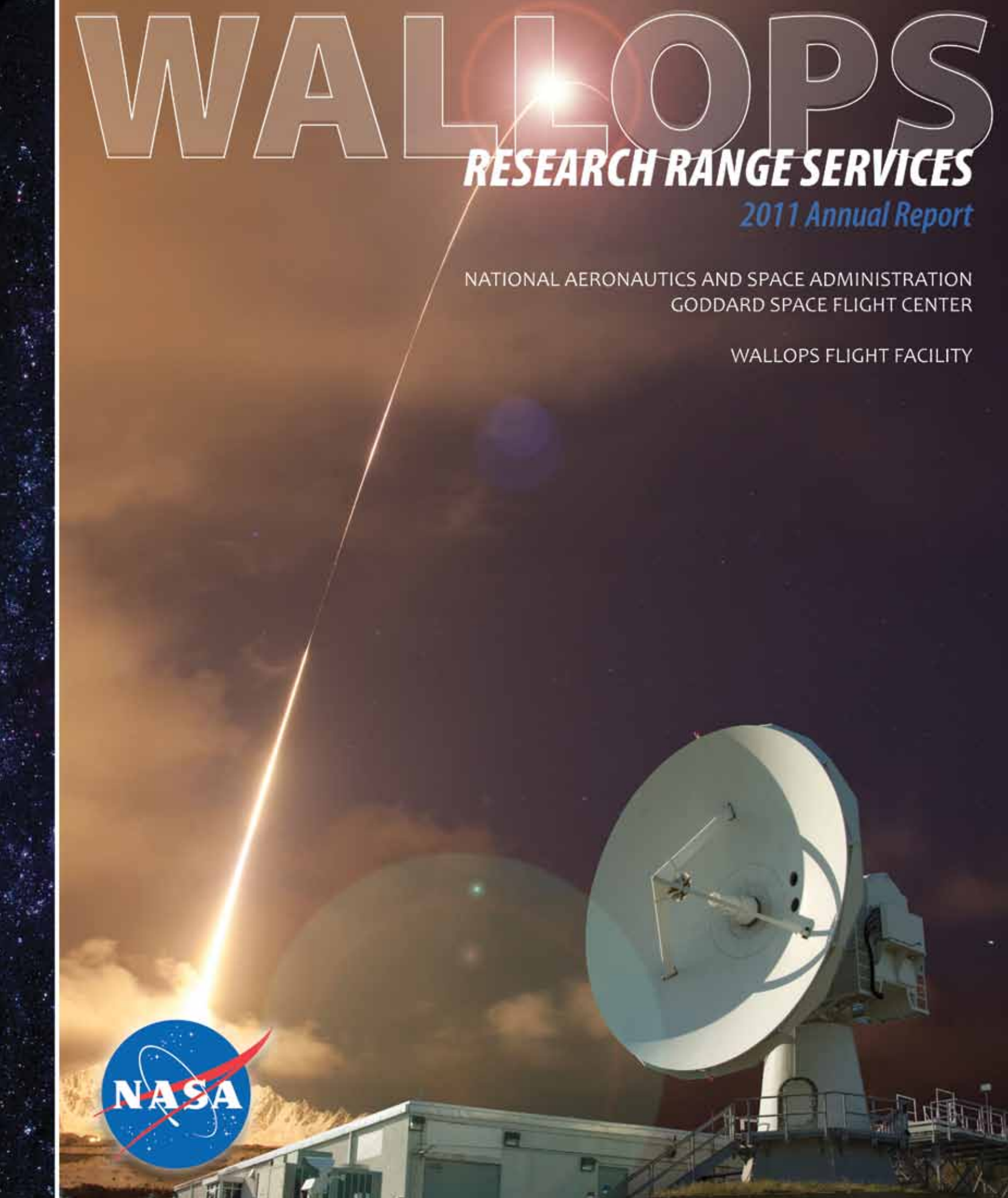
WALLOPS

RESEARCH RANGE SERVICES

2011 Annual Report

NATIONAL AERONAUTICS AND SPACE ADMINISTRATION
GODDARD SPACE FLIGHT CENTER

WALLOPS FLIGHT FACILITY



Jay Brown

The 2011 Research Range Services Annual Report is dedicated to Jay Brown. A valuable friend and member and member of the Range, Jay retired from Wallops Flight Facility in March 2011 as the Range and Mission Management Office Test Director.

Jay was a multitalented person who not only directed all NASA operations on the Research Range before his retirement but also found his stress-relief by participating in the Wallops Music Club. Jay was a fixture among fellow Wallops' musicians by playing the bass guitar and providing vocals.

Jay served in the U.S. Air Force from 1966 to 1970 as an electronics technician. In 1974, Jay earned his Bachelor of Arts degree in psychology from Loyola College in Baltimore Maryland, and started his career shortly after that same year. During his 37-year Wallops career, Jay supported campaigns around the world including places such as Peru, Antarctica, Canada, Greenland, Kwajalein Atoll and Puerto Rico.

The Research Range Services Program operates a full-service airport and has restricted airspace for aircraft such as the NASA P-3 to perform operational flights.

COVER
Launch of RENU sounding rocket in Norway

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INTRODUCTION

This year, the Research Range Services (RRS) Program continued their long-standing tradition of delivering consistently superior support to a myriad of customers. These customers include NASA's mission directorates, 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 Wallops Flight Facility (WFF), Poker Flat Research Range near Fairbanks, Alaska, and other remote locations such as the Andøya Rocket Range in Norway.

An Optical Systems Group technician prepares high speed cameras in a mobile optical dome.

RRS personnel support many flight vehicles including orbital and suborbital rockets, manned and unmanned aircraft, satellites, the Space Shuttle and research balloons. The summer was particularly busy as the Research Range provided services to launch an Air Force satellite into low-Earth orbit, assisted a university professor collecting atmospheric data, and supported multiple universities with a sounding rocket mission all within a two-week period. The RRS Program's dedicated, experienced and highly skilled engineers and technicians assured error-free and safe Range operations for real-time capture and display of mission-specific flight, payload and science data.

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

- A newly developed Range Operations Management System tool which allows effective management and control of Research Range configurations and documentation, maintenance, operations scheduling, asset management and discrepancy reporting, and a new digital imaging database 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 array of monitors to provide real-time display of all flight events
- An aeronautical research airport with special runway surfaces, arresting gear and restricted airspace.

WALLOPS

INTRODUCTION

- Fixed and mobile radar systems for tracking launch vehicles, satellites and aircraft
- Fixed and mobile telemetry systems to collect state-of-health and science experiment data
- Fixed and mobile optical and television systems
- Ground-based and aerial video and photography, professional archiving and 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 management and coordination
- Master station time equipment to synchronize Range activities and data

The RRS program also offers world class sustaining engineering and project management services to underwrite WFF's widely recognized status as a flexible, full-service, customer-friendly Research Range. The RRS Program's engineers and technicians routinely establish and verify instrumentation metrics, adapt Research Range instrumentation and optics to unique customer requirements, assist in performing root cause analyses, implement minor to moderate system upgrades, and perform link analysis calculations to ensure adequate radar, telemetry, and command support for an unparalleled diverse set of challenging missions. The RRS Program's engineers are also leading Research Range technology development activities sponsored by both NASA and the Department of Defense to support advanced mission planning systems and new in-flight communications and safety systems.

This fiscal year 2011 Annual Report highlights and spotlights the projects that continued our long track record of successfully, safely, efficiently, and professionally enabling research worldwide and of which, we, the RRS Program Team, are most proud.

The FPQ-6 Radar, known locally as Radar 5, is the most powerful radar system in the RRS arsenal.

PROGRAM MANAGEMENT OVERVIEW

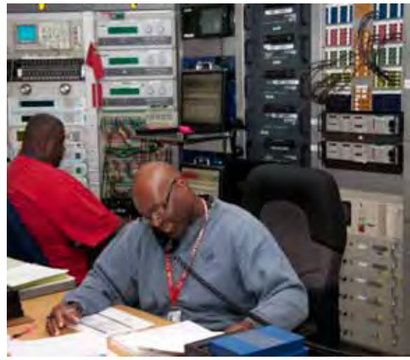
Directorate: Science Mission Directorate
Division: Heliophysics
Program Executive: Ms. Cheryl Yuhas
Program Manager: Mr. Steven Kremer
Lead Center: Goddard Space Flight Center
Performing Facility: Wallops Flight Facility
Program Type: Research Range Services

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, technicians, and other personnel into one cohesive team whose objective is to collect data from a multitude of flight platforms and payloads.

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

The RRS Program has a full roster of highly experienced Range Service Managers (RSM) who are ready to build, coordinate, and manage cohesive teams to tap the minds of engineers and involve the expertise of technicians. These teams work to configure mobile and fixed Range to provide services around the globe.

All operations conducted at Wallops Flight Facility (WFF) and other remote launch ranges, such as Poker Flat Research Range near Fairbanks Alaska and Andoya Rocket Range in Norway, require state-of-the-art technologies and multimillion dollar systems to support unmanned aerial vehicles, sounding rockets, expendable launch vehicles or any other flight platform. Each operation requires a total commitment to excellence.



At Wallops, effective management and integration of all aspects of mission support is where the rubber meets the road. In 2011, RRS Program personnel were responsible for Range instrumentation support for NASA orbital and sub-orbital programs and programs for other government and civilian agencies. They assured 100 percent success for a multitude of programs executed at WFF while simultaneously managing remote campaigns in Alaska and Norway and downrange tracking/command sites. Highly skilled RRS managers leave no stone unturned to:

- Ensure total success in meeting our customer's requirements through risk assessment and mitigation, comprehensive operator certification, configuration management, pre-mission testing, proven operating procedures, and post-mission support.
- Ensure a "green range" for all missions through effective corrective and preventive maintenance for all WFF facilities and equipment.
- Creatively use state-of-the-art engineering expertise and technology advancements to meet new mission requirements, improve Range safety, reduce operational costs and replace obsolete equipment.
- Provide expertise and management skills to oversee the 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.

