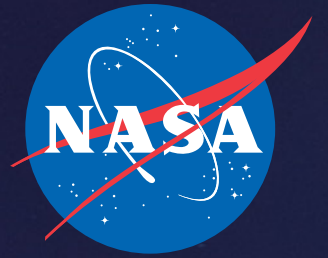


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**WALLOPS  
RANGE  
ANNUAL  
REPORT**



# DEDICATION

## LINDA THOMPSON

Ms. Linda Thompson retired from NASA in 2019, capping more than three decades of mission operations support and project management with the agency. Her tenure includes managing more than 100 mission for more than 14 years - many of which have produced groundbreaking science, enabled space exploration, and equipped American servicemen with vital surveillance and reconnaissance. Equally as important, Linda has been a strong advocate of NASA's goal to inspire and educate the scientists, technologists and engineers of tomorrow by leveraging unique mission involvement by professors, teachers and students.

In the late 1970s, Linda became an electronics technician, supporting several NASA missions as a contractor. Linda's technical excellence, effective communication and successful leadership that she garnered as a technician and then software programmer was undeniable. Eventually, NASA leadership saw fit to hire her in 1991 as a computer engineer.

In the early 1990s, Linda honed her skills serving as a product development lead for the command and data handling product design team, then moved to become an instrument manager with the Balloon Science Program before making her final switch to the Wallops' Range and Mission Management Office, where she spent the past 15 years of her career as project manager (PM).

Linda's first assignment was to oversee a 40-member engineering and technical support team for the development of telecommunications, power, avionics, attitude control systems, mechanical and thermal flight support systems, as well as groundstation systems in support of three successful Cosmic Rays Energetics and Mass (CREAM) Scientific Balloon Project missions in Antarctica. These were the first of their kind and included a then record-setting flight of 42 days. Her leadership for CREAM was acknowledged with multiple accolades, including the Exceptional Achievement for Engineering and Outstanding Teamwork awards.

Once the CREAM project concluded, Linda was handed the PM duties for the Living with a Star Geospace-Related Radiation Belt Storm Probe balloon project as the first mission selected under the NASA Explorers Mission of Opportunity to be managed at Wallops. The project completed two highly successful campaigns in Antarctica in which Linda ensured systems development, qualification, and management of the development project budget, schedule, resources, configuration management and risk.



Wanting to give back to the community and expand young minds, Linda developed and volunteered countless hours to establish the Wallops Saturday Youth Program. Linda organized and led weekly sessions for local underprivileged youth to teach them about flight properties, rocket performance and launch operations. At completion, the youths launched the

rockets they manufactured and came away with a greater appreciation of aerospace and the knowledge to advance to space and aviation careers, enabling them a better life away from what was known. Linda was recognized for this priceless contribution to our young people by receiving multiple awards, including the Goddard Space Flight Center's Outstanding Teamwork award.

Linda was able to adapt to different programs by tackling new challenges head-on, evident by leading aircraft, satellite, payload and rocket programs simultaneously, consistently achieving great success. NASA Wallops' Aircraft Office was in-demand for an aircraft to replace a platform which was in re-wing and found an unmodified C-130 to utilize for a four-year science campaign. The ACT-America project was faced with not only science flights, but the full electrical and structural modification of the aircraft. Linda was hand-picked by management to oversee the modification effort and the science campaign for flights taking place in Nebraska, Louisiana, and Virginia. The mission achieved major success in advancing society's ability to predict and manage future climate change by enabling policy-relevant quantification of the carbon cycle. In chorus with ACT, Linda led the development and qualification of the ISS-CREAM International Space Station (ISS) Project, which launched and docked flawlessly on the Japanese module of the ISS.

We thank Linda for her 40 years of service to NASA and wish her the best of luck in the next chapter of her life.

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# INTRODUCTION

## RESPONSIVE RANGE

My fellow Range members, industry partners, customers, and friends, it is my great honor to introduce the unparalleled achievements of the Range and Mission Management Office (RMMO), and the Wallops Range as a whole during 2019. This unprecedented period was full of challenges and an incredible operations tempo, but our team members were up to the task each and every time. Allow me a few moments of your valuable time to discuss some of our highlights, even as we prepare to fulfill the challenge of what promises to be another astonishing year in 2020 while we maintain our reputation as the industry leader for assuring responsive, safe, low-cost range operations and strong commercial partnerships. Here we go.

After an exhaustive nationwide search, Wallops Flight Facility (WFF) was selected as the U.S. launch site for Rocket Lab Electron missions. In an amazing one-year push by the Mid-Atlantic Regional Spaceport (MARS), construction is already complete for Launch Complex 2 (LC-2) in preparation for the first mission flying the Air Force Monolith payload scheduled for summer 2019. WFF personnel are hard at work completing development of the NASA Automated Flight Termination Unit (NAFTU) that will enable this mission, as well as a new tide of commercial venture-class launch providers. This new Rocket Lab launch capability could deliver as many as 12 missions per year from Wallops, and will bring a great economic influx to the area. In late-breaking news, Wallops just learned that the NASA Science and Technology Mission Directorate selected Rocket Lab to launch the CAPSTONE spacecraft as the first Artemis mission to cis-lunar orbit in February 2021.

Due to its unmatched flexibility, WFF was selected as a primary site for the Defense Advanced Research Projects Agency (DARPA) Launch Challenge. The goal of the DARPA Launch Challenge is to demonstrate responsive and flexible space launch capabilities from the burgeoning industry of small launch providers. Construction of the pad is nearing completion, and the team is working hard solving the technical challenges presented by this new responsive way of conducting mission operations.

WFF supported a brand new East Coast capability for U.S. Navy Fleet Forces with the establishment of the GQM-163A Coyote program at Wallops. Two GQM-163As were successfully launched from Wallops on September 10-12, 2019, with more missions planned for 2020 and beyond. This is a major advancement in Navy training that adds important realism to fleet exercises, resulting in vastly superior combat readiness and saving millions in taxpayer dollars by eliminating the need to relocate to the Pacific Coast. The NASA/Navy teams worked together to overcome multiple challenges resulting in new capabilities for America's warfighters.

The Research Range Services (RRS) team also built their travel miles, flying all around the world and supporting sounding rocket missions like the highly successful Norway Grand Challenge, Kwajalein WINDY, and Alaska campaigns. These missions provided the RRS team with extreme technical challenges in mission complexity and extreme weather. I am proud to report that all missions were successful and all requirements were met, and these valuable science missions will help fill the blank spaces in our knowledge about the interactions between the Earth and Sun.

Here at home we supported the Antares resupply mission to the International Space Station (ISS) with two successful Antares launches. In a first for WFF, partnering with the Missile Defense Agency (MDA), we conducted a mission processing classified telemetry, allowing for future classified missions. We stayed true to our science and engineering roots by supporting various launches in the educational outreach area at the University and High School level. To date, WFF has supported more than 650 students and 42 states in this valuable program, ensuring the future of our agency by developing the workforce of tomorrow.

The WFF engineering team was also extremely busy. We continue to upgrade and maintain our systems, completing major upgrades to our radar assets, to include adding mission support using the X-band Weibel RADARs,



which will provide much needed tracking capabilities. Upgrades were also performed on the LSTAR radar, as well as an expansion of the Coastal Surveillance radar network, increasing our surveillance capabilities. The enhancements to the Bermuda site are completed and the site is fully operational.

The team supported multiple NASA missions all around the globe without any serious injuries or incidents in 2019. Through diligent hazard assessment and proactive activities, such as the Wallops Safety Awareness Campaign and the completion of monthly safety inspections of Range facilities, our personnel have ensured that the NASA mission is accomplished in a safe and environmentally sound manner.

The accomplishments you just read about could not be completed without the professionalism, expertise, commitment and dedication of our most important asset: the Wallops family of civil servants and government contractors. I look forward to seeing what this motivated group of go-getters can achieve in 2020 - Ad Astra!

