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SUBORBITAL AND SPECIAL ORBITAL PROJECTS DIRECTORATE

Doing Business at Wallops Flight Facility

A Customer Guide

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Check the Wallops Documentation Web site at
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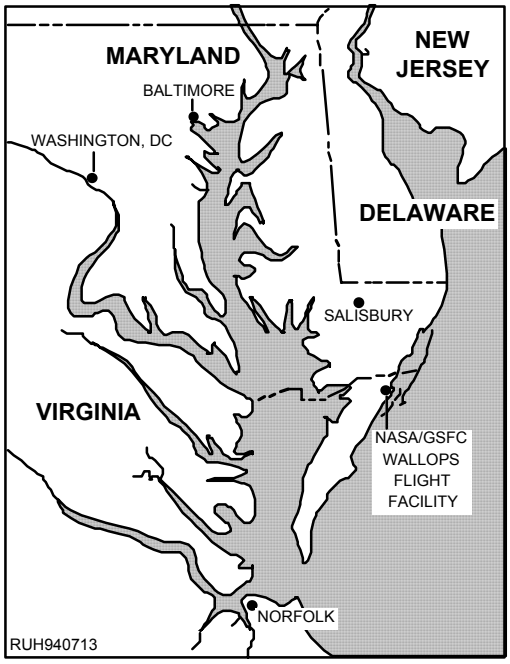
Preface



The NASA/Goddard Space Flight Center (GSFC) operates the Wallops Flight Facility (WFF) located on the Eastern Shore of Virginia. NASA supports space and Earth science research and aerospace technology development through the use of rockets, balloons, aircraft, and Shuttle-based carriers. In support of these activities, Wallops offers a variety of services and operates a number of unique research facilities, including a launch range, research airport, scientific laboratories, and manufacturing and testing facilities. Because of unique scientific requirements, Wallops also maintains capabilities to conduct research activities worldwide. Wallops' customers represent NASA, other United States Government agencies, foreign and commercial organizations, and educational institutions. *Doing Business at Wallops Flight Facility: A Customer Guide* is a capabilities document that provides descriptions of facilities, along with policies and procedures for facility use.

Additional copies of the *Customer Guide* may be obtained from the Policy and Business Relations Office (Code 802), NASA, GSFC/Wallops Flight Facility, Wallops Island, VA 23337-5099; or it may be downloaded from the WFF Web site at http://www.wff.nasa.gov.

Abbreviations and acronyms used in the *Customer Guide* are listed in Appendix A. Detailed technical information regarding research range instrumentation and facilities is contained in documentation listed in Appendix B, References.

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Part I: Introduction

1.1 Overview

Wallops Flight Facility claims a heritage of low-cost operations, experienced personnel, customer-focused support, and a common sense safety program. As an operational research site for the next generation of low-cost launch technologies, NASA/GSFC Wallops Flight Facility supports the commercial development of space technologies and the dissemination of information through educational and outreach programs. We are recognized as a role model for pioneering productive and innovative government, industry, and academic partnerships.

Our ongoing programs and projects support all four NASA enterprises—Earth Sciences, Space Science, Aeronautics and Space Transportation Technology, and Human Exploration and Development of Space—as well as the development and testing of space-based technology.

Wallops' key mission elements include

Suborbital Flight Projects—Wallops manages and implements NASA's sounding rocket, balloon, and scientific aircraft programs in support of the Earth Sciences and Space Science enterprises. New technologies, such as ultra-long duration balloons, are integrated into the program.

Low-Cost Orbital Missions—Wallops manages and provides technical support for University Class missions and Space Shuttle-based carrier systems.