From the initial dreams of a principal investigator through the completion of data analysis, the RMMO project managers in coordination with the RRS range services managers are the glue that bonds the talents and efforts of the extended team of professionals needed to ensure successful completion of every mission. Project managers take a back seat to no one; their vision, technical expertise and management skills are truly world class.

RESEARCH RANGE SERVICES ASSETS: $231.7 MILLION

Telemetry Systems	Per Unit	Qty	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	$1.0	2	$2.0
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	$12.0	2	$24.0
9-Meter System	$4.0	1	$4.0
MITS	$2.0	1	$2.0

Atmospheric Radars	Per Unit	Qty	Total ($M)
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	Qty	Total ($M)
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

Surveillance Radars	Per Unit	Qty	Total ($M)
Airport Surveillance Radar	$10.0	1	$10.0
Sea Surveillance	$1.0	1	$1.0
Pathfinder	$0.7	2	$1.4
Active Protective System	$2.5	1	$2.5

Command Support Systems	Per Unit	Qty	Total ($M)
Fixed UHF Command System	$4.0	1	$4.0
Mobile Command System	$1.4	1	$1.4
Mobile Range Control System	$2.1	1	$2.1
Radio Frequency Communication	$3.0	1	$3.0
Timing System	$0.8	1	$0.8
Video and Optical Systems	$12.0	1	$12.0
Mobile Power Systems	$0.3	4	$1.2

Range Control	Per Unit	Qty	Total ($M)
Range Control Center	$10.0	1	$10.0

RENU Mission in Norway

Research Range Services (RRS) personnel supported the launch of a Black Brant XII December 12, 2010, carrying the Rocket Experiment for the Neutral Upwelling (RENU) payload within the Arctic Circle at the rocket range in Andøya, Norway. The payload was designed to study electron precipitation and ion flow in the cusp of the aurora.

The rocket's fourth stage was a new Nihka Motor which had a limited flight history. RRS personnel determined due to this brief flight heritage, an off-axis tracking station was necessary in Tromsø, Norway. This additional tracking station is normally only utilized with medium-class expendable launch vehicles. RRS personnel transferred its largest and most capable telemetry antenna to track the rocket to receive, record, and display science data that was being "broadcast" from the science instruments in the payload. Working closely with Norwegian engineers and technicians, RRS personnel equipped Tromsø and Svalbard with full ground stations to provide telemetry data. This team configured telemetry systems, conducted data flows and properly trained all involved. Conducting operations in the Arctic Circle during December brings its own obstacles. During the setup, RRS crews were faced with tormenting weather conditions as the temperatures were below freezing and as hurricane force winds swept through the area.

Before the launch, a crew of RRS personnel traveled between Svalbard, Andøya and Tromsø multiple times within a nine-day period to oversee telemetry systems setup, slaving system setup, conduct data flows and training, meet with international officials and support operations discussions with Norwegian officials.

Prior to launch, RRS personnel conducted daily data flows, tests and satellite tracks. In addition, the mobile range took advantage of an opportunity to track another sounding rocket from Andøya. Personnel quickly set up the telemetry and supported the countdown of a German/Canadian sounding rocket, but did not track from either Andøya or Tromsø. This "test flight" proved invaluable by identifying configuration problems at the Tromsø site and helping refine the tracking concept of operations at the Andøya site. When it came time to track our primary mission, our Andøya crew tracked off the pad and the Tromsø crew acquired at T+11 seconds, right on the horizon.

"Telemetry support was outstanding," said John Hickman, operations manager for the Sounding Rockets Program Office at Wallops Flight Facility. "The WFF 7 meter tracked through the Nihka plume and provided good data until loss of sight."

FIRE and PolarNOx;

Motor Test launch - Poker Flat Research Range Missions

For a third straight year, the Research Range Services (RRS) Program at Wallops Flight Facility supported sounding rocket launches and conducted major activities at Poker Flat Research Range near Fairbanks, Alaska. During fiscal year 2011, RRS successfully supported three sounding rocket campaigns and two maintenance trips, ensuring missions in the frozen north were never left out in the cold.

During this campaign, the RRS Program demonstrated its ability to reach out and support operations around the world. In just more than a month, during the dead of winter, RRS personnel were required to relocate mobile telemetry assets used in Norway halfway around the globe to Poker Flat in time to support the 2011 winter campaign. To further complicate matters, another sounding rocket mission was planned to launch during this same time frame at the Wallops Research Range presenting a major stress on available instrumentation and operations personnel. Despite these difficulties, RRS rose to the challenge and successfully supported all three launches.

While in Alaska, harsh weather conditions ruled the day with temperatures consistently dropping to -40 degrees. Every day the team was required to drive nearly an hour north of Fairbanks, braving the snow-covered, winding mountain roads to provide crucial launch support during a four-week campaign. Despite the elements, Range personnel successfully supported two launches – the Far Ultraviolet Imaging Rocket Experiment (FIRE) and the Polar Night Nitric Oxide (PolarNOx) missions – January 28, 2011, and February 5, 2011, respectively.

As April arrived and the spring flowers began to pop up through the winter landscape, an unexpected mission also bloomed on the Poker schedule. A Black Brant motor test slipped onto the schedule for an April launch date. In less than two months, RRS organized, mobilized and shipped out to not only support this unexpected launch, but also to execute a maintenance mission in order to better ensure range operations for many years to come.

During this maintenance trip, the RRS team corrected a problem with one of the telemetry antennas, ensuring it could better support the launch and also performed a variety of other routine maintenance procedures. When an unexpected power surge hit the range after the launch, the RRS team did what they could with their remaining time to bring all the systems back online. They very nearly succeeded, leaving only one telemetry antenna issue for a future RRS crew. During the nearly five-week campaign, this dedicated RRS team performed required maintenance activities and supported the test launch of the Black Brant motor on April 26, 2011.

Always looking ahead, RRS again returned to Poker in August 2011 to install an upgrade in the communication system used throughout the range. This new system brings Poker Flat up to speed with current technology, improves maintenance capability, and has the added benefit of allowing users to tailor the communication system to their unique mission needs. Outside of the communication system upgrade, instrumentation site surveys were conducted to investigate potential upgrades and system relocations to ensure better support for all customers in the future.

Science Mission Directorate
WALLOPS
OPERATIONAL MISSIONS
& ACCOMPLISHMENTS

FIRE

LAUNCH VEHICLE:	Black Brant IX
MISSION:	36.257 UG (FIRE)
WALLOPS ID:	NRO-4938
LOCATION:	PFRR: Pad 3
LAUNCH DATE:	28 January 2011
LAUNCH TIME:	28:10:46:00Z
PAYLOAD:	Far-Ultraviolet Imaging Rocket Experiment (FIRE)

Polar NOx

LAUNCH VEHICLE:	Black Brant IX
MISSION:	36.256 UE (PolarNOx)
WALLOPS ID:	NRO-4937
LOCATION:	PFRR: Pad 3
LAUNCH DATE:	5 February 2011
LAUNCH TIME:	08:11:11Z
PAYLOAD:	Polar Night Nitric Oxide (PolarNOx)

Black Brant Motor Test

LAUNCH VEHICLE:	Black Brant IX
MISSION:	36.278 (BBIX Motor Test)
WALLOPS ID:	NRO-5008/X-112-271
LOCATION:	PFRR: Pad 3
LAUNCH DATE:	26 April 2011
LAUNCH TIME:	117:08:00:00Z
PAYLOAD:	SRPO Diagnostic Payload

SubTEC-V

Suborbital Technology Experiment Carrier Mission

Research Range Services (RRS) personnel continued their support of the Suborbital Technology Experiment Carrier (SubTEC) mission with the launch of a Terrier-Improved Orion sounding rocket from the Wallops Research Range on June 10, 2011.

This mission was the fourth flight of the SubTEC series and was configured to provide a reusable platform for development testing of sounding rocket and other technologies.

The RRS Program supported the mission with a full suite of Range services which included three tracking radar assets, telemetry, optical, meteorological, command and control and other services. See Figure 1.

Most sounding rockets leave Wallops launch pads without a hitch; however, range personnel faced what was classified as a misfire on June 9, 2011, as the rocket failed to ignite when commanded. Range personnel couldn't remember the last time a misfire occurred at the Research Range, but the Wallops Test Director enacted safety protocols and directed the Launch Pad Supervisor to evaluate the misfire, determine the cause, and provide input for a possible solution.

The Launch Pad Supervisor determined that the firing command never reached the vehicle – the result of a short circuit. Range personnel worked together with NASA's Sounding Rockets Program Office to determine the vehicle was not compromised and allowed the Test Director to proceed with launch operations the next day.

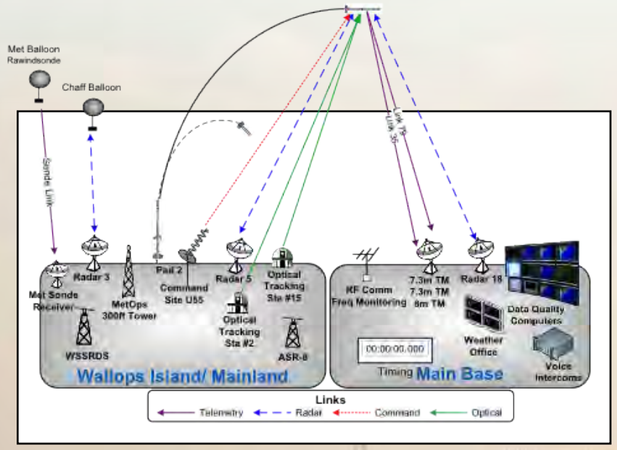


Figure 1: This graphic represents the RRS fixed range configuration for the SubTEC launch. This graphic enables RRS project managers to effectively communicate the range support approach to the entire Wallops community.