*- Robert E. Jameson*

Deputy Chief, Wallops Flight Facility  
Chief, Range and Mission Management Office



**WALLOPS**  
RANGE



# MISSION ACCOMPLISHMENTS





# NG-11

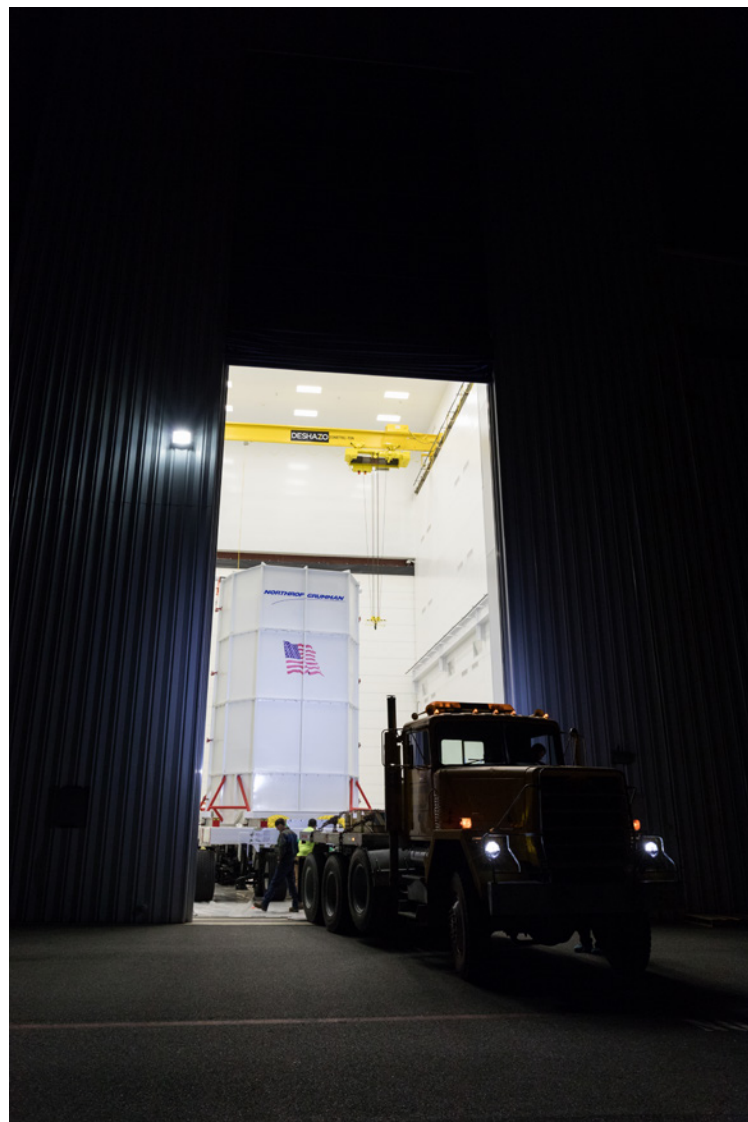
*Wallops Range | April 17, 2019*

On April 17, 2019, at 4:46 p.m. Eastern Standard Time (EST), NG-11 blasted off into the afternoon skies from the Eastern Shore's own Wallops Flight Facility (WFF), destined for the International Space Station (ISS). It was the tenth launch of the Northrup Grumman (NG) Antares vehicle under the NASA CRS-1 contract. The vehicle, carrying the Cygnus spacecraft filled with supplies, including several "Moustronauts", launched from the Mid-Atlantic Regional Spaceport's (MARS) Pad OA.

NG, in partnership with NASA and MARS, worked over several months preparing for this successful launch. NASA WFF is responsible for providing Range services to include facilities for cargo and vehicle preparation, assisting in spacecraft fueling, and providing tracking, telemetry, and command services. MARS is responsible for the launch pad preparation. NG owns and provides the launch vehicle and spacecraft under the NASA CRS-1 contract.

This mission was a pathfinder for the upcoming NG CRS-2 contract. This was the first mission where NG completed final cargo loading at the pad. Using the new Mobile Payload Processing Facility (MPPF) at Pad OA, NG "popped the top" of the nosecone to load two cargo bags and four powered lockers twenty-four hours before launch.

The Cygnus spacecraft, named S.S. Roger Chaffee in memorial of fallen Astronaut Roger Chaffee who died in service in 1967, carrying 3426 kg of cargo, was successfully placed into orbit and rendezvoused with the ISS two days later. The S.S. Roger Chaffee remained berthed to the ISS for 109 days. It was unberthed from the ISS on December 6, 2019, with 2443 kgs of disposable mass. It remained in orbit for approximately four additional months releasing multiple small payloads. A destructive reentry occurred on December 6, 2019. The S.S. Roger Chaffee remained in space for a total of 232 days, the longest duration Cygnus mission to date.







# NG-12

*Wallops Range | November 2, 2019*

For the second time in 2019, the Antares vehicle carrying the Cygnus spacecraft, named S.S. Alan Bean in memorial of fallen Astronaut Alan Bean who was the fourth person to walk on the moon, launched from the WFF to head toward the ISS. NG-12 lifted off from MARS' Pad OA on November 2, 2019, at 9:59 a.m. EST. The early morning skies were lit up with a near perfect launch of the upgraded Antares 230+ configuration.

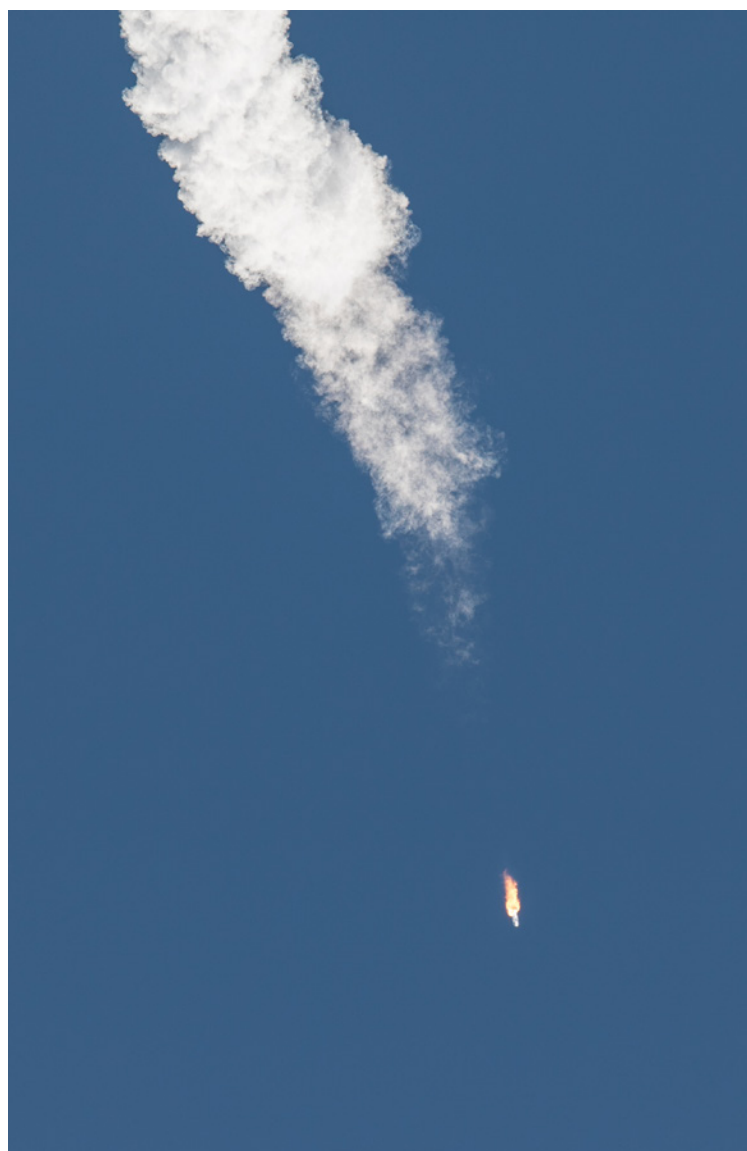
The mission is the first of at least six missions that will fly out of WFF under the new NASA CRS-2 contact. In addition, both the Antares vehicle and the Cygnus Spacecraft were upgraded to accommodate larger and heavier payload capacity. The vehicle will provide an increase of up to 8050 kgs of mass to orbit. The spacecraft upgrades include increased cargo carrying capacity, improved thermal control systems, and additional propellant tanks for maneuvering.

NASA, NG, and MARS, utilizing their very successful partnership in service to our country, worked several months after the launch of NG-11 preparing for a successful launch.

NASA WFF is responsible for providing Range services to include facilities for cargo and vehicle preparation, assists in spacecraft fueling, and providing tracking, telemetry and command services. MARS is responsible for the launch pad preparation. NG own and provide the launch vehicle and spacecraft under the NASA CRS-2 contract.

The Cygnus Team for the first time "officially" completed 24 hour late load activities at Pad OA. They utilized the MDPF, popped the nosecone top, and loaded the cargo bay with 13 cargo bags and ten deck lockers, six of which were powered.

The Cygnus spacecraft, carrying 3693 kg of cargo, was successfully placed in orbit and two days later rendezvoused with the ISS. The S.S. Alan Bean is still attached to the ISS. For the first time, two external payloads were attached to the Cygnus spacecraft. The spacecraft is also being loaded with disposable mass. The unberthing and destructive reentry of the S.S. Alan Bean is scheduled for early February 2020.





# SRPO SUPPORT

## *Wallops Range*

In 2019, the Range and Mission Management Office (RMMO) supported the Sounding Rocket Program Office (SRPO) with Range Services and infrastructure to launch multiple missions both at Wallops and abroad. These missions are sourced from many different customers and cover a wide array of mission types from NASA research to Department of Defense (DoD).

## **ABBETT**

*Wallops Range | September 18, 2019*

The Abbett mission successfully launched aboard a Black Brant IX sounding rocket from the Wallops Range on September 18, 2019. The reimbursable mission for the Missile Defense Agency (MDA) was a new mission to eject classified objects above a specified altitude and capture the ejections via three high-speed video encrypted telemetry links. This was a first for the support of a sounding rocket with classified telemetry at Wallops.