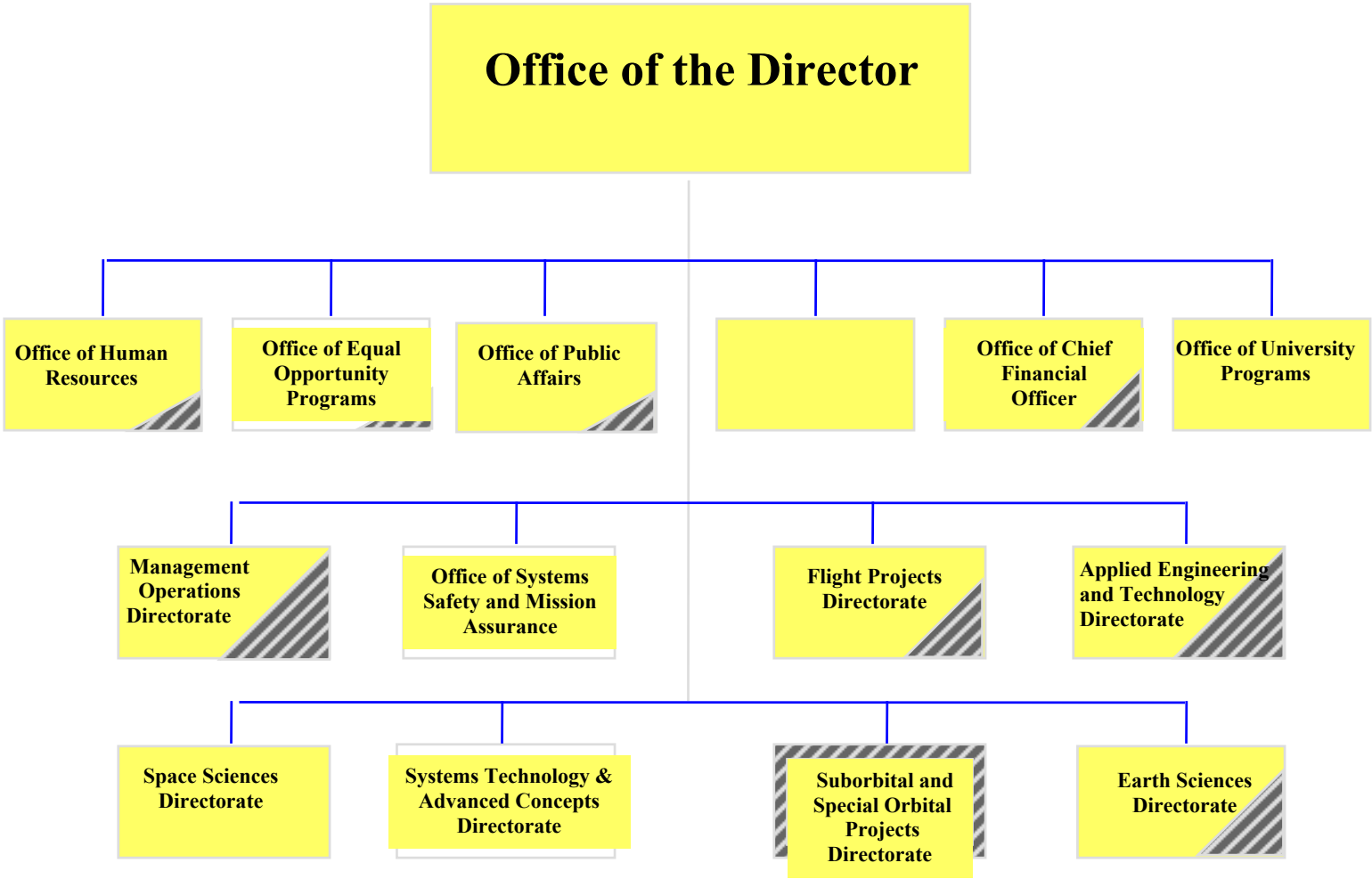
Mission Operations—Wallops provides fixed and mobile launch ranges and a research airport. The range provides the services necessary for a wide variety of research, development, and operational missions, including rocket, balloon, and aerial vehicle flights. Wallops also manages and operates satellite tracking stations locally and at other worldwide locations. The Research Range supports NASA, DoD, commercial, and academic organizations.

Science and Technology—Wallops Earth scientists research global climate change. Wallops engineers develop new technologies that improve capabilities of flight projects or lower costs of access to space.