WALLOPS
OPERATIONAL MISSIONS
& ACCOMPLISHMENTS

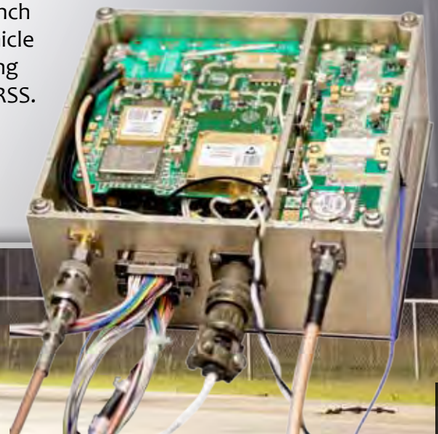
Science Mission Directorate

Range surveillance and payload recovery is another key service provided by the RRS Program. Primary investigators often need to evaluate data from the payload after the flight portion of the mission is over and in some cases, the recovered payload is often the only source of recorded data when real-time telemetry is not implemented. The RRS Program was tasked with locating the SubTEC-V payload and retrieve it from the Atlantic Ocean. Two surveillance aircraft and one recovery vessel successfully spotted and recovered the payload for a return trip to Wallops Fight Facility.

LAUNCH VEHICLE:	Terrier Improved Orion
MISSION:	SubTEC-V SMART
WALLOPS ID:	NRW-5007
LOCATION:	WFF: Pad 2 MRL
LAUNCH DATE:	10 June 2011
LAUNCH TIME:	07:16:00L
PAYLOAD:	NSROC TM Link 1 (2235.5) SMART TM Link 2 (2279.5)

LCT2

The Small Rocket/Spacecraft Technology (SMART) payload demonstrated Space Cube V1.5 avionics operations. RRS not only provided support for the sounding rocket but also supplied technology which transmitted telemetry data through NASA's Tracking and Data Relay Satellite System (TDRSS). The Low Cost Telemetry Transceiver (LCT2) is a software-defined transceiver developed at Wallops Flight Facility and enables two-way data transmission between a ground site and a launch vehicle using TDRSS.



Daytime Dynamo

In its continued efforts to support the academic research community, the Research Range Services (RRS) Program provided services for the July 10, 2011, launch of a sub-orbital mission known as "Daytime Dynamo", consisting of Black Brant V and Terrier-Orion sounding rockets.

The sub-orbital vehicles carried payloads to study the Earth's atmosphere and were launched only 15 seconds apart, requiring the range to configure its instrumentation to receive data from two vehicles.

The Daytime Dynamo mission required very specific atmospheric conditions to gather the data required by the research team and after several counts over the preceding days, these conditions were finally met. As fate would have it, the projected launch time corresponded exactly with a pass-over of not only the International Space Station (ISS), but also the Space Shuttle and the research team said the launch could not be slipped past its currently scheduled launch time.

LAUNCH VEHICLE:	Black Brant V (21.141)
MISSION:	Daytime Dynamo
WALLOPS ID:	NRW-4979
LOCATION:	WFF: Pad 2 ARC Launcher
LAUNCH DATE:	10 July 2011
LAUNCH TIME:	10:00:00L
PAYLOAD:	TM Link 1 (2235.5) TM Link 2 (2279.5)

Did You Know...

The Black Brant V vehicle carried instrumentation to measure the Earth's electric and magnetic fields, plasma and neutral density while the Terrier-Orion sounding rocket released vapor trails to provide a means to illuminate the neutral winds in the upper atmosphere.

This challenge proved the abilities of not only the RRS crew, but also the instrumentation they operated. In the months before the mission, it was decided that five radars would be supported—three on one vehicle, two on the other. The requirement was to have at least two radars per vehicle as part of mission assurance.

When the Space Station and Shuttle arrived at the party, the RRS team had to develop a plan that would allow them to support all three missions. Through the expert coordination and teamwork of the customer and RRS teams, the requirement for two tracking radars per vehicle was waived during the countdown and two radars were allowed to break away from launch support to fulfill their ISS/Shuttle missions, leaving the remaining three to track the vehicles. Of those three, two radars were assigned to track the first vehicle, leaving the last radar to stand alone and track the second vehicle.

As the rockets blasted into the sky, crews and instrumentation performed outstandingly, including the stand-alone radar, allowing the research team to gather their atmospheric data and NASA to obtain the tracking data needed for the ISS and Shuttle.

RRS believes in the power of teamwork and open communication and this launch provided a perfect example of what can happen when all parties work together.

LAUNCH VEHICLE:	Terrier-Orion (41.091)
MISSION:	Daytime Dynamo
WALLOPS ID:	NRW-4980
LOCATION:	WFF: Pad 2 MRL Launcher
LAUNCH DATE:	10 July 2011
LAUNCH TIME:	10:00:15L
PAYLOAD:	TM Link 1 (2215.5) TM Link 2 (2259.5)

Terrier Mark 12 Test Flight

In July 2011, just three months prior to Research Range Services (RRS) Program's next sounding rocket campaign support requirement in Norway, a problem was discovered with the 1970's era Terrier Mark 12 solid rocket – managed by the Sounding Rockets Program Office.

During a refurbishment process for the 1970's era technology, it was discovered that the motor's propellant had undergone some shrinking. The problem resulted in out-of-length specifications and reduced the spring load on the cartridge. A solution consisting of a steel spacer plate at the fore-end of the cartridge was developed and implemented, but required a test flight to verify its functionality and characterize the modified motor's performance.

The Terrier Mark 12 Test Flight was quickly developed and carried out at the Wallops Research Range. The entire project progressed at supersonic pace from planning to execution, completing launch activities less than a month from initiation. The accelerated tempo was necessary, as the tests were accomplished just in time to keep the 2011 Norway deployment on-schedule. The test flight was an unconditional success, verifying the effectiveness of the steel spacer and providing crucial data for predicting stage performance of future science missions for the customer.

The Range employed both radar and telemetry assets to track the rocket, but unlike most missions, the critical portion of the trajectory was just the first 6 seconds of launch rather than near apogee. This meant that all systems needed to immediately acquire and track the Terrier Mark 12 at liftoff with no room for error. Wallops operators and instrumentation were up to the task and produced flawless vehicle telemetry and tracking data.

The Terrier was the U.S. Navy's first operational shipborne medium-range surface-to-air missile. The flight tests of the Terrier began in 1951, and the Terrier became operational on Navy surface ships in 1956. It was designated the SAM-N-7 and underwent several enhancements before its eventual retirement from military service in the late 1980s.

LAUNCH VEHICLE:	Terrier Mark 12
MISSION:	Modification Test Flight
WALLOPS ID:	NRW-5046
LOCATION:	WFF: Pad 2 MRL Launcher
LAUNCH DATE:	8 September 2011
LAUNCH TIME:	09:45:00L
PAYLOAD:	N/A

Viking 300 UAV - NASA UAV Tech Project Demonstration

The smallest of the flight vehicles supported by the Research Range Services (RRS) Program is the unmanned aerial vehicle (UAV). Some of these aircraft have a wingspan of no more than 4 feet but play an important role in the collection of earth and atmospheric science information.

The busiest UAV project during fiscal year 2011 was the NASA UAV Tech Project. Pilots completed flights to collect attitude and navigation data and other proficiency flights to prepare for operations for their APPLANIX, INMARSAT, mini-ATM and Photometric payloads.

The Range team provided a 1,500-foot UAV runway located on the shores of the Research Range, communications, weather forecasting, frequency monitoring, air and video surveillance, and project management. The Range team remained flexible during the missions due to required flight weather conditions coupled with ongoing local Navy and Taurus II operations that impacted the availability of airspace and safe operating conditions.

2011 Flight Dates:

Oct. 7-8, 2010
Feb. 16, 2011
May 13, 2011
Sept. 11, 2011

SpaceX

Research Range Services (RRS) personnel continue to be at the cutting edge of addressing tomorrow's space transportation needs. RRS joined forces with NASA's Johnson Space Center to support SpaceX's Commercial Orbital Transportation Services (COTS) Demonstration Flight 1, SpaceX's first launch under NASA's COTS Program. The two-stage Falcon 9 expendable launch vehicle took flight from Cape Canaveral, Fla., December 8, 2010, to deploy the Dragon spacecraft. The Dragon's role on future launches will be to resupply the International Space Station (ISS) with supplies and eventually carry crew members to the ISS. NASA is partnering with commercial companies like SpaceX in a symbiotic and highly productive relationship to develop and demonstrate space transportation capabilities.

The Dragon spacecraft separated from the second stage and demonstrated operational communications, navigation, maneuvering and reentry capabilities. For this demonstration flight, Dragon orbited the Earth as SpaceX tested all of its systems and subsequently initiated thruster firing to begin reentry, returning the Dragon capsule to Earth for a Pacific Ocean splashdown off the coast of California.

Research Range Services provided command uplink, telemetry, and radar support throughout the mission. Powerful RRS antennas provided tracking, receiving, and processing of telemetry data and video from Dragon during the launch and subsequent orbit as it passed over the Research Range. RRS played a pivotal role in mission success by providing SpaceX back-up S-band Command Uplink support for the Dragon capsule and radar tracking during the launch and ascent phase and the first orbit to the U.S. Air Force's Eastern Range.

Research Range Services personnel provided command uplink, telemetry, and radar support throughout the mission for this Falcon 9 expendable launch vehicle.

SpaceX conducted comprehensive tests of the Dragon spacecraft as it orbited the earth.