## SUBTEC-8

*Wallops Range | October 24, 2019*

The SubTEC-8 mission successfully launched aboard a two-stage Terrier MK70 - Improved Malemute sounding rocket from the Wallops Range on October 24, 2019. This SubTec-8 is the eighth mission in the continuing SubTec series. The SubTec missions are intended to demonstrate multiple technologies, improve SRPO capabilities and support range development initiatives. The primary purpose of this mission was to demonstrate the sub-payload to main payload communication via an Engineering & Technology Directorate (ETD) developed swarm communication experiment. The secondary objective was to provide a flight opportunity for an assortment of ten SRPO/ETD development components.

Along with a number of first use experiments, this was the first night time recovery of a sounding rocket for Wallops.

### EXPERIMENTS FLOWN

- SWARM
- APSU (Airborne Power Supply Unit)
- Solid State Altimeter
- A.R.T. (Autonomous Rocket Tracker)
- Low Cost Star Tracker
- GPS/S-Band Combo Antenna
- Axon 40Mbit/s encoder
- NAFTU (NASA/Sagrad Autonomous Flight Termination Unit)
- 3-axis Accelerometer
- Redesign of Spin Motors



# COYOTE (GQM-163A)

Wallops Range | September 10 + 12, 2019



NASA supported a brand new East Coast capability for Navy Fleet Forces with the establishment of the GQM-163A (commonly referred to as the Coyote) program at Wallops Flight Facility. This is a major advancement in Navy training that adds important realism, resulting in vastly superior combat capable forces.

Two GQM-163As were successfully launched from Wallops on September 10 and 12, 2019. The GQM-163 Coyote is a supersonic sea-skimming target built by Northrop Grumman and used by the U.S. Navy as a successor to the MQM-8 Vandal for training exercises. The Coyote is initially boosted by a Hercules MK70 booster. After the booster stage is expended the missile switches to an Aerojet MARC-R-282 solid-fuel rocket/ramjet engine for sustaining its flight. The GQM-163A vehicle and booster assembly consists of two primary subsystems: The MK70 solid propellant motor and the GQM-163A target vehicle. The flight duration is 110 seconds, including approximately six seconds of the MK70 stage 1 boost.

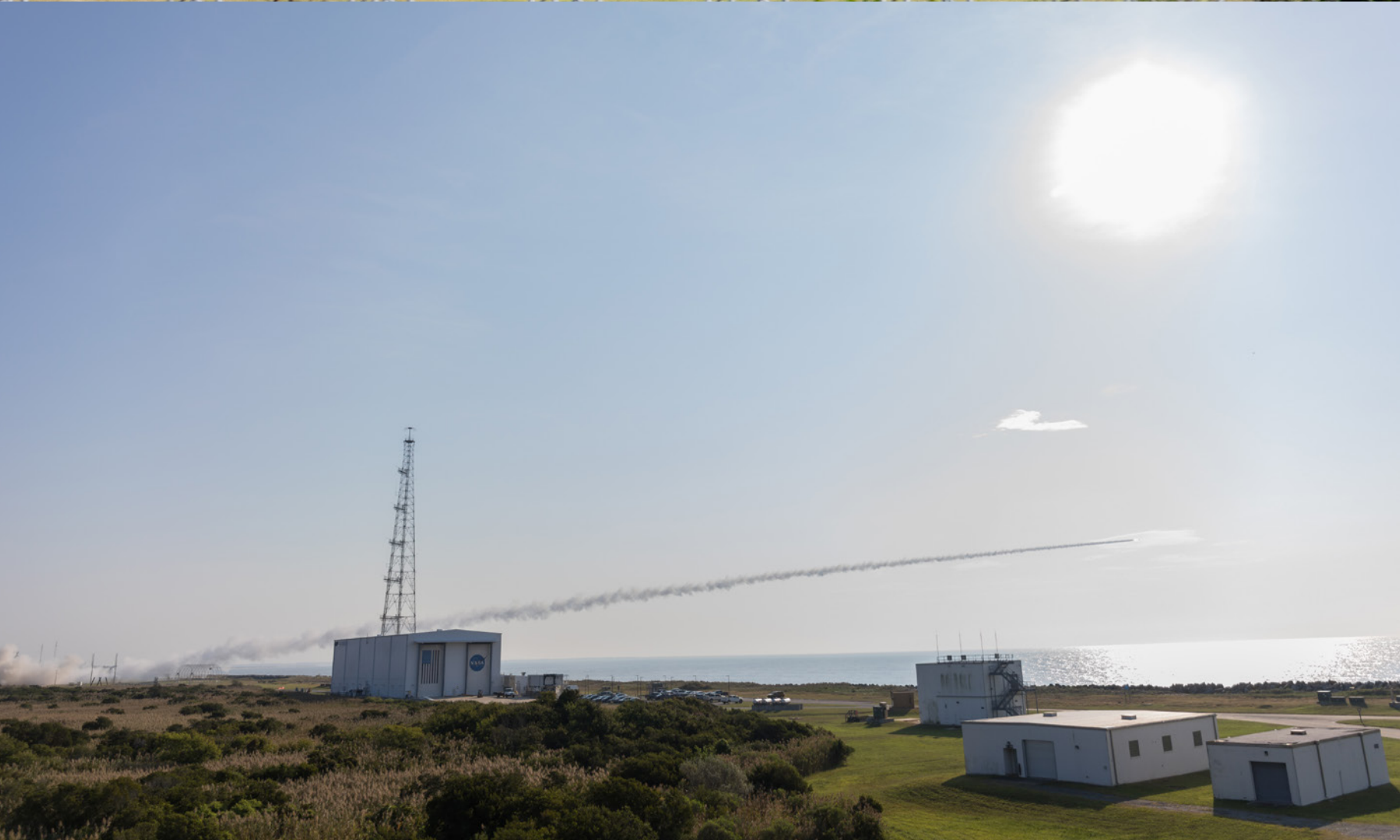
NASA supported a number of upgrades and first-use items in support of the Coyote Program, first of which was the Navy's MK7 launcher that was completely refurbished and installed on Pad 3B.

Given the range and sea skimming profile of the targets, solutions for relaying Telemetry (TM) and Flight Termination (FTS) needed to be developed. Wallops worked with the Air Test and Evaluation Squadron (VX-30) out of Point Mugu in California for use of a P-3 for the FTS relay solution and AIRtec out of St. Mary's County Airport, Maryland, for TM relay and hazard area surveillance.

Range clearance was complex due to the flight profile and length of the safety corridor. The Surveillance Coordinator had to manage five aircraft and two boats to survey and clear the target hazard pattern and also the Navy's ship launched missiles.

This was the first time the Range had requirements to receive C-Band telemetry and to accomplish this they upgraded the 6M TM system to achieve the capability. For redundancy, the Range also tied into the existing Patuxent River C-Band assets located on Wallops Island for the first operational support of a NASA mission.

Other firsts for this mission were the integration of the Common Display System (CDS) in the Range Control Center and a new COMET mobile command antenna installed at building W-10.



# CUBESAT GROUNDSTATION

## *Wallops Range*

Small satellite payloads are becoming increasingly popular choices among universities for low-cost scientific and technology research. The Wallops Range helps manage these projects by supporting the Atmospheric SmallSat Ground Station (ASGS) and UHF Ground Tracking Station.

NASA's CubeSat Launch Initiative (CLI) provides opportunities for small satellite payloads built by universities, high schools and non-profit organizations to fly on upcoming launches. In 2019, the Antares NG-11 and NG-12 missions had CubeSats as part of their payload. Through innovative technology partnerships, NASA provides these CubeSat developers a low-cost pathway to conduct scientific investigations and technology demonstrations in space, thus enabling students, teachers, and faculty to obtain hands-on flight hardware development experience.

To support Small Satellite (SmallSat) operations, Wallops Flight Facility (WFF) has a UHF Ground Tracking Station to track CubeSats from previous launches throughout the years.

Through the year, the ground station tracked CubeSats launched from Rocket Lab's Electron vehicle with missions from NASA centers around the country. CubeSats were also deployed directly from the International Space Station (ISS), increasing tracking support needed from the ground station.