Educational Outreach—Partnerships formed with industry and academia foster educational outreach programs. Wallops also carries out a wide array of education and outreach programs that support the development of future engineers and scientists.

The Goddard Space Flight Center organization chart is displayed on the following page. Shaded areas indicate key mission elements and personnel assigned to Wallops Flight Facility.

Goddard Space Flight Center



Wallops Personnel

1.2 Vision

Wallops Flight Facility will be a national resource for enabling low-cost aerospace-based science and technology research.

1.3 Mission

Wallops Flight Facility will:

- *Enable scientific research through the development and deployment of low-cost, highly capable suborbital and orbital research/payload carriers and science platform mission services.*
- *Enable aerospace technology and facilitate commercial use of space through advanced technology development, testing, operational support, and facilitation of the commercial launch activity at WFF.*
- *Enable education, outreach and innovative partnerships by providing science and technology educational opportunities, and pursuing innovative partnerships with academia, other government agencies, and industry.*

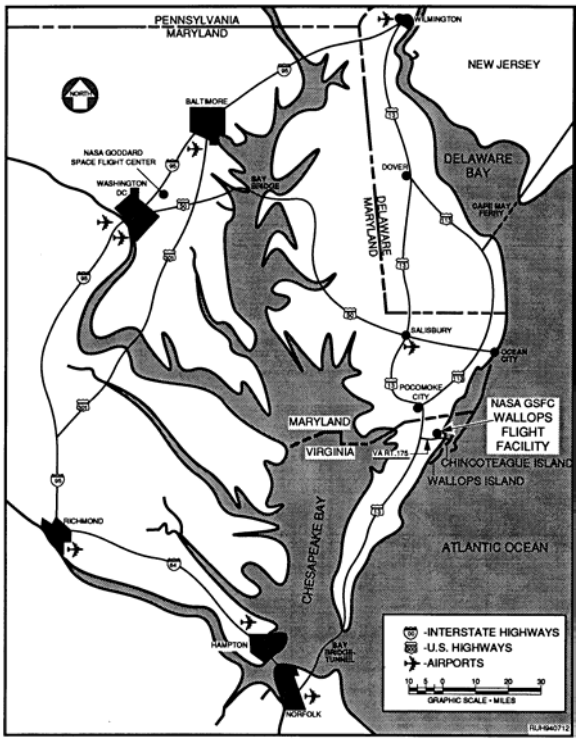
1.4 History

For more than 50 years, Wallops has provided launch support for some of the highest priority research programs in the United States. Founded in 1945, Wallops was established by the National Advisory Council on Aeronautics (NACA) as a test site for aeronautics research projects. During the 1940's and 1950's, prior to the era of high-speed wind tunnels, Wallops activities focused on providing operational testing for new aerodynamic configurations aboard rockets. During the 1960's, Wallops focused on support for numerous flight projects leading to human exploration of space, such as Little Joe, which tested the ejection system for the Mercury capsule. From the 1960's through the 1980's, Wallops supported the launch of more than 40 Scout rockets. During the 1990's, Wallops evolved its mission beyond operational support to include project management and implementation of various NASA space and Earth science activities aboard suborbital and small orbital carriers. During its history, Wallops has conducted more than 15,000 launches. For a more detailed history of Wallops Flight Facility, visit our Web site at http://www.wff.nasa.gov.

1.5 Geography

Wallops Flight Facility and Research Range encompass more than 6,000 acres over three different land parcels. The WFF Main Base is located on Virginia's Eastern Shore 5 miles south of the Maryland state line. The Main Base is home to most of NASA's administrative, engineering, fabrication, testing, and project management activities, as well as the Research Airport and Range Control Center. The Mainland and Wallops Island are located approximately 7 miles to the southeast, adjacent to the Atlantic Ocean. Wallops Island is the site of the Wallops Launch Range and many supporting facilities.

Wallops Main Base



Road Map to Wallops Flight Facility

Wallops Island

Major air carrier service is available to Baltimore-Washington International Airport, Ronald Reagan National Airport, Philadelphia International Airport, or Norfolk International Airport. Commuter air service is available to Salisbury, Maryland, except from Norfolk.