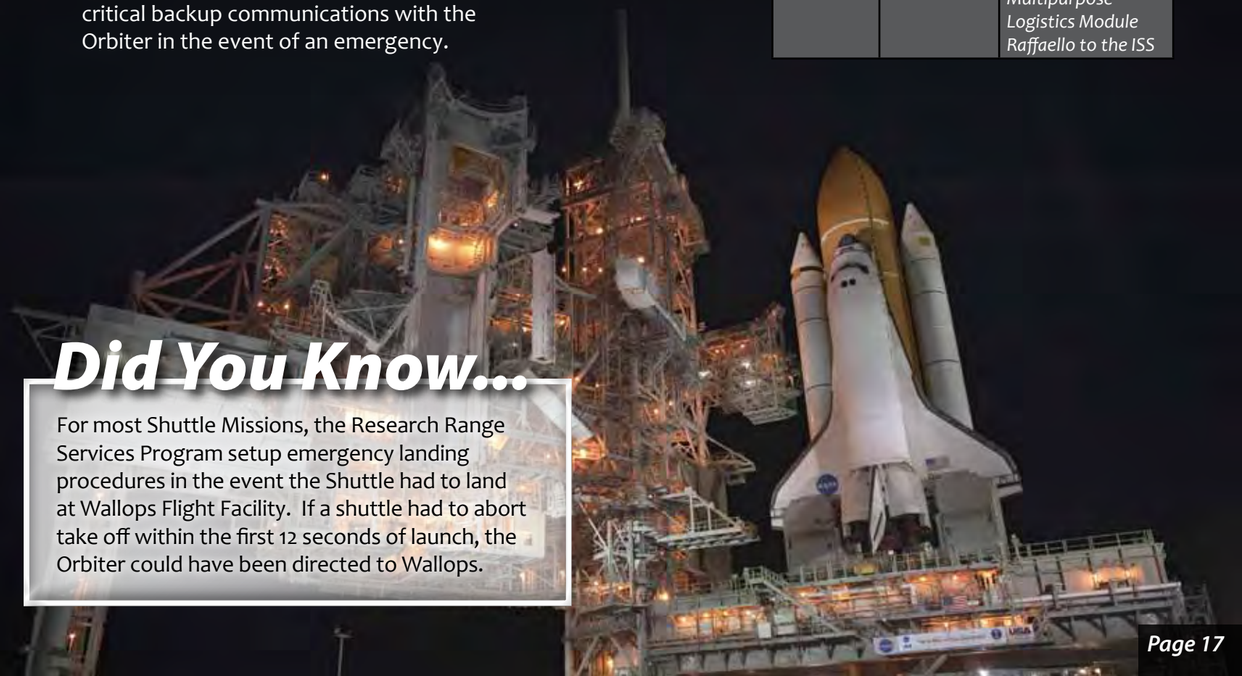
Space Shuttle Missions

During fiscal year 2011, Research Range Services (RRS) personnel supported the final three Space Shuttle missions. Overall, more than 400 passes were tracked with valuable data transmitted to Eastern Range controllers and Johnson Space Center (JSC) navigators as part of pre-launch, launch and on-orbit mission activities.

The Range's two main radars shared the workload of simultaneously tracking the Orbiter and the ISS during the rendezvous and separation phases of the mission. Without this tracking, the mission control team would not have had an independent tracking source during those final critical minutes to make performance assessments and, if necessary, an abort determination. Prior to each launch, Range tracking radars, telemetry, and command systems personnel worked with the Eastern Range controllers, Goddard Space Flight Center (GSFC) network managers and JSC navigators to ensure RRS system readiness.

Voice circuits were thoroughly tested with GSFC and JSC prior to launch to ensure critical backup communications with the Orbiter in the event of an emergency.

Operation	Date	Mission
STS-133	24 Feb. 2011 - 9 Mar. 2011	Discovery's 39th and final mission. Crew delivered the Permanent Multpurpose Module Leonardo to the ISS
STS-134	16 May 2011 - 1 June 2011	Endeavour's 25th and final flight. Crew delivered the Alpha Magnetic Spectrometer and the ExPRESS Logistics Carrier to the ISS
STS-135	8 July 2011 - 21 July 2011	Atlantis flew the Space Shuttle Program's final mission. Primary cargo was the Multipurpose Logistics Module Raffaello to the ISS



Did You Know...

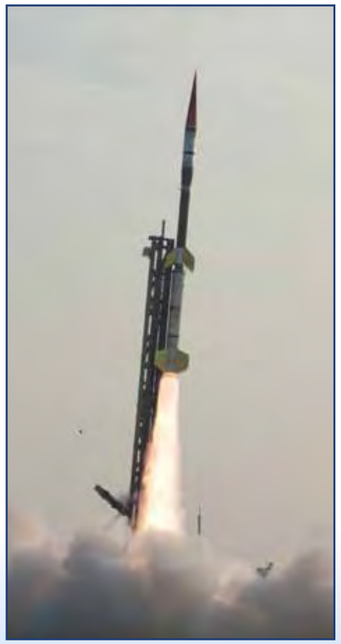
For most Shuttle Missions, the Research Range Services Program setup emergency landing procedures in the event the Shuttle had to land at Wallops Flight Facility. If a shuttle had to abort take off within the first 12 seconds of launch, the Orbiter could have been directed to Wallops.

Track-Ex Navy Sounding Rocket

The Research Range Services (RRS) Program supported a U.S. Navy tactical sounding rocket operation, which took flight from Wallops Flight Facility's Research Range in the early morning hours of January 22, 2011.

The Navy Aegis Readiness Assessment Vehicle Type B mission, more commonly known as ARAV-B Track-Ex, was a two-stage Terrier-Oriole sounding rocket which simulated tactical contact for Navy Fleet ship-board systems and instrumentation. Three Navy ships – USS Monterey, USS Ramage and the USS Gonzalez – participated in the exercise and all successfully tracked the missile target.

Preparation and ultimate support for this mission had its challenges as RRS personnel and equipment were split between the Research Range at Wallops and the Poker Flat Research Range near Fairbanks, Alaska. Successful and simultaneous missions from one end of the country to the other displayed the range's flexibility and mobile capabilities as radar, telemetry, optical and command and control performed flawlessly.



Range instrumentation is the avenue that provides data to the RRS program and its customers to proceed with launch. With the count active and proceeding at the 90-second mark, wind speed data collected from a weather balloon radiosonde indicated winds were too strong for launch. The count was stopped until winds were at an acceptable limit.

LAUNCH VEHICLE:	Terrier-Oriole
MISSION:	Navy ARAV-B Track-Ex
WALLOPS ID:	NRW-4967
LOCATION:	WFF: Pad 2 MRL Launcher
LAUNCH DATE:	22 January 2011
LAUNCH TIME:	01:10:00L
PAYLOAD:	Nose Tip (Primary) Oriole (Secondary)

Other services provided consisted of radio frequency monitoring, range control and surveillance.

WALLOPS
DEPARTMENT OF DEFENSE SUPPORT

Did You Know...

Conducting operations safely is not compromised on the Research Range. In order to keep those high standards, a new sea surveillance radar system was engineered which paid immediate dividends as it located two small vessels traveling toward the hazard area. However, the surveillance coordinator was able to make contact with the vessels to keep the Range green for launch.

Operationally Responsive Space-1 (ORS-1)

The Research Range Services (RRS) Program supported the Operationally Responsive Space-1 (ORS-1) launch from Pad 0B June 29, 2011, aboard a Minotaur-I vehicle. This successful mission was the fourth Minotaur to leave the shores of the Research Range in the past four years. With this mission, RRS continued its collaboration with the U.S. Air Force and Orbital Sciences Corporation.

ORS-1 is the first satellite in the Department of Defense's Operationally Responsive Space program designed to support Combatant Command operations as a directly tasked surveillance satellite. The mission focused on the quick deployment of a small satellite with innovative sensor technologies to provide real-time support to commanders in the battlefield. It incorporates a modified version of the SYERS-2 optical sensor used in the U-2 aircraft.

The RRS Program employed all available range support assets to support this mission including radar, telemetry, optical, meteorological, command and control, communications, surveillance and other services. This included a deployment to Coquina, N.C., with mobile radar, telemetry and command assets. The remote configuration was necessary at this location to acquire and relay real-time data from the launch vehicle during the second- and third-stage rocket burn while the primary assets at Wallops were attenuated by plume exhaust. Additionally, RRS coordinated with the Eastern Range to utilize the Air Force telemetry assets in Antigua to deliver real-time data.

Mission success for this operation focused on weather and meteorological operations and the Range's ability to handle weather-driven events. Weather and meteorology services dealt admirably with very difficult weather conditions. They were able to clearly predict conditions at the pad during the first launch attempt with a powerful electrical storm approaching, thus allowing a scrub to be declared early enough for critical stand-down actions to occur before inclement weather entered the area. The storm caused equipment failures throughout the Range, including electrical damage to communication systems, the timing system, optical sensors and multiple radar systems. Despite this, RRS brought all systems back on line during pre-mission setup and the following day's countdown proceeded nominally for all Range instrumentation.

To support the comprehensive weather analysis for this mission, RRS acquired high-resolution weather balloons and developed procedures for their implementation specifically to support this launch – the first use of this technology at WFF!

WALLOPS
DEPARTMENT OF DEFENSE SUPPORT

LAUNCH VEHICLE:	Minotaur-I
MISSION:	ORS-1
WALLOPS ID:	W-23-820
LOCATION:	WFF: Pad 0B
LAUNCH DATE:	29 June 2011
LAUNCH TIME:	23:09:00L
PAYLOAD:	ORS-1 Spacecraft

Patuxent River Aircraft Support

Research Range Services (RRS) personnel continued to provide support to the research, test, development, and evaluation of various aircraft and instruments that are owned and operated by the Naval Air Warfare Center Aircraft Division (NAWCAD) at Patuxent Naval Air Station, Md. The Wallops Research Range boasts of a full-service airport with two 8,000-foot runways and routinely supports aircraft such as the F-18, F-35, P-8, MH-60 and Search and Rescue (SAR) helicopters.

Wallops Flight Facility has supported the Navy with ongoing projects since 1996. During the course of the past year, 903 flight events spanning 271 days were supported by RRS.

RRS provides project management, engineering, range instrumentation, airfield support, operations day coordination, and products necessary to meet the Navy's requirements. The aircraft are provided with daily telemetry data capture/relay, fuel and air traffic management six days a week. On occasion, certain missions also require radar, command, communications and frequency monitoring services.