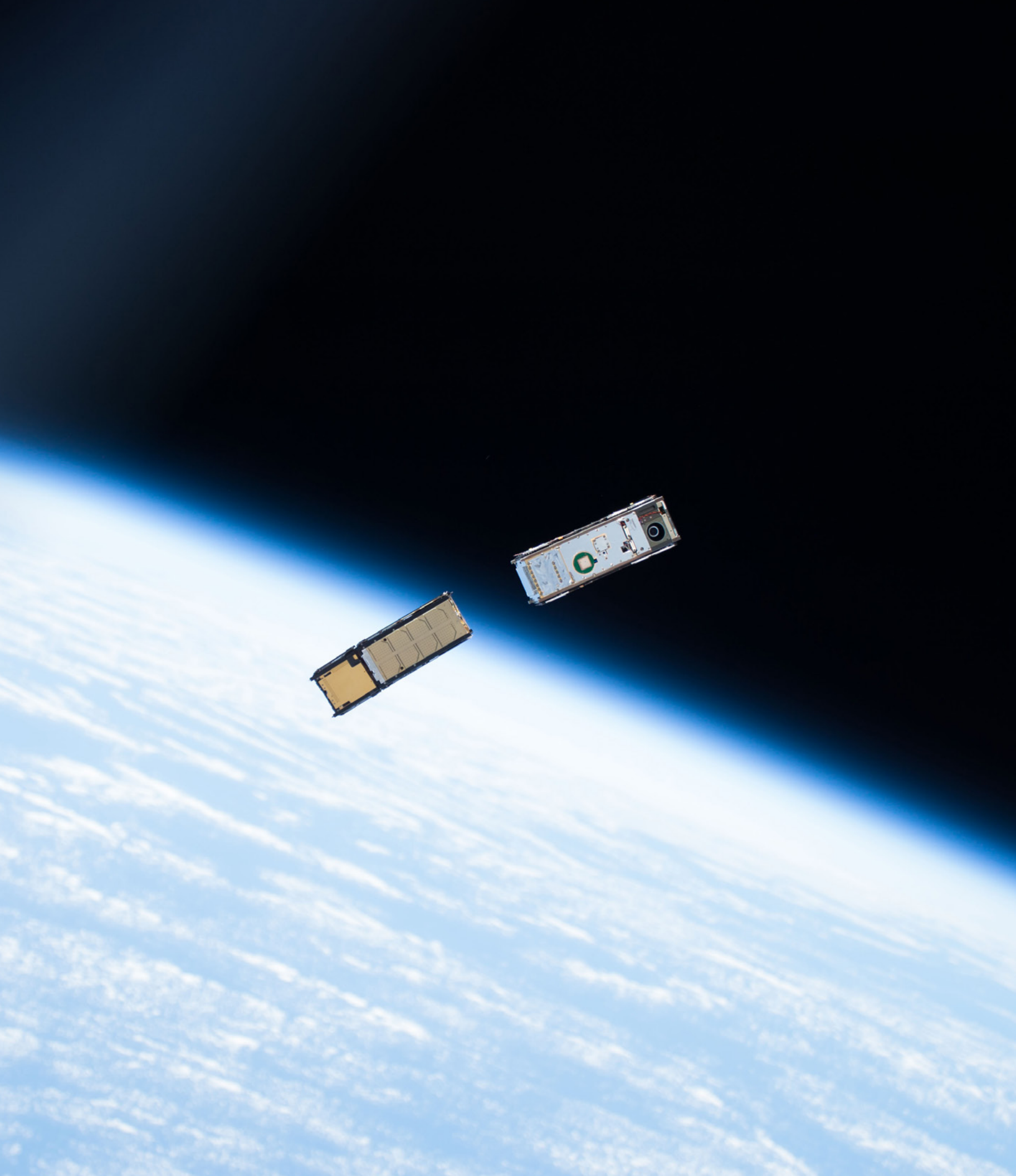
As support increased, the technical team continued to evaluate the performance of the ASGS telemetry and command processing software installed in late 2018. As 2019 was preparing to close out, software enhancements were procured. The ASGS system is fully functional with additional software and some hardware upgrades enhancing the overall ground station performance.

The ground station continues to provide 24/5 support. In 2019, 4399 passes were scheduled for the nine on-orbit CubeSats with 87 percent of the passes tracked and 74 percent responding.

Overall, 2019 was a productive year for the CubeSat community utilizing the 18-meter UHF antenna with positive customer feedback. Wind restrictions, customer inability to command, customer mission operations issues, customer cancellations, and occasional non-routine station maintenance issues were the primary reasons for missed passes. Tracking support is anticipated to increase by nine new CubeSats by April 2020, which would increase total spacecraft support to 17.







# UAS SUPPORT

## FIRESOUT UAS

*VA Space UAV Runway | 2019*

NASA Goddard Space Flight Center's (GSFC) Wallops Flight Facility (WFF) has provided Range support for the Fire Scout Unmanned Aerial System (UAS) flights, scheduled for three week-long campaigns throughout 2019. Support included safety for flight and ground elements to assure public safety, frequency authorization, airfield/hangar support, fueling, restricted airspace, vehicle/engine wash-down, and overall project management support. The primary goal of this Navy training campaign is to conduct link-checks, functional check flights, and unit level training with the MQ-8B between Wallops UAS Airfield and R-6604 A/B restricted airspace. These initial three campaigns set the foundation for a long-term training detachments for the Fire Scout team.

The MQ-8B Fire Scout Vertical Takeoff and Landing Tactical Unmanned Aerial Vehicle (VTUAV) is a United States Navy (USN) autonomous rotary-wing aviation system designed to provide intelligence surveillance, reconnaissance, target acquisition and communications relay capabilities. The VTUAV system also includes a Mobile Mission Control Station (MMCS) with associated antennas. The MMCS serves as the command post and work area for command and control of the vehicle and onboard payload systems. The payloads and sensors installed are the Brightstar II FLIR with EO/IR, LASER RangeFinder (LRD). Not all of the payloads are utilized on each campaign.



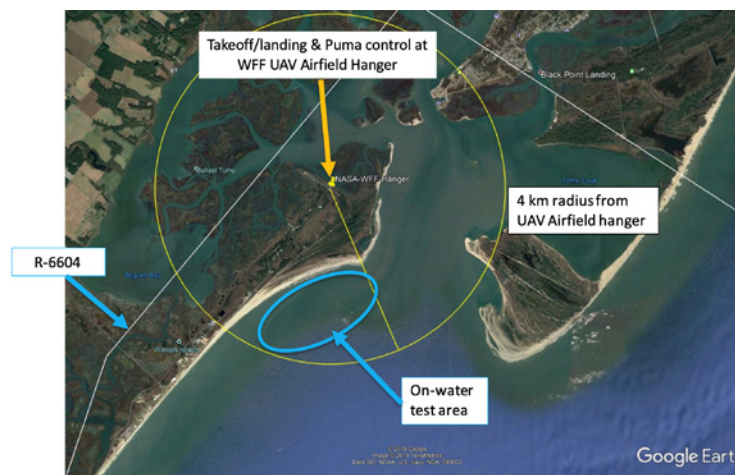
# PUMA UAS

*Wallops Range | October 2019*

NASA GSFC WFF provided Range support for the US Naval Research Lab (NRL) RQ-20 Puma flights on October 7-11, 2019, including safety for flight and ground elements to assure public safety, frequency authorization and overall project management support. The Puma vehicle carried the Edge Computing Field Experiment (ECFE) optical payload to examine the ability of a fully-automated find, fix, engage and assess system for future missions in maritime environments. The RQ-20 is a UAS with 9'2" wingspan, powered by lithium ion batteries. The aircraft had no modifications specific to the flights at Wallops. The payloads and sensors are installed to be contained within the standard payload bay configuration of the aircraft.

Even though NRL was met with several environmental and technical challenges, they were able to achieve their primary goal of testing the payloads in a maritime environment. During the weeklong testing window, the team ran into many obstacles. Early in the week, weather was not conducive to launching/flying a UAS. In an effort to accomplish their objectives, the Range and Puma team used out of the box thinking to gather some data. The Range queried several locations, including Navy, MARS, and NASA assets, to achieve an elevated location which the Puma fuselage could be affixed with an Atlantic Ocean view. After choosing the MARS Pad-OB gantry, the Range coordinated a boat asset to a position offshore for tracking purposes.

Later in the week, the weather cleared but the team was met with other technological challenges. The Puma team claimed some of their objectives were met even though they never actually flew the UAS. The Range's problem solving abilities was put on full display and allowed the Project to be successful.



# MOBILE DEPLOYMENTS



## NORWAY GRAND CHALLENGE

The Norway Grand Challenge Initiative (GCI) is a multiyear effort involving the launch of several different missions from organizations around the world. Despite the logistical and environmental challenges of deploying support equipment to such a remote environment, the Research Range Services (RRS) team was able to successfully complete all required missions and hopes to support more in the future.

## VISIONS-2

*Ny-Ålesund*

## TRICE-2

*Andøya Space Center*

This beginning of the campaign consisted of two separate “salvo” missions, VISualizing Ion Outflow via Neutral atom Sensing-2 (VISIONS-2) and Twin Rockets to Invenstigate Cusp Electrodynamics II (TRICE-2), with each mission consisting of two rockets which launched within minutes of each other. VISIONS-2 launched from Ny-Ålesund, while TRICE-2 would be launching from Andøya Space Center (ASC) in Andenes, Norway.

In Ny-Ålesund, the RRS team configured and tested telemetry equipment and photography assets, while the project manager worked to coordinate activities with other groups supporting the launch. For the VISIONS-2 mission, the telemetry team supported as the prime trackers along with the ASC telemetry crew positioned next to them, while the Norwegian crew in Andenes served as “downrange” support when the payload flew out of the range of the Ny-Ålesund equipment. For the TRICE-2 mission, those roles were reversed, and the Andenes crew was prime, with the Ny-Ålesund crew as “downrange” support. In Ny-Ålesund, two telemetry antennas, the 7M-2 and the 20-foot antenna were on site to support, as well as the MPS-4 power van to ensure a continued track of the vehicle and to record data in the event of a power failure. In addition to this, the roll away telemetry readout racks, a new system in the RRS range architecture, was also supporting.