1.6 Other Resident Organizations at Wallops Flight Facility

United States Navy (USN) Surface Combat Systems Center (SCSC) provides facilities that replicate USN fleet ships for purposes of training and technology validation. The Naval Air Warfare Center (NAWCAD) from Patuxent River, Maryland, also maintains facilities and personnel at Wallops. NAWCAD makes regular use of the Research Range for missile launches and aircraft development testing. Main Base facilities include housing for personnel and dependents, food services, medical clinic, and Base Exchange.

United States Coast Guard (USCG) is represented by Station Chincoteague and Group Eastern Shore, both quartered on Chincoteague Island. Dependent housing occupies several acres on the Wallops Main Base. Search and rescue helicopters and other aircraft use the airport as a base of operations.

National Oceanic and Atmospheric Administration (NOAA) operates a field site of the National Environmental Satellite, Data, and Information Service (NESDIS), which produces multidimensional imagery from polar orbiting and geostationary satellites operated by NOAA.

Virginia Commercial Space Flight Authority (VCSFA) markets the Wallops Research Range and operates the Virginia Space Flight Center (VSFC) on Wallops Island in partnership with NASA. The VSFC offers a "one-stop shopping" place for low-cost, safe, reliable, user-friendly space launch facilities and services for commercial, Government, and scientific/academic users, both foreign and domestic, who want to purchase launch range services through a commercial spaceport. VSFC has established commercial launch facilities and often serves to broker NASA-supplied range services through a Space Act Agreement or contractual relationship, thereby allowing multiple approaches to integrated WFF range services. See additional information on VSFC facilities and services at http://www.vaspace.org/.

Marine Science Consortium (MSC) is a non-profit corporation dedicated to promoting teaching and research in the marine sciences. Founded in 1968, the MSC established operations at Wallops Flight Facility in 1971. The MSC is a cooperative educational venture, where 16 member institutions pool resources to offer courses and to provide residential and laboratory facilities to students from all member institutions. For more information, visit the MSC Web site at http://www.msconsortium.org.

Part II: Capabilities

2.1 Overview

The Wallops Flight Facility supports a wide variety of projects for a diverse customer base. These projects range from small rockets, balloons and aircraft, to orbital launch spacecraft. Services include project management, engineering, fabrication, testing, and operational support. Wallops supports space and Earth science research and aerospace technology development for NASA for meteorological studies, sounding rocket operations, Space Shuttle tracking, orbital launches, next-generation launch vehicle development, small spacecraft development, and aeronautical research projects.

Wallops supports a wide array of U.S. Department of Defense (DoD) research and development (R&D) and training missions, including target and missile launches, and aircraft development.

A growing percentage of Wallops Flight Facility business comes from the private sector. Wallops regularly provides launch support for the emerging commercial launch industry, either directly or through the Virginia Space Flight Center. Wallops also supports numerous aircraft companies that utilize the Research Airport for activities such as water ingestion testing.

2.2 Flight Programs and Projects

2.2.1 Sounding Rocket Program

The NASA Sounding Rocket Program provides end-to-end mission support primarily for the NASA space science community through the use of suborbital rockets. The program also regularly supports non-NASA customers, such as DoD, on a cost reimbursable basis. The program provides suborbital spacecraft and launch services support to the scientific academic community, DoD and other Government agencies, and to international sounding rocket groups and scientists. The program has yielded numerous research papers and important scientific findings, and has served as the proving ground for the development of a variety of satellite instrumentation. These missions also provide hands-on training for new scientists through the graduate study programs of educational institutions that participate in the program.

Since the program's beginning in 1959, there have been more than 3,000 flight missions with a science mission success rate of 86 percent and a launch vehicle success rate of more than 95 percent. The program is a low-cost, quick-response effort that currently provides approximately 20 to 35 flight opportunities per year to space scientists. Scientific disciplines supported include upper atmospheres, plasma physics, solar physics, planetary atmospheres, galactic astronomy, high-energy astrophysics, and micro-gravity research. The sounding rockets are launched from a variety of fixed and mobile launch sites throughout the world.