TacSat-4 Support

The Range and Mission Management Office (RMMO) supported the launch of TacSat-4 from the Kodiak Launch Complex, Kodiak, Alaska, on September 27, 2011. RMMO provided project management and coordinated flight and ground safety services for the U.S. Air Force customer. The payload was a U.S. Navy communications satellite which was placed into low-Earth orbit aboard a Minotaur IV+ expendable launch vehicle.

TacSat 4 is the fourth in a series of U.S. military experimental reconnaissance and communication satellites. The TacSat spacecrafts are designed to allow military commanders on a battlefield to request and obtain imagery and other data from a satellite as it passes overhead. Collected data will be delivered to field commanders in minutes rather than hours or days.

This is the second Minotaur mission supported by Wallops from the Kodiak Launch Complex. Both missions were sponsored by the Operationally Responsive Space (ORS) office.

WFF Flight Safety was lead on both missions using the Kodiak Range Safety Telemetry System (RSTS). All prelaunch documentation and testing was performed using WFF procedures and processes.

EDUCATION & PUBLIC OUTREACH

The Range Research Services (RRS) Program has historically participated in developing future astronauts, engineers and technicians. Each year, many universities launch rockets carrying various payloads to introduce students to rocketry and science data collection . These two programs are supported to further the education of curious minds and introduce students to the world of technology. Other initiatives are created to introduce America's youth to the high-tech world of NASA. The following operations and programs were conducted in the past year to excite and motivate the nation's next generation.

Wallops Rocketry Academy for Teachers and Students: July 14-15, 2011

With the increasing importance of Science, Technology, Engineering and Math (STEM) education, the Sounding Rockets Program Office (SRPO) is interested in supporting the local education community by establishing a rocketry workshop program, the Wallops Rocket Academy for Teachers and Students (WRATS). After conducting a pilot program in the summer of 2010, with the NASA Sounding Rocket Operations Contract (NSROC) interns, the workshops now offer annual school participation. During the three- to five-day workshops, participants build, test and fly model rockets. The intent of the workshops is to familiarize students and faculty with using model rockets as educational tools.

The launch window for the WRATS program was scheduled with the Wallops Flight Facility Test Director and all appropriate supporting personnel including the Research Range Services (RRS) Air Traffic Control Tower. The model rockets launched from a suitable location on the airfield.

The vehicles used in the WRATS program are standard model rockets, constructed to the manufacturer's specifications by the participating students and teachers. Other vehicles to be used for the program will be either various ESTES model rockets or the HV ARCAS scale model of the ARCAS sounding rocket, manufactured by Aerotech.

WALLOPS
EDUCATION
& PUBLIC OUTREACH

University Student Launch Initiative (USLI)

The Research Range Services (RRS) Program provided Range services to the University Student Launch Initiative (USLI) for Level 2 rockets launched May 21, 2011. RRS support included optical tracking and high speed video, timing, frequency monitoring, two prime tracking radars and one backup, airspace surveillance, sea surface surveillance and weather office information.

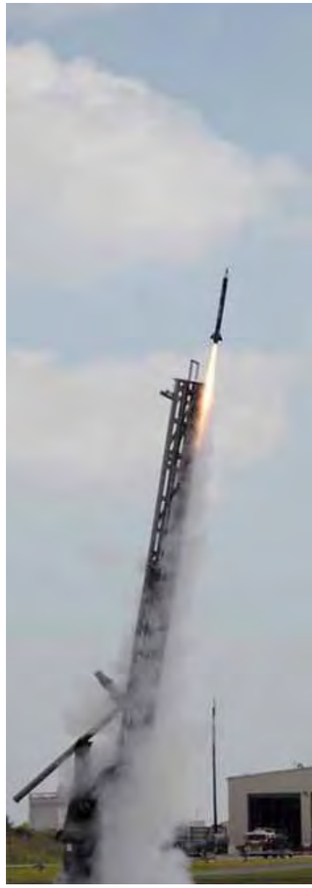
LAUNCH VEHICLE:	MCC High-Powered Model Rocket
MISSION:	USLI - Level 2 (Mitchell Community College
WALLOPS ID:	NRW-4984
LOCATION:	WFF: Pad 2 MRL
LAUNCH DATE:	21 May 2011
LAUNCH TIME:	141: 1620+05z

LAUNCH VEHICLE:	MSU High-Powered Model Rocket
MISSION:	USLI - Level 2 (Mississippi State University)
WALLOPS ID:	NRW-4983
LOCATION:	WFF: Pad 2 MRL
LAUNCH DATE:	21 May 2011
LAUNCH TIME:	141: 1858+05z

LAUNCH VEHICLE:	"Aethon" High-Powered Model Rocket
MISSION:	USLI - Level 2 (Univ. of Alabama - Huntsville
WALLOPS ID:	NRW-4985
LOCATION:	WFF: Pad 2 MRL
LAUNCH DATE:	21 May 2011
LAUNCH TIME:	141: 1431+03z

Each school participated in a lottery to determine launch sequence: University of Alabama Huntsville won and launched first without incident with their vehicle reaching apogee at 12,346 feet. Mitchell Community College, Statesville, N.C., successfully launched its rocket second reaching apogee at 4,648 feet, and finally the Mississippi State University team successfully launched, and their vehicle reach an altitude of 7,776 feet.

All three payloads were successfully recovered offshore by the Range's surveillance and recovery team and returned to the student teams for analysis.



RockSat-X: July 21, 2011

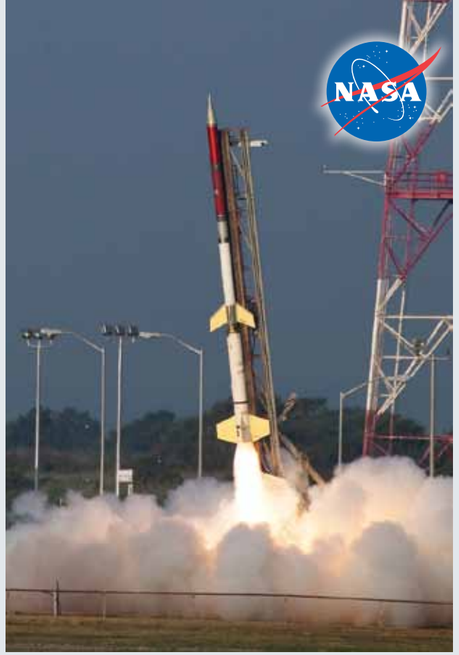
RRS provided support and Range services to a Terrier-Improved Orion July 21, 2011. RRS support included optical, timing, frequency monitoring, two prime tracking radars and one backup, telemetry downlink, air and sea surveillance consisting of two ships and two aircraft and meteorological data.

LAUNCH VEHICLE:	Terrier Improved Orion
MISSION:	RockSat X
WALLOPS ID:	NRW-5013
LOCATION:	WFF: Pad 1
LAUNCH DATE:	21 July 2011
LAUNCH TIME:	07:58:00L
PAYLOAD:	TM Link 1 (2235.5) TM Link 2 (2279.5)

Recovery was provided using the contract vessel Thomas Reed, with both aircraft attempting to locate the payload and dye markers. Onboard the vessel was a reporter from a Salisbury, Maryland news station. Clouds in the area severely hampered the ability of the aircraft to locate the payload; however, personnel on the Thomas Reed were able to spot and retrieve the payload.

RockOn-IV: June 23, 2011

RRS provided operational support for the RockOn-IV mission, which is a myriad of college students coming together for one mission. RockOn-IV is an annual, recurring mission associated with the RockOn workshop held at NASA Goddard Space Flight Center's Wallops Flight Facility (WFF) each summer. This workshop provides college students and instructors with a hands-on, university-level rocket flight training experience. The workshop is a collaborative effort by the Colorado Space Grant Consortium (CSGC), the Virginia Space Grant Consortium (VSGC) and WFF. A two-stage Terrier-Improved (Mk12) Orion sounding rocket was used to transport student payloads and was successfully launched June 23, 2011.



The RRS support included precision tracking radar, range timing and communications, radio frequency monitoring, sea and air surveillance, range data processing and display, payload recovery, meteorological data, and optical tracking.

The RockOn-IV Terrier-Improved Orion reached an altitude of 392,583 feet.

LAUNCH VEHICLE:	Terrier M12 - Improved Orion
MISSION:	RockOn-IV
WALLOPS ID:	W-113-838
LOCATION:	WFF: Pad 1 50K
LAUNCH DATE:	23 June 2011
LAUNCH TIME:	174: 10:1759Z
PAYLOAD:	Student RockSAT-C & W Experiment Canisters

Shaping Tomorrow's Engineers

The Research Range Services (RRS) Program routinely invites local students, from elementary school through university, to help shape tomorrow's engineers, medical professionals, and yes, maybe even the country's next astronaut! This past fiscal year, RRS has educated 595 students during 25 tours of Wallops Flight Facility. The students are introduced to the scientific facilities on base, put their hands on hardware being fabricated for upcoming missions, and even get to participate in a launch countdown so they understand the intricacies of putting a launch vehicle in the air.

Students come from all walks of life including local elementary schools, the Boy Scouts, Civil Air Patrol and numerous colleges. RRS project managers and other NASA employees routinely volunteer their time during the duty day to share their career experiences at Wallops for the tour members.

Schools:
Stephen Decatur Middle School
Moravian Academy
White Marsh Elementary
Baylake Pines School
Salisbury Middle School
University of Maryland Eastern Shore
Worcester Preparatory School
Salisbury Baptist Academy

Children's Groups:
Marine Science Consortium
Eastern Shore Rocketry Challenge
Reach for the Stars
Salisbury University Science Camp
Virginia Spaceflight Academy
Boy Scouts of America
Civil Air Patrol Cadets
NASA Develop Team

NASA Robotics

Robot 3389, a product of students at Parkside High School in Salisbury, Maryland, competes at the Chesapeake Regional March 19, 2011.