Down in Andenes, support was also provided in the form of a photographer, telemetry technician, and a mission engineer who was served as a liaison between the Norwegian telemetry group and personnel from Wallops Sounding Rocket Program Office (SRPO). After completing all necessary testing, given the notoriously cloudy and windy conditions typically experienced at those latitudes, the team settled in for what was expected to be a long haul wait for good weather and good science conditions.

Remarkably, just four short days into the window, the lead scientist for VISIONS-2 called to start the final countdown. After a few short holds to make sure the science was in exactly the right position, the first rocket roared away, followed quickly by the second rocket. The RRS team was able to successfully track both rockets and capture the required launch photographs.

The excitement was not over yet, however, as the TRICE-2 mission was still raring to go. The team returned to work the next day to reconfigure for TRICE-2 and begin their count. As the count progressed, the lead scientist for TRICE-2 indicated that science conditions were looking very promising for a launch. Sure enough, later that morning, the lead scientist called to pick up the count and both rockets were launched a few minutes later. The team successfully acquired both rockets as they passed over the horizon, recording the data that the scientists would later analyze. Breathing a sigh of relief, the team secured the site and returned home to spend some time with their families prior to heading back up north for the next round of launches.



# MOBILE DEPLOYMENTS

## NORWAY GRAND CHALLENGE *CONTINUED*

*Ny-Ålesund | Andøya | Andenes*

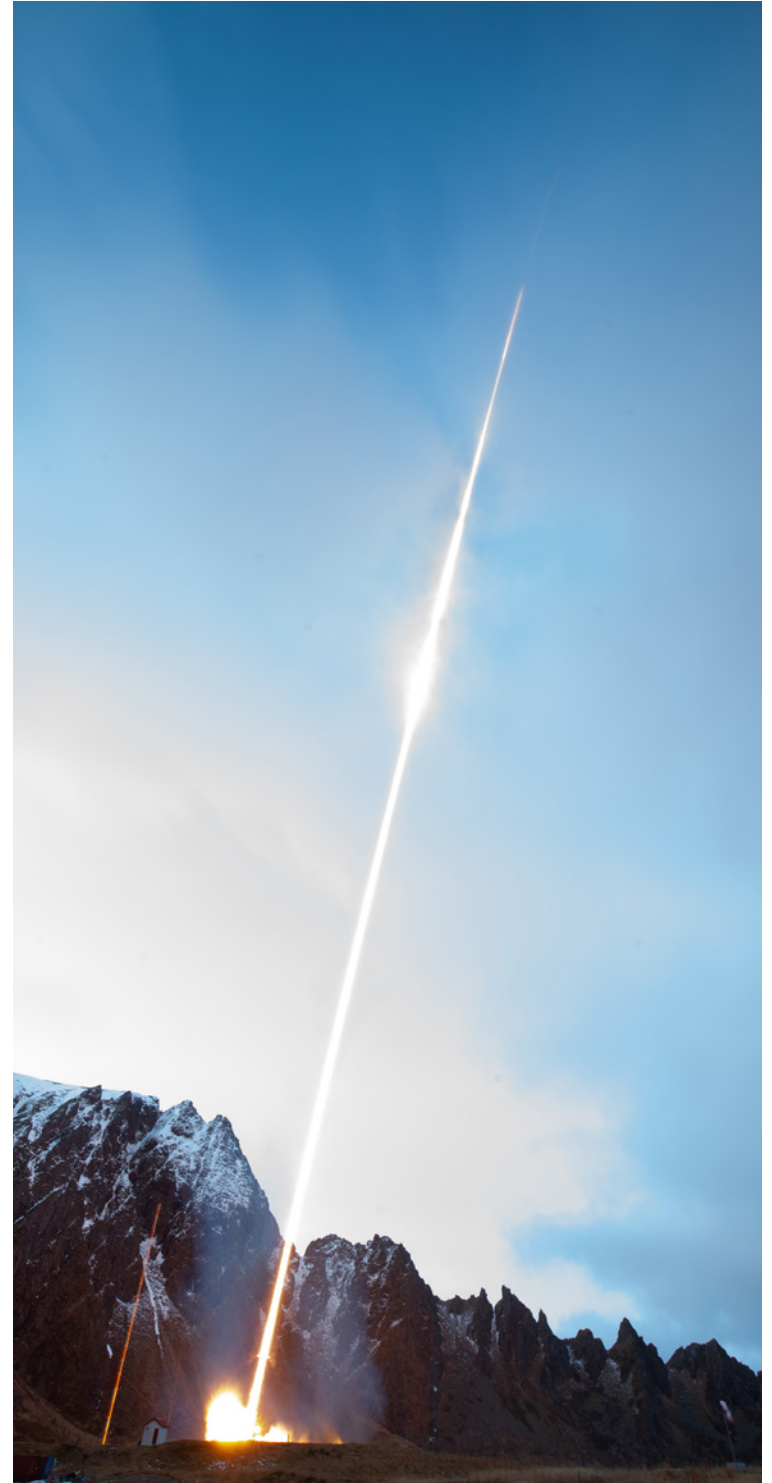
### CAPER-2

*Andøya Space Center | January 4, 2019*

After having already supported a launch in late 2018, an intrepid team of RRS personnel once again travelled to the world's most northern permanent settlement to support a second rocket salvo. Situated at 79° N, the scientific community of Ny-Ålesund on the island of Svalbard plays host to scientists and researchers from all over the globe. After ringing in the New Year with their Norwegian hosts and their scientific guests, the RRS team was back to work supporting a launch window that opened on January 2, 2019.

For this particular launch, the RRS team was considered “downrange support” given that the rocket would launch from Andøya Space Center (ASC) down in Andenes, Norway. In Ny-Ålesund, two telemetry antennas, the 7M-2 and the 20-ft antenna were on site to support, as well as the MPS-4 power van to ensure continued track of the vehicle and to record data in the event of a power failure. Support was also provided in Andenes in the form of a photographer and a mission engineer who was serving as a liaison between the Norwegian telemetry group and personnel from Wallops on the NASA Sounding Rocket Program Office.

The typical January weather condition experienced in Andenes is cloudy and windy which caused the team to settle in for what was expected to be a long haul in waiting for good weather and good science conditions. Luckily, just two short days later on January 4, 2019, both vehicles successfully launched from Andenes. As they cleared the horizon, the RRS team acquired the vehicles and tracked until the expected loss of signal as the payload dipped below the terrain. After the mission, the team quickly gathered the data to bring home to the various end users and secured the site until the planned return later in the summer.

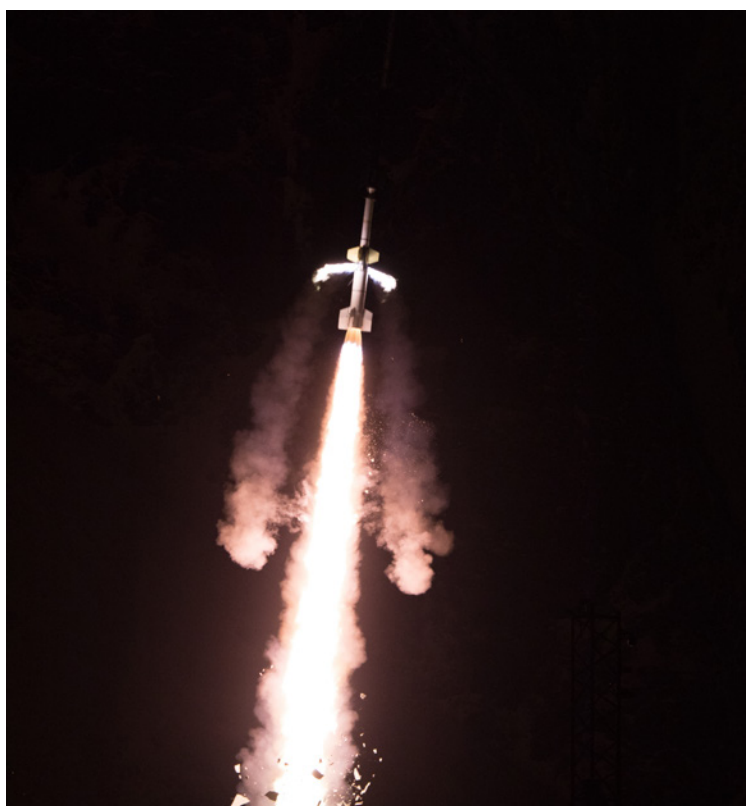




## AZURE

*Andøya Space Center | April 5, 2019*

A team deployed to Andenes in support of the Larsen Auroral Zone Upwelling Rocket Experiment (AZURE) mission, but this time only a photographer and a mission engineer were required to support. Once the Norwegian's telemetry station was configured and complete with initial testing, the mission engineer returned home, but the photographer remained on site to provide coverage of day-to-day activities and launch photos during the successful mission on April 5, 2019.