Systems and services provided to users of the program encompass the complete support spectrum, including mission management, payload design and development, launch vehicles, recovery systems, attitude control systems, data collection and telemetry systems, mission analysis, payload testing and flight qualification, and launch operations. The program is conducted with less formal and expensive reliability and quality assurance processes employed in larger and more costly orbital, shuttle, and deep space programs. This informal, low-cost approach also includes the extensive use of surplus military motors. These practices are instrumental in enabling the program to support the high flight rate within the available NASA resources while maintaining a high success rate.

The NASA Sounding Rocket Operations Contract (NSROC) contractor carries out most mission-specific services for implementation of the Sounding Rocket Program. As such, the NSROC contractor designs, fabricates, integrates, and performs flight qualification testing of suborbital payloads; provides launch vehicles and associated hardware; and performs various functions associated with launch operations and subsequent activities.

In support of unique scientific requirements, the Sounding Rocket Program conducts missions from worldwide locations, including mobile field campaigns. For more information, refer to the 810-HB-SRP, *Sounding Rocket Program Handbook*.

2.2.2 Balloon Program

The NASA Balloon Program provides support for scientific investigations sponsored by the NASA Office of Space Science. The program maintains permanent facilities at the National Scientific Balloon Facility (NSBF) in Palestine, Texas, and the Scientific Balloon Flight Facility (SBFF) in Fort Sumner, New Mexico. The program also maintains a Balloon Research and Development Laboratory at Wallops.

The Balloon Program at Wallops currently provides 25 to 30 balloon flights per year for payloads up to 7,000 pounds. Flight duration ranges from 1 to 32 days with float altitudes around 130,000 feet. The Ultra Long Duration Balloon project is working towards increasing flight durations to 100 days with a pressurized balloon system. Another recent balloon development is the 60 million cubic foot balloon, which can lift 1,600 pounds to 160,000 feet.

The Balloon Program provides a cost-effective way to make scientific observations in the near-space environment - above 99 percent of the Earth's atmosphere. Balloons frequently offer the only viable flight opportunity for large instruments or cost-constrained experiments. Balloons recently have had a 100 percent launch vehicle success rate.

The NASA Balloon Program is divided into two main areas: Flight Operations and Technology Development. NASA provides overall program and technology management, while the contractor carries out mission implementation.

The program occasionally supports DoD and foreign government cooperative programs on a cost reimbursable basis. Additional information is available through the Balloon Program Office Web site at http://www.wff.nasa.gov/balloons/.

2.2.3 Aircraft Program

The ability of NASA scientific aircraft to respond quickly and cover remote and large areas worldwide makes them useful tools in conducting scientific research. Equipped with computers, lasers, radar and other instruments, a Wallops Lockheed P-3B Orion serves as an airborne scientific platform used to support NASA scientists and other Earth scientists from universities and other government agencies, both domestic and foreign. The aircraft supports scientific studies involving volcanoes, forest ecological systems, ice formations, atmospheric phenomena, ocean dynamics, and plant life.

The P-3B, with a range of 3,800 nautical miles, 12 hours airtime, and a maximum altitude of 30,000 feet, can be set up for an experiment and deployed for a science mission in as little as two weeks. It has multiple instrumentation ports, airborne radar, and special features to support remote sensing and instrumentation development.

Aircraft equipped with scientific instruments fly under satellite sensors to evaluate and verify satellite data. Also, instruments for future satellites are tested and evaluated on the scientific aircraft prior to being flown in space.

Wallops also leases Twin Otter aircraft for lower altitude, short duration Earth Science projects. Additional information on research aircraft can be found in the 830-AOM-0001, *Aircraft Operations Manual* at http://www.wff.nasa.gov/~apb/.