Another NASA program for young people is the NASA Robotics Alliance Project, which was designed to inspire students to pursue careers in Science, Technology, Engineering, and Math (STEM) through robotic competitions and activities. Since the program has a small budget, RRS stepped in to provide logistical support to transport technical equipment for a for a For the Inspiration and Recognition of Science and Technology (FIRST) Robotics team to Baltimore for a competition.

Travel for the robotics program can drain finances quickly. RRS again stepped in to provide technical assistance and equipment for a sponsored video-game tournament held at Wallops in April 2011. The tournament was sponsored by the NASA House Team 1829 to raise funds.

RRS also provided extra support by driving a 15-passenger van to St. Louis from April 27 to May 2, 2011, to assist the robotics program participating in the FIRST Robotics World Championship.

RRS prides itself in outreach to students to help spark interest in the minds of young people who might be looking for a career in space or science. Since the robotics program has a difficult time finding organizations to assist their cause with resources, time and personnel, RRS will continue to assist this initiative.

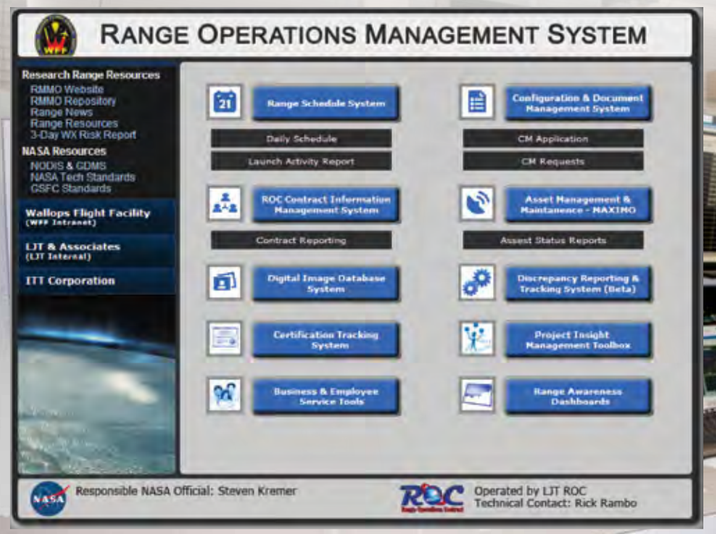
Students from around the Delmarva Peninsula attend the For the Inspiration and Recognition of Science and Technology (FIRST) robotics competition at the Chesapeake Regional March 19, 2011.

ROMS

The Range Operations Management System (ROMS) provides a "one stop shop" for information management and access to applications used within the Research Range Services (RRS) Program. The ROMS application cloud serves RRS personnel as a launch pad for applications used to maintain and operate Range assets, as well as record and control mission and project planning. RRS management access the ROMS to establish task orders and assign projects to the Range Operations Contract (ROC).

ROMS is also a growing repository of information for the work performed within the RRS. The Range schedule and launch activity is reported within the scheduling services. Range asset status is reported from the Maintenance and Asset management system combined with the discrepancy reporting system – both contained in the ROMS.

The ROMS structure permits growth and development as information needs expand in the RRS. There are several new developments underway to improve cost, schedule, risk, and task planning and management. ROMS is also used to research past projects in its document repository and Lessons Learned Library soon to be released.



Video Distribution

Taurus II launch operations required a more sophisticated video distribution system capable of transmitting HD-SDI video formats from Launch Pad 0A to the Launch Control Center (LCC) and ultimately to the Range Control Center (RCC). The Video Working Group, led by RRS personnel, engineered a new fiber-based system capable of distributing up to 48 video signals with extremely low latency.

The LCC receives the video signals from Pad 0A and distributes that to four critical view stations for safety officials and engineers to make real-time decisions during the launch countdown. The video is then regenerated for the fiber system and sent to the RCC and ultimately the base cable television system.

Video Recording

Distributing the video during the countdown is critical; however, all signals must be recorded in case forensic analyses are required post launch. Once again the RRS Video Working Group engineered a system capable of ingesting 40 HD-SDI native video formats and recording. Once the video is collected, the new system is capable of coding the video in numerous formats to meet the needs of the Range. For instance, the recording system feeds the analog video switch for video distribution in the Range Control Center while simultaneously sending a digital format to the to the cable television head end unit for dissemination base-wide and to other video feeds within the NASA office of Communications System.

The recording system also acts as a storage location until post processing of all recorded sources is conducted. Once all deliverables are met, RRS technicians will ready the recording system for the next operation.

Telemetry

Telemetry capability has been upgraded throughout the Range in order to support the requirements of processing five simultaneous links of data from the launch vehicle. This includes upgrades to receiving, processing, routing and recording capability at WFF Fixed Telemetry, Telemetry Readout, and mobile systems at both Coquina, N.C. and Bermuda locations.

The Mobile Integrated Telemetry System (MITS) will provide the Research Range the capability to track, receive, process and record up to five telemetry links. MITS will be integrated with one of the mobile 7-meter telemetry antenna systems and be located in Bermuda to support TII operations, but is also a self-contained telemetry system that can be deployed on mobile campaigns supporting other Research Range missions around the globe. The system incorporates the latest in technology including a new antenna control unit, telemetry receivers, bit synchronizers, IRIG-B chapter 10 telemetry recorders and telemetry over IP gateway processors. Research Range Services personnel completed this challenging project from conception to design to operational readiness in less than 10 months.

Fixed telemetry processors are also being replaced in order to convert the primary vehicle data link parameters into the proper format for tracking data and safety display. The engineering work has been completed to confirm this new capability and testing is underway.

Range Timing

The range timing system has been upgraded to provide expanded capability. A completely new system is in development, including improved clock displays and timing generators, which will allow the range to process and display multiple formats for both Universal Time Code and Program Time to support mission operations.

Weather Systems

RRS completed efforts to expand the weather forecasting capabilities by obtaining remote weather systems and integrating those with the existing WFF system. These remote systems are to be deployed to Coquina, N.C. and other remote support sites to provide downrange conditions to the launch team. Furthermore, improvements to the Leading Environmental Analysis and Display System (LEADS) allow these additional sensors to be displayed and greatly improves the graphical interface for all weather data.

Marine Band Radio Upgrade

RRS completed the installation, testing, and documentation of the new Marine Band Radio System. This system was used on all missions during the last six months and improves performance during surveillance operations to ensure reliable communications up to a range of more than 70 miles.

Radar Boresight Trigger and Control

RRS completed the Radar 18 bore sight trigger and control upgrade by enhancing the system control over a more reliable fiber network instead of the previous unreliable buried copper network. This system was used for shuttle support, so a reliable solution was needed. In collaboration with other NASA codes, the RRS team led the group to complete the project and minimized the loss of range availability.

WALLOPS
PROGRAM MODERNIZATION

Wallops MOVE

The purpose of the Mission Operations Voice Enhancement (MOVE) Project is to replace existing mission voice system with Commercial Off-the-Shelf (COTS) products suitable to meet the mission voice conferencing and voice recording requirements at all NASA Centers and locations.

The newly updated communications system now has a robust architecture for managing voice conferencing to provide improved mission support. Mission voice systems now meet the high availability and expectations required for mission critical infrastructure. The systems have a built-in expansion capability sufficient to support the expected increase in required voice services for no less than 10 years of continued mission operations.

The system is controlled and configured locally. Interfaces are standards-based, leveraging the advantages of future technology while providing for transition from today's legacy systems in a manner that minimizes impact to system users.

The Wallops Research Range Services personnel successfully completed the installation of the MOVE digital voice system at the Wallops Research Range. This enhancement to the range's communication system will supply missions reliable communications required during countdowns and daily operations at the Wallops Research Range.

Poker MOVE

The Research Range Services (RRS) Program upgraded voice communications with a Mission Operations Voice Enhancement (MOVE) system at Poker Flat Research Range (PFRR) near Fairbanks, Alaska. RRS engineers selected a state of the art, commercial-off-the-shelf product capable of meeting all voice conferencing and voice recording requirements.

The PFRR installation challenged RRS engineers due to the range's remote location and extreme weather conditions. RRS project managers worked the planning phase to ensure a smooth installation process during a relatively small window that began in April 2011. This gave engineers and technicians a 4- to 5-month schedule to install the entire new infrastructure before the start of the Alaskan winter when temperatures routinely dip below 40 degrees Fahrenheit.

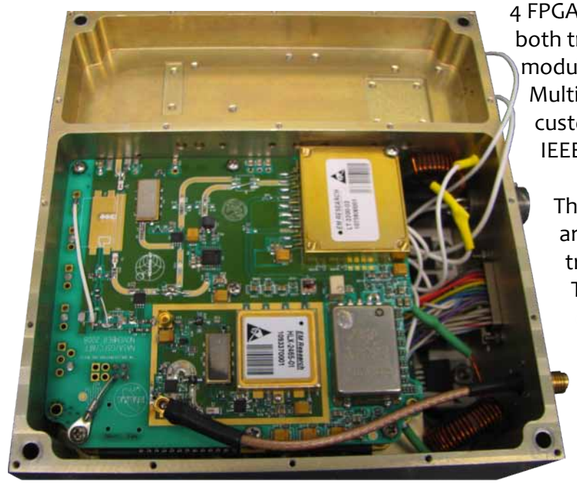
The MOVE system was installed in July 2011, and the remaining infrastructure installation was completed during the PFRR summer maintenance trip in late Summer 2011.

This upgrade at PFRR will supply the range with reliable communications required during mission countdowns and reliable communications during daily operations.

Low Cost OFDM Transceiver

The RRS Technology Development Group continued the development of the Low Cost Orthogonal Frequency-Division Multiplexing Transceiver (LCOT). The goal of this project is to develop a low-cost transmit and receive communication system providing Orthogonal Frequency-Division Multiplexing (OFMD) modulation on a flight proven platform to be used for aeronautical telemetry.

The previous transmit-only communication systems utilized a Xilinx Virtex II FPGA used for baseband data filtering and unit monitor and control. An upgraded board based on a Xilinx Virtex 4 FPGA has been designed and built that incorporates both transmit and receive capability. This LCOT module transmits Orthogonal Frequency-Division Multiplexing signals at 10 watts out through a custom high power amplifier and conforms to the IEEE 802.11.g spectral mask.