# EDUCATION AND PUBLIC OUTREACH

**VETERANS  
UPWARD  
BOUND**



**WOR-WIC**  
COMMUNITY COLLEGE





# ROCKON!

*Wallops Range | June 20, 2019*

The RockOn! 2019 mission successfully launched aboard a two-stage Terrier MK12 - Improved Orion sounding rocket from the Wallops Range on June 20, 2019. The rocket carried 37 student experiments from the RockOn/RockSat-C program as its payload.

The Research Range Services (RRS) team supported the mission with multiple services, including radar, command and control, optical tracking, surveillance, payload recovery, and many other elements that help enable the launch of a sounding rocket. The mission was a continuation of the annual RockOn! Sounding Rocket Workshop which represents the collaborative effort of the Colorado Space Grant Consortium, the Virginia Space Grant Consortium, and Wallops Flight Facility (WFF). It marked the twelfth mission of the RockOn! program and the eleventh for RockSat-C.

In addition, Cubes-in-Space, a nationwide program for middle school students, flew multiple small cubes with experiments on this mission. To date, the RockOn! missions have included more than 650 participants across 42 states and Puerto Rico.

## **PARTICIPATING UNIVERSITIES**

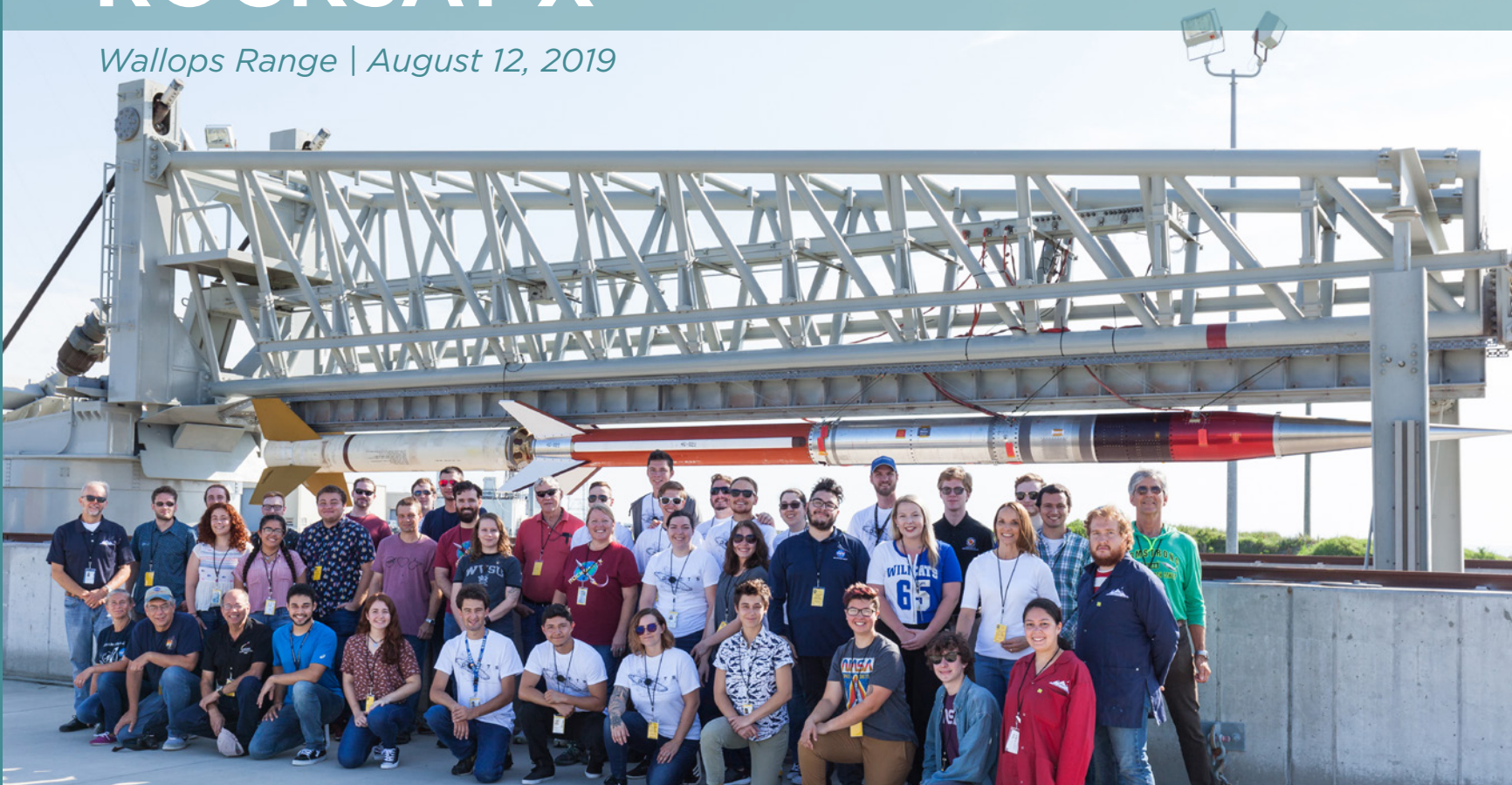
- Temple University
- Langston University
- Clemson University
- Delgado Community College
- West Virginia University
- University of Delaware
- University of Wisconsin Milwaukee
- Steven's Institute of Technology
- Hobart and William Smith Colleges





# ROCKSAT-X

Wallops Range | August 12, 2019



The RockSat-X 2019 mission is a continuation of the successful annual RockSat-X Sounding Rocket Workshop. It represents the collaborative effort of the Colorado Space Grant Consortium, the Virginia Space Grant Consortium, and Wallops Flight Facility. The workshop was a follow-on experience to the Rock-On! Program and provided university educators and students from nine different universities with a space flight opportunity of increased complexity. The workshop provided hands-on rocket flight training experience.

As with similar sounding rocket campaigns from Wallops Island, the Research Range Services (RRS) team provided the pad launcher, communications, data processing, radar, telemetry, timing, optical tracking, payload recovery, surveillance, and weather services. During the count, the surveillance display system in the Range Control Center went down and had to be restarted, which caused a 14 minute delay in launch. Public safety is critical and without the display system, the Range would not have been able to detect if aircraft or boats were in the hazard area. The RRS team reacted quickly and was able to restart the system and ensure it was functioning properly before proceeding with the launch.

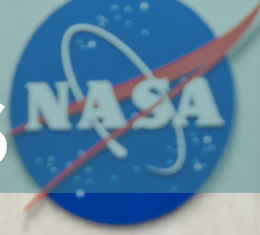
The RockOn! and RockSat programs provide an excellent opportunity to expose the next generation of scientists and engineers to rocketry and space experimentation. Students are able to work on a payload and actually get to launch it into space. Some of these students may eventually be part of the NASA workforce due to the inspiration they receive from programs like this.

## PARTICIPATING UNIVERSITIES

- Arapahoe Community College
- College of the Canyons
- Community College of Aurora
- Red Rocks Community College
- University of Kentucky
- University of Maryland
- University of Nebraska
- University of Puerto Rico
- West Virginia University



# RCC TOURS



*Wallops Range*



Throughout the year, the Wallops Range hosts a multitude of tours to educate the public on the ins-and-outs of launching a rocket from Wallops Flight Facility. Tours are given to a wide range of participant types and professional levels from middle school students and senior citizens to other government agencies and councils. Visitors are taken right to the main stage of the Range Control Center (RCC) where the magic happens and the biggest decisions are made on whether a rocket will take flight. From the safety room to test director's console, a range official escorts visitors on a ride of launching rockets into sub-orbital and orbital space. The video wall gets fired up and the visitors get to experience what it would be like to watch a rocket launch for themselves in the seats of NASA's brightest who work up until the very last minute to make every mission successful. The tour not only focuses on the successful launches but the failures as well.

## PARTICIPATING ORGANIZATIONS

- Maryland College Park Rocketry Club
- Delaware Technical University
- Arcadia Middle School
- Surface Combat Systems Center (SCSC)
- Cape Henlopen Senior Center
- RockOn/RockSat-C Students (6 groups)
- Virginia Space Flight Academy
- Ocean Pines Community Center
- University of North Dakota Space Studies STEM
- Worcester County Economic Development Middle School STEM Program
- Range Commanders Council
- Pocomoke Senior Center
- Salisbury University Astrobiology
- University of Maryland Eastern Shore (UMES)

# BERMUDA STEM OUTREACH

## *Bermuda*

Showcasing NASA's long-standing partnership with Bermuda in support of human spaceflight and space exploration, NASA formally dedicated its newly-established Bermuda Tracking Station on the Cooper's Island Nature Reserve, the site of the former Apollo-era NASA site in Bermuda. The tracking station, established as part of a \$5.3 million renovation and outfitting project, provides radar, telemetry, and command for launches from NASA's Wallops Flight Facility and Cape Canaveral.

NASA Wallops led two major trips to promote the NASA presence in Bermuda and STEM activities. The NASA delegation for the grand opening included the International Space Station (ISS) Director and Wallops Flight Facility Director. In coordination with the U.S. Consulate, NASA hosted the event that included Bermuda Government, education and business leaders, and the media. The event reestablished the partnership between NASA and Bermuda and revealed a deep pride in the Bermudians for their connection with NASA spaceflight programs. The NASA delegation visited public and private schools, giving presentations on the ISS, the Antares launch vehicle and the Wallops mission, and interacted with the students on STEM topics.

