3 scheduled for the 2015 campaign is to validate the design of a supersonic parachute; ring sail, disk sail, or disk gap. The final design of the supersonic parachute is pending results of a failure review board on the SFDT No. 1 parachute. The multi-center NASA team is working towards a deployment date of mid-March 2015 for the start of the 2015 campaign.

The LDSD fires its thrusters after it reaches orbit.

FTX-19 Missile Defense Agency

RRS will continue its support of the nation's national defense with a sounding rocket salvo scheduled for February 2015. Known as Fleet Training Exercise (FTX)-19, this mission will support the U.S. Navy Fleet by launching a salvo of sounding rockets to simulate engagement of a missile raid against Navy ships. The three Navy Aegis Readiness Assessment Vehicles (ARAV Type-A) Terrier-Improved Orion vehicles will serve as simulated missiles which each ship will track. The three ARAV-A targets will be launched less than 30 seconds apart from the shores of the Wallops Range on a near 90 degree azimuth. The RRS team will include a full battery of services which will include precision radar tracking, telemetry, surveillance, photography, meteorology, and communications support.

A test rocket is launched into the sky with the Milky Way Galaxy in the background.

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The Wallops Range is seen during the final stages of the 2014 beach restoration project.

WALLOPS
RANGE