The main building blocks of the LCOT module are the DC/DC converter, mezzanine board, transceiver board and the high power amplifier. The RRS personnel have focused their efforts this year on bringing together all the subsections of the LCOT module so that the interface between them is seamless. After completion of all the subsection testing, the final module configuration will be tested and then delivered tothe customer, the U.S. Air Force, for flight testing at Edwards AFB.

Autonomous Flight Safety System

The RRS Technology Development Group continued to provide engineering services for the development of the Autonomous Flight Safety System (AFSS) throughout fiscal year 2011. The AFSS is a NASA project to develop algorithms and software for an autonomous onboard system that can augment or replace the function of the traditional human-in-the-loop ground commanded flight termination Range Safety System.

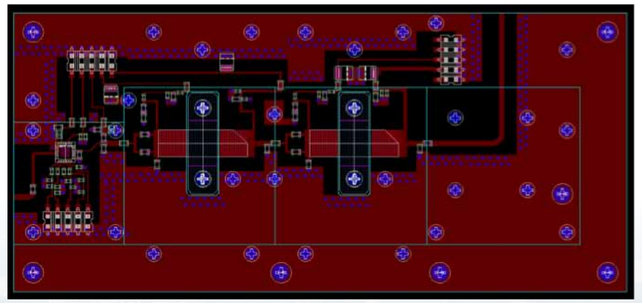
The goal of this project is to develop an autonomous flight termination system meeting the requirements of the Range Commanders Council for autonomous systems, RCC-319.

The software is currently undergoing independent verification and validation at the NASA IV&V facility. The team is also working with other agencies and companies to develop commercially available flight hardware systems to host the software.

WALLOPS
PROGRAM MODERNIZATION

Next Generation SmallSAT Low Cost Telemetry Transceiver

The RRS technology development group continues to support the SmallSAT project with the objective of providing a new more efficient amplifier design to be used for power-limited missions, such as UAVs. During fiscal year 2011, RRS successfully prototyped the newly-designed power amplifier and recently started final testing and layout. This design reduces the typical DC power consumption by almost 50 percent. With the ability to apply lessons learned from challenges faced in the past, the project team prototyped each individual stage of the power amplifier obtaining more accurate S-parameter measurements to compare to the vendor provided S-parameters. This approach ensured accuracy through the use of scientific techniques.



Graphic detailing the circuit board layout from the power amplifier design.

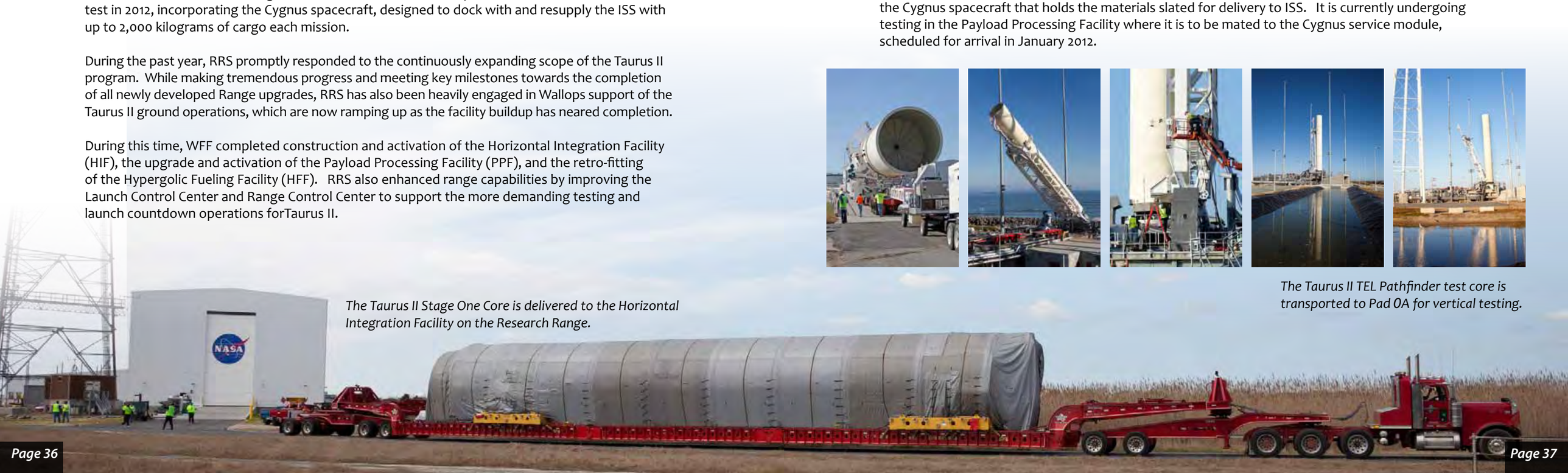
Taurus II

Range development and support for the Taurus II mission continues to be a prime focus for Research Range Services (RRS). In 2008, Wallops Flight Facility (WFF) was selected to host the new Orbital Sciences Corporation vehicle as part of NASA's Commercial Orbital Transportation Services (COTS) contract to resupply the International Space Station (ISS) following the last mission by the Space Transportation System (Space Shuttle) in July 2011.

The first test flight of the new launch vehicle is currently scheduled to occur in February 2012. Weighing 240,000 kilograms and able to insert a 7,000 kilogram payload into low-Earth orbit, Taurus II will be the largest launch vehicle to ever ascend from the Research Range. Further demonstration and operational missions will follow this test in 2012, incorporating the Cygnus spacecraft, designed to dock with and resupply the ISS with up to 2,000 kilograms of cargo each mission.

During the past year, RRS promptly responded to the continuously expanding scope of the Taurus II program. While making tremendous progress and meeting key milestones towards the completion of all newly developed Range upgrades, RRS has also been heavily engaged in Wallops support of the Taurus II ground operations, which are now ramping up as the facility buildup has neared completion.

During this time, WFF completed construction and activation of the Horizontal Integration Facility (HIF), the upgrade and activation of the Payload Processing Facility (PPF), and the retro-fitting of the Hypergolic Fueling Facility (HFF). RRS also enhanced range capabilities by improving the Launch Control Center and Range Control Center to support the more demanding testing and launch countdown operations forTaurus II.



The Taurus II Stage One Core is delivered to the Horizontal Integration Facility on the Research Range.

With the activation of the HIF, RRS was able to accept delivery of Taurus II launch vehicle cores for the first and second missions. These vehicles are currently undergoing integration processing at the HIF to prepare them for their eventual delivery to Launch Pad 0A via a Transporter Erector/Launcher (TEL) and subsequent launch.

As part of the countdown of the first Taurus II launch, the TEL Pathfinder operation was conducted in October 2011. The TEL rolled out of the HIF carrying a simulated Stage 1 and made the 1 mile journey to Launch Pad 0A. The mass simulator was raised to the vertical position on the pad, validating both the TEL hydraulic systems and the pad interfaces including electrical, fuel, air conditioning, and the rapid retract system for launch.

Another exciting milestone was met with the arrival of an enormous Antonov An-26 aircraft delivering the first Cygnus Pressurized Cargo Module (PCM) in August. The PCM is the component of the Cygnus spacecraft that holds the materials slated for delivery to ISS. It is currently undergoing testing in the Payload Processing Facility where it is to be mated to the Cygnus service module, scheduled for arrival in January 2012.

The Taurus II TEL Pathfinder test core is transported to Pad 0A for vertical testing.

WALLOPS
LOOKING AHEAD

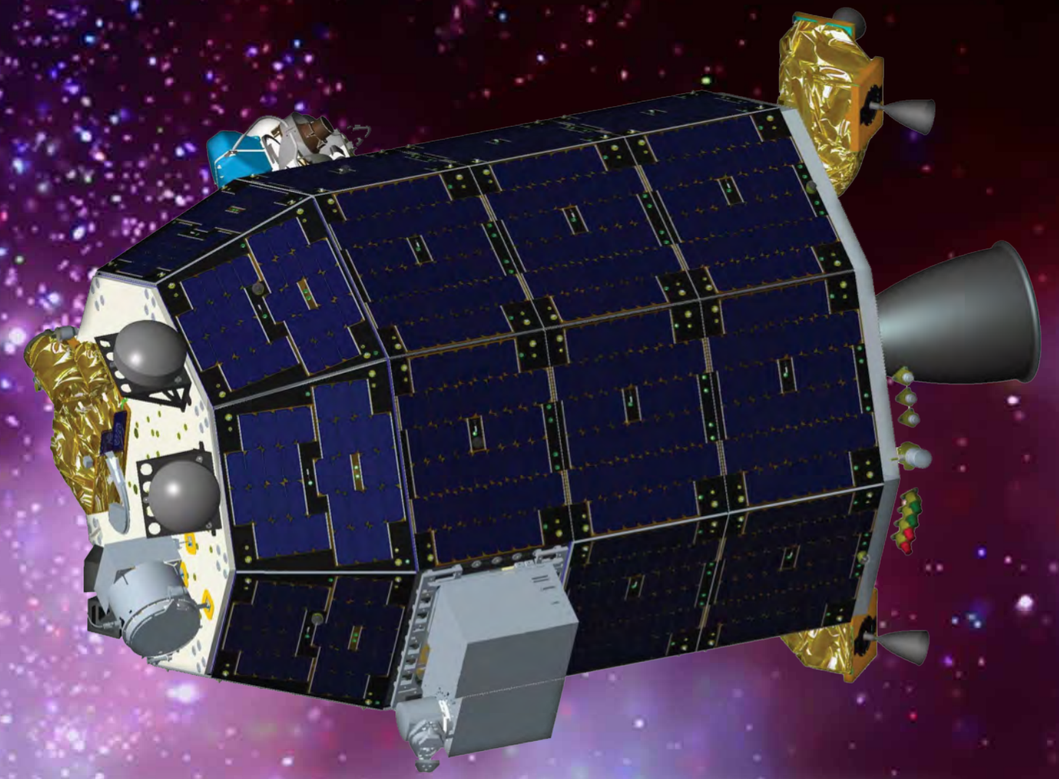
LAUNCH VEHICLE:	Minotaur V
MISSION:	NASA LADEE
WALLOPS ID:	NRW-4791
LOCATION:	MARS Launch Pad 0B
LAUNCH DATE:	May 2013
PAYLOAD:	LADEE Observatory

LADEE
NASA's Lunar Atmosphere and Dust Environment Explorer

Wallops Research Range is destined to be the launch range for NASA's Lunar Atmosphere and Dust Environment Explorer (LADEE) mission scheduled to be conducted in 2013. The payload will orbit the moon to characterize the atmosphere and lunar dust environment. LADEE will gather detailed information about conditions near the surface and environmental influences on lunar dust. A thorough understanding of these influences will help researchers predict how future lunar exploration may shape the moon's environment and how the environment may affect future explorers. It will also help scientists understand other planetary bodies with exospheres, or very thin atmospheres, like the moon.