The NASA team held a conference with Bermuda educators to better understand their needs in regards to exposing their students to science topics connected with NASA programs. Establishment of this connection with educators was vital to meeting NASA's obligations in the Bermuda-U.S. Agreement for operating the tracking station. The team met with Bermuda business leaders to explain the mission for the NASA tracking station and define the scope of activities that would be taking place there. The goodwill established at this meeting stands to pay huge dividends towards gaining cooperation for use of Bermuda services to support NASA operations there. The team also met with the staff of the U.S. Consulate in Bermuda to explain the importance of NASA missions in Bermuda, and thank them for their assistance with coordinating all the logistics of the visit. This further cements the proud relationship between NASA, the U.S. Consulate, and the Bermudian government and people for the vital role Bermuda plays in resupplying the ISS and conducting Space Launch System flight operations.

Wallops also sent an education team to perform STEM outreach events and establish the Bermuda Space Camp. The team met with members from Bermuda's Ministry of Home Affairs to confirm the camp agenda and support requirements. In addition, they partnered with the U.S. Consulate to host a gathering that brought a variety of local education supporters together to discuss the unique education needs throughout Bermuda. The team initiated the Bermuda Space Camp with the theme of the 50th Anniversary of Apollo 11 and Return to the Moon. The students built kites and model satellites and completed engineering design challenges, and learned the fundamentals for rocketry. The camp, held at Bermuda College, included classes on gravity and buoyancy, coding, alternative power, weather and hurricanes, and climate change. The team also provided NASA and space-related books for the Bermuda Library summer reading program. Children from the reading program visited the tracking station where the NASA Senior Policy Advisor for the ISS gave a presentation to the students.



# RANGE CAPABILITY ADVANCEMENTS







NATIONAL AERONAUTICS AND SPACE ADMINISTRATION  
Wallops Space Flight Center  
Wallops Flight Facility

MOBILE POWER SYSTEM NO. 3

5.4W 2

WARRIOR

# BERMUDA UPGRADE

*Bermuda Tracking Station*



## BERMUDA TRACKING STATION PROJECT

In 2019, the project installed a 20-foot tower outside the operations center for the placement of Radar 8. After the completion of Radar 8's refurbishment, the radar was relocated to Bermuda and installed on the tower. The radar's instrumentation containing four racks, a console, and a graphics workstation were installed in the operations center alongside the telemetry and command instrumentation. A new retractable radome was installed around the radar, equipped with its own HVAC system to protect the antenna from the harsh beach environment. Following the installation of all system components, initial testing was performed by the engineering team to ensure that the system was ready for launch operations.

After the initial completion of the Bermuda Tracking Station Project, the station successfully supported NG-11 and NG-12 ELV launches to the International Space Station (ISS), as well as tracking the Ionospheric Connection Explorer (ICON) Pegasus launch. Additionally, 2019 saw the installation of Radar 8's instrumentation console in the Bermuda operations center, the placement of Radar 8 on its new 20-foot tower, and the installation of the radar's protective radome.

2020 will see final testing of Radar 8, along with a final project ORR, project acceptance, and project completion.



# ROCKET LAB

## *Wallops Range*

In October 2018, NASA and Virginia Space entered into an agreement with Rocket Lab to build an additional launch pad, Launch Complex 2 (LC-2), to conduct dedicated flights of small spacecraft missions.

The NASA Wallops Flight Facility (WFF) Range team worked diligently to create the program architecture, vehicle certifications and range support service infrastructure in direct collaboration with the Rocket Lab and Mid-Atlantic Regional Spaceport (MARS) teams. Specifically, the Autonomous Flight Termination Unit (AFTU) team is working directly with Rocket Lab and the FAA to finalize the certification efforts for the Autonomous Flight Termination System (AFTS).

Construction on LC-2 commenced in February 2019, with the site operational just ten months later in December 2019 and final pad testing to be completed in January 2020.

More than 150 local construction workers and contractors were involved in the development of the launch complex, with many Virginia-based companies supplying services, hardware, and materials for the site. Locally built infrastructure includes the 66-ton launch platform and 44-foot, 7.6-ton strongback.

During the entire effort, the Range has been working closely with outside agencies and experienced personnel from the FAA, and entire NASA launch community.



# SURVEILLANCE UPGRADES

## Wallops Range

In 2020, the Range will be procuring and installing Commercial off the Shelf (COTS) surveillance assets to enhance the Wallops Range situational awareness during missions. Surveillance radars support the detection and tracking of surface and air targets operating on the Wallops Range. These radar systems provide critical data required to assure the safety of public and non-participating aircraft and surface vessels operating in the vicinity of the Wallops Range. In addition, these radars are necessary to perform safe and efficient control of range aircraft and surface vessels that support Wallops Range operations.



## COASTAL SURVEILLANCE RADAR (CSR)

The Coastal Surveillance Radar (CSR) will provide coverage to the south end and back bay areas of Wallops Island. The COTS solution will enhance Range surveillance capabilities; improving ability to detect, identify and clear potential fouling vessels within surface hazard areas



## LIGHTWEIGHT SURVEILLANCE AND TARGET ACQUISITION RADAR (LSTAR)

The Lightweight Surveillance and Target Acquisition Radar (LSTAR) will be installed on the Mainland and the Main Base. It will provide 360 degree, 3-D electronic scanning capabilities for detecting and tracking the most difficult airborne targets. These radars reliably detect and track unmanned aircraft systems, fixed and rotary wing aircraft, such as ultralights, paragliders and hang gliders. The LSTAR systems are ideal sensors to be part of the Range Surveillance system.

# SURVEILLANCE UPGRADES

## *Wallops Range*

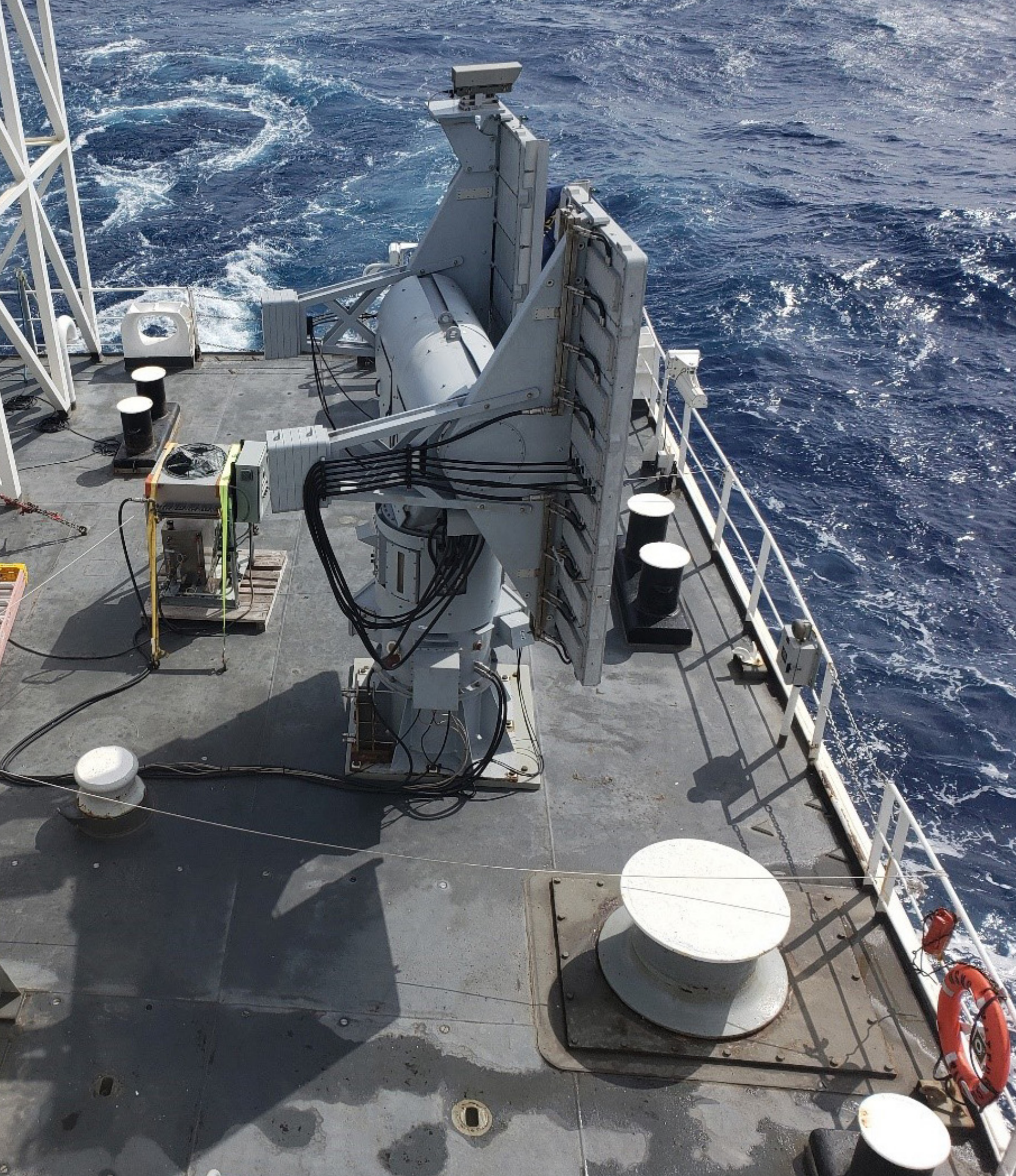
### **X-BAND RADAR PROJECT**

The X-Band Radars known as X-1 and X-2 are multi-frequency trajectory radar (MFTR-2100) capable of tracking in real-time for multiple objects. In 2019, the X-Band radar project saw the refurbishment of the X-2 Radar and its loan to the U.S. Navy's Strategic Systems Programs. The U.S. Navy successfully operated the X-2 Radar aboard the Launch Area Support Ship USNS Waters off the coast of Southern California during test flights of four unarmed Submarine Launched Ballistic Missile Trident II (D5) strategic weapon systems. These tests allowed the U.S. Navy to validate performance expectations of the life-extended Trident II (D5) strategic weapon system.