The LADEE mission represents several unique opportunities and challenges. NASA is taking on several roles with this mission including launch customer, mission integrator, and the launch range. This mission marks the maiden flight of the U.S. Air Force's Minotaur V Launch Vehicle. The Minotaur V concept leverages the Orbital Sciences Corporation's flight proven heritage for avionics, structures, and fairing with relatively minor changes to create the five-stage configuration. The LADEE Observatory spacecraft is equipped with a hypergolic propulsion system for lunar orbital insertion. These types of propulsion systems are driving facility modifications to multiple buildings located on the Wallops Research Range. The LADEE mission's launch trajectory may also require that NASA extends its instrumentation coverage across the entire Atlantic Ocean.

Research Range Services (RRS) personnel are working to meet these challenges through development of mission requirements, coordination of support plans with multiple organizations, and providing system engineering expertise. While still in the planning phase, the RRS program is playing a pivotal role in shaping the LADEE program.



The LADEE mission seeks to achieve three major scientific goals: Determine the global density, composition, and time variability of the fragile lunar atmosphere before it is perturbed by further human activity; Determine if the Apollo astronaut sightings of diffuse emission at many kilometers above the surface were sodium glow or dust and; Document the dust impactor environment (size-frequency) to help guide design engineering for the outpost and also future robotic missions.

Our Direction of Progress

Over the past six decades, Wallops Flight Facility has continually demonstrated flexibility and adaptability in meeting the aerospace research needs of the United States. Wallops Research Range embodies key characteristics that enable the pursuit of emerging opportunities in an evolving aerospace environment. The emergence of commercial space sector capabilities to serve U.S. civil and national security needs for low earth orbit transportation, a recommitment and focus on low cost and efficient operations, and expanding science and technology markets positions Wallops Research Range for growth like no other launch, test, and evaluation facility.

Wallops Research Range's strategy for future growth can be described at a high level by three distinct eras. ***The Expansion and Optimization Era*** will be characterized by Wallops Research Range's focus on expanding its customer and mission base. The research range will work to optimize planning processes and enhance its capabilities to support aeronautic, suborbital, and orbital test, evaluation, and operational missions. During the ***Modernization and Mobility Era***, Wallops Research Range's fixed and mobile infrastructure and instrumentation will be modernized. Wallops Research Range's efforts in this era will enable it to offer better range services to a broader set of customers and missions, especially in aeronautics and medium lift orbital transportation. In the ***Virtual Era***, Wallops Research Range will pursue integration of technology to enhance range flexibility and operability. This will enable more diverse and demanding operations that fall in line with evolving customer needs for global and temporal range capabilities with minimal ground infrastructure.

WALLOPS
THE WAY FORWARD

To fully realize its future potential, Wallops Research Range will pursue five strategic goals that align with these eras and position Wallops Research Range to capture current and emerging opportunities. The time is now to take action and align Wallops Research Range to meet these new demands and opportunities.

Wallops Research Range will pursue the following strategic goals to meet the current and evolving future aeronautic, suborbital, and orbital flight project needs of government, academic, and commercial customers:

STRATEGIC GOAL #1	Expand Wallops Research Range's test and evaluation customer base through growth in targeted areas aligning with the research range's mission and capabilities.
STRATEGIC GOAL #2	Enhance positioning as an operational orbital transportation launch range for select government and commercial organizations.
STRATEGIC GOAL #3	Ensure customer satisfaction through operational excellence and adaptability.
STRATEGIC GOAL #4	Modernize research range infrastructure and instrumentation to support evolving customer and mission requirements.
STRATEGIC GOAL #5	Maintain and enhance work force excellence through increased recruitment and training, and hands-on experience opportunities.

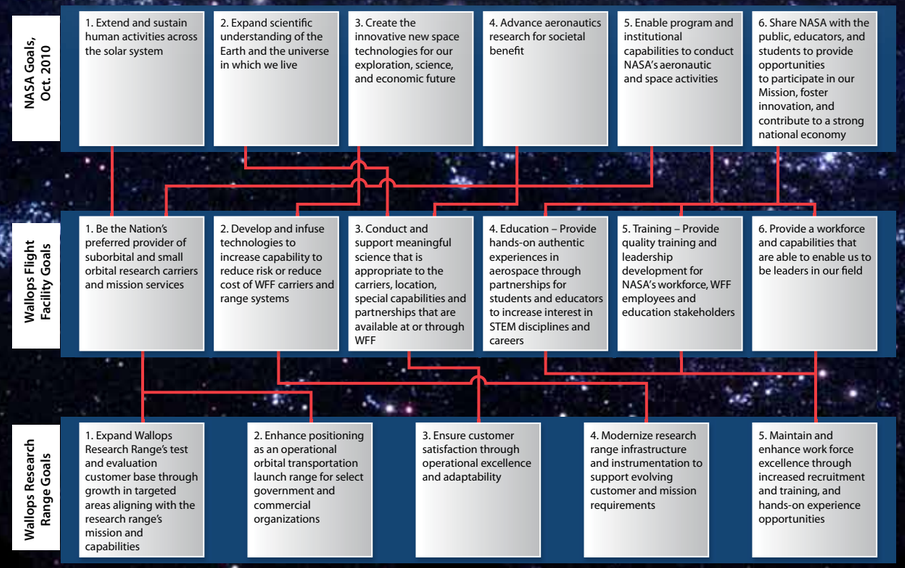
Alignment of Wallops Research Range Strategic Goals with Future Growth Eras

The five strategic goals focus on positioning Wallops Research Range for successful growth in the three eras that define its future and enable the pursuit emerging opportunities.

	Strategic Goal 1	2	3	4	5
Expansion & Optimization Era	✦	✦	✦	✦	✦
Modernization & Mobility Era		✦	✦	✦	✦
Virtual Era			✦	✦	✦

Wallops Research Range's strategic goals not only enable the range to compete in a rapidly evolving aerospace environment, but also directly support the strategic goals being implemented by Wallops Flight Facility and NASA headquarters.

Alignment of Wallops Research Range, Wallops Flight Facility, and NASA Strategic Goals



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Wallops Research Range Initiatives

Wallops Research Range's five strategic goals outline and establish its path for future growth. To achieve these goals, Wallops Research Range will pursue specific supporting objectives with associated performance measures and targets that will enable progress to be assessed. To achieve these objectives over the next five to ten years, Wallops Research Range will pursue a set of initiatives that will drive the performance measures for the objectives it supports.

Wallops Research Range initiatives are grouped into three main categories:

1. Prepare for Change: To make progress toward its strategic goals, Wallops Research Range must ensure its workforce, partners, and customers understand and agree with the direction it is headed. This group of initiatives focuses on communicating Wallops Research Range's strategic goals to achieve buy-in among all affected parties.

2. Baseline and Assess: Initiatives in this group will help Wallops Research Range make well-considered and transparent decisions regarding future changes. These initiatives are focused on collecting and documenting Wallops Research Range's current markets and capabilities and potential future market needs. This information will be assessed to define and pursue the most effective options for future growth.

3. Implement Changes: This group of initiatives consists primarily of efforts and activities that will enable Wallops Research Range to make tangible progress toward achieving its strategic goals. It includes efforts to ensure internal organizations are clearly focused on the right priorities, and coordination with external partner and customer organizations to implement changes and improvement to accommodate future business and growth. In addition, these activities will help Wallops Research Range in achieving the correct balance across supporting operations, maintaining and improving facilities, developing its workforce, and building new capabilities.

The first and third initiatives include significant external involvement by ensuring stakeholders are on board with Wallops Research Range's strategic goals and direction, and by highlighting specific opportunities for direct involvement in helping achieving them. To that end, it will be crucial for both internal and external stakeholders to have insight into Wallops Research Range's decision-making process in selecting actions for future changes. It is vital that any Wallops Research Range

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decision process be transparent and collaborative, to include each of its partner and customer organizations. For example, the managers of NASA's sounding rocket and balloon programs, along with managers of commercial Taurus II program and Department of Defense orbital transportation and Ballistic Missile Defense activities, need to understand Wallops Research Range's perspective on how specific launch and range capabilities will evolve so they can anticipate which capabilities will be available to them in the future. Partner organizations, such as Virginia Commercial Space Flight Authority, need to be engaged collaboratively and assured that Wallops Research Range's decisions are in step with cooperative arrangements and resources to ensure alignment with their goals as well.

Wallops Research Range's next steps regarding the strategic plan will focus on "Preparing for Change," presenting the vision, mission, strategic goals and challenges to internal stakeholders such as leadership and staff to ensure alignment with all plan elements. Following this activity, all actionable goals consisting primarily of the plan's "will" statements will be organized, prioritized, and mapped into the above implementation phases and produce a schedule-based implementation roadmap. This phased, schedule-based implementation roadmap will enable Wallops Research Range to effectively direct efforts and allocate resources to achieve the goals outlined the strategic plan.

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