Range personnel also supported the U.S. Navy and gained valuable experience during this endeavor. Team members participated in pre-deployment system configuration efforts and system testing at the Mid-Course Radar Facility at Kennedy Space Center, Florida, and assisted in installing the radar onto the USNS Waters at Charleston, South Carolina. Additionally, Range personnel are supporting NASA's Commercial Crew Program certification of the SpaceX's Dragon capsule during an In-Flight Abort Test (IFAT) aboard the Falcon 9 vehicle from Kennedy Space Center in January 2020.

The coming year will see the delivery of the X-2 Radar's trailer, which will mobilize the system for future mission support, both within and outside of NASA.





# UPCOMING MISSIONS







# UPCOMING MISSIONS

## ANTARES NG-13 & NG-14

In 2020, Northrup Grumman (NG) has two scheduled Antares launches with the Cygnus Spacecraft, NG-13 and NG-14, in February and August, respectively. These missions will be part of the ongoing CRS-II mission to resupply the International Space Station. NG will continue the synergistic partnership with NASA, and MARS to provide pad and range services. NG will continue to utilize the more robust Antares 230+ configuration and the large Cygnus spacecraft for each of these missions.

## ROCKET LAB

In October 2018, NASA and Virginia Space entered into an agreement with Rocket Lab to build an additional launch pad, Launch Complex 2 to conduct dedicated flights of small spacecraft missions. Construction on Pad Launch Complex 2 commenced in February 2019, with the site operational just 10 months later in December 2020 and final pad testing to be completed by January 31st. More than 150 local construction workers and contractors were involved in the development of the Launch Complex, with many Virginia-based companies supplying services, hardware and materials for the site. Locally built infrastructure includes the 66-ton launch platform and 44 foot, 7.6-ton strongback.

Rocket Lab is planning on launching during quarter 2 of 2020 to provide a dedicated launch for the USAF Space Test Program (STP). This will be the first time a Rocket Lab Electron vehicle will be launched from the U.S. and the first to utilize the NASA Automated Flight Termination System (AFTS).





# UPCOMING MISSIONS

## SOUNDING ROCKET CAMPAIGNS

The Research Range Services (RRS) team continues to support the Sounding Rocket Program Office (SRPO) by providing launcher operations, communications, data processing, radar, telemetry, timing, optical tracking, payload recovery, surveillance, and weather services.

## ROCKON

The RockOn workshop continues its support of the next generation in June 2020. This workshop is an opportunity to provide exposure to, and spark interest in, space-based science missions to universities. This is accomplished by flying two classes of experiments. First time participants generally fly the simpler kit built experiment. As educational institutions gain more experience, it is expected they will progress towards developing their own unique RockSat-C class experiments. This particular launch will be on a two-stage Terrier-Improved Orion.

## DYNAMO-2

In August 2020, SRPO is planning two launches of Dynamo-2 on a Black Brant 9 two-stage sounding rocket. The Black Brant 9 has a Terrier first stage and a Black Brant second stage. The overall objective of this suite of instruments on the Dynamo-2 payloads is to measure DC electric fields, plasma density, currents, neutral winds, neutral density and temperature, and ion mass distributions.

## ROCKSAT-X

Also in August 2020, the RockSat-X which will carry student developed experiments. This mission is a follow-on mission of the RockOn and RockSat-C programs. RockSat-X experiments are more advanced and include full-featured sounding rocket support systems, including telemetry, attitude control and recovery. RockSat-X experiments are exposed to the space environment enabling measurement of variables outside the payload. The payloads will be launched using a two-stage Terrier-Improved Malemute.

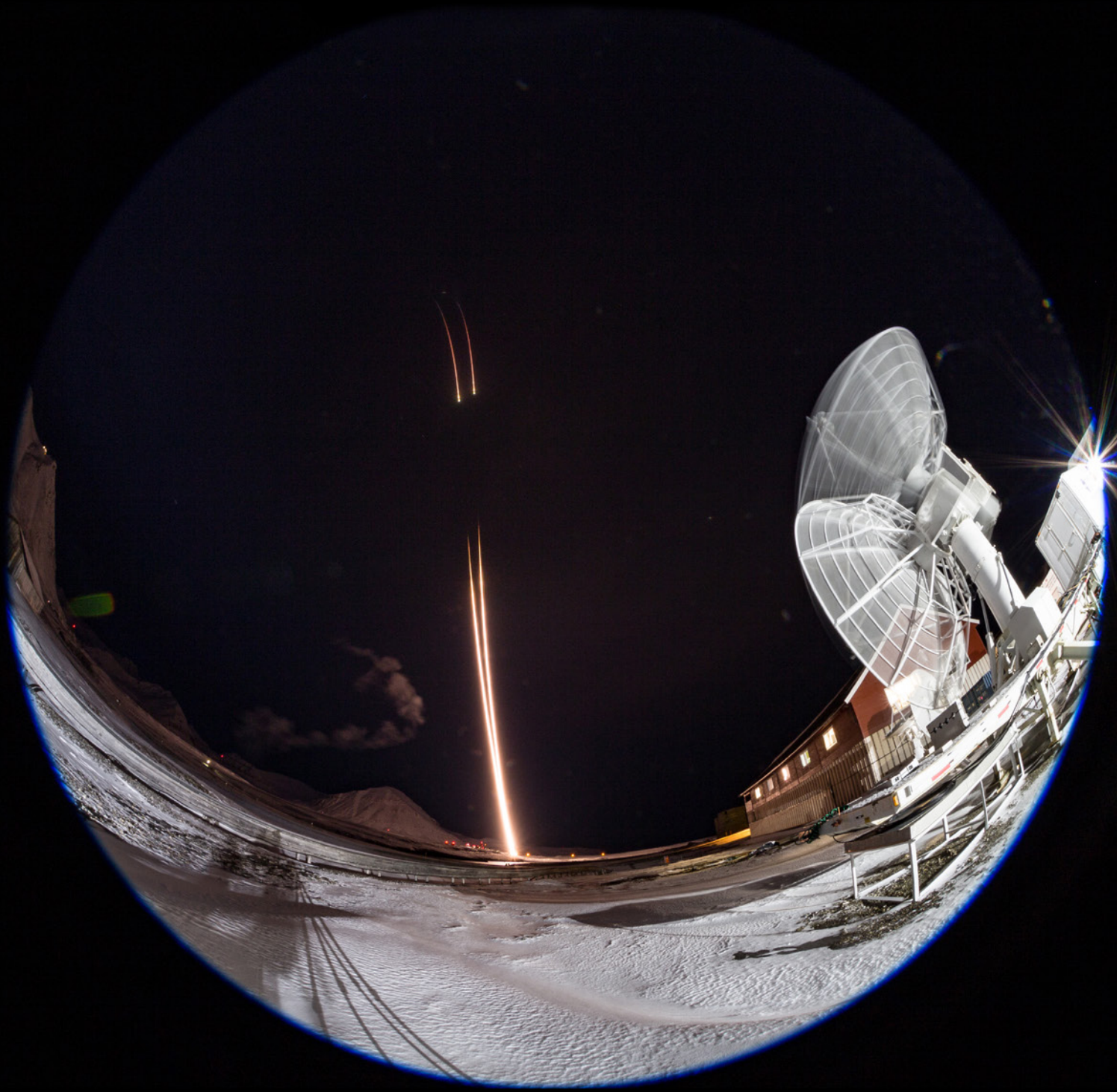
## VIPER

The VIPER mission is an observational and modeling effort to understand Very Long Frequency (VLF) wave penetration through and propagation above the Earth's ionosphere. The two-stage Terrier-Improved Malemute sounding rocket will support this payload.









**NATIONAL AERONAUTICS AND SPACE ADMINISTRATION**

Goddard Space Flight Center • Wallops Flight Facility

34200 Fulton Street, Wallops Island, Va. 23337

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**WALLOPS**

— R A N G E —