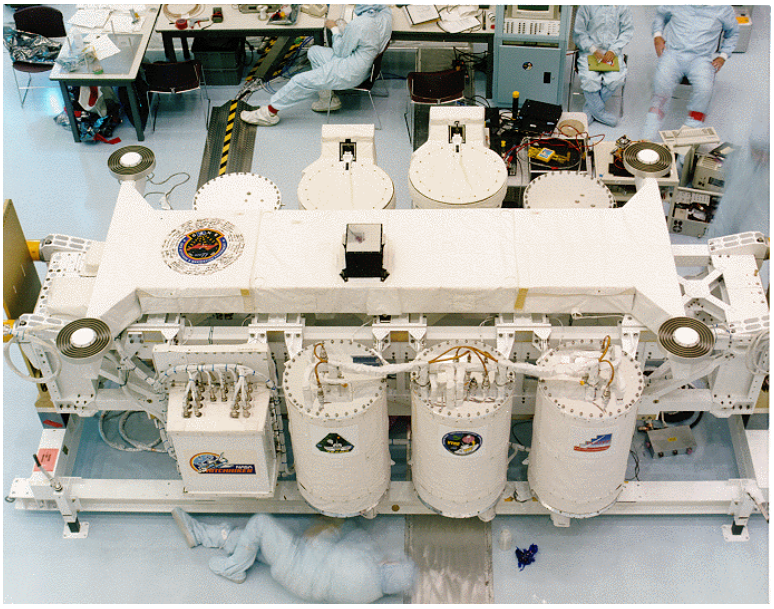
2.2.4 Shuttle Small Payloads Project

The Shuttle Small Payloads Project (SSPP) designs, develops, tests, integrates and flies small payload carrier systems for the Space Shuttle. These carriers–the Getaway Special (GAS) and Space Experiment Module (SEM)–support payloads supplied by NASA, other U.S. Government agencies, universities, high schools, domestic commercial customers, and foreign customers. The carriers can support payloads that range in size between 6 pounds (2.7 kilograms) and 200 pounds (90.9 kilograms).

Carrier systems are described below.

- **SEM** (Space Experiment Module) is a self-contained assembly of structure, power, command, and data storage capabilities for small experiments exclusively for educational institutions.

- The **GAS** (Get Away Special) carrier provides limited mechanical and electrical interfaces for self-contained experiments. Simple crew control functions may be performed; however, the user addresses internal system requirements.



GAS Carriers Being Prepared for Flight

Additional carrier information is provided in the Carrier Programs Comparison chart found on the Wallops Web site at http://sspp.gsfc.nasa.gov.

2.3 Operational Test Capabilities

The Wallops Research Range is part of the Wallops Flight Facility and is managed by GSFC Suborbital and Special Orbital Projects Directorate. The range consists of a launch range, an aeronautical research airport, and associated tracking, data acquisition, and control instrumentation systems. The range includes authorized operating space, primarily over the Atlantic Ocean, and authorized frequency spectrum.

2.3.1 Launch Range

NASA maintains and operates an integrated launch range and research airport at Wallops to support a large array of NASA flight projects. Wallops also operates a fully capable mobile launch range to support operational needs worldwide. NASA and its contractors provide project management, safety, data services, ordnance handling, and logistical services.

Range Control Center

The focal point for all research range operations is the Range Control Center (RCC) located on the Main Base. Data from the range support instrumentation, e.g., closed circuit television, weather, radar, and telemetry data, are acquired, processed, and made available for video display throughout the facility. This data assimilation in conjunction with communications and command links facilitates the coordination, control, and safe conduct of Wallops missions.

Launch Facilities

The Wallops Island Launch Range is an integrated research range offering fixed and transportable launch facilities. The island site is comprised of six launch pads (some containing multiple launchers); three blockhouses for launch control; and assembly buildings to support the

preparation and launch of suborbital and orbital launch systems. User-provided launch systems can be accommodated.

A listing of capabilities and characteristics of launchers can be found in 840-HDBK-0001, *Wallops Flight Facility Range User's Handbook.*

Instrumentation

The Wallops Research Range possesses a highly capable set of range control and data instrumentation systems, including the following:

- Fixed and mobile telemetry systems
- Fixed and mobile radar systems
- Fixed and mobile UHF transmitter systems
- Fixed and mobile command systems
- Data and voice communication systems
- High-speed tracking cameras
- Compatibility with downrange federal instrumentation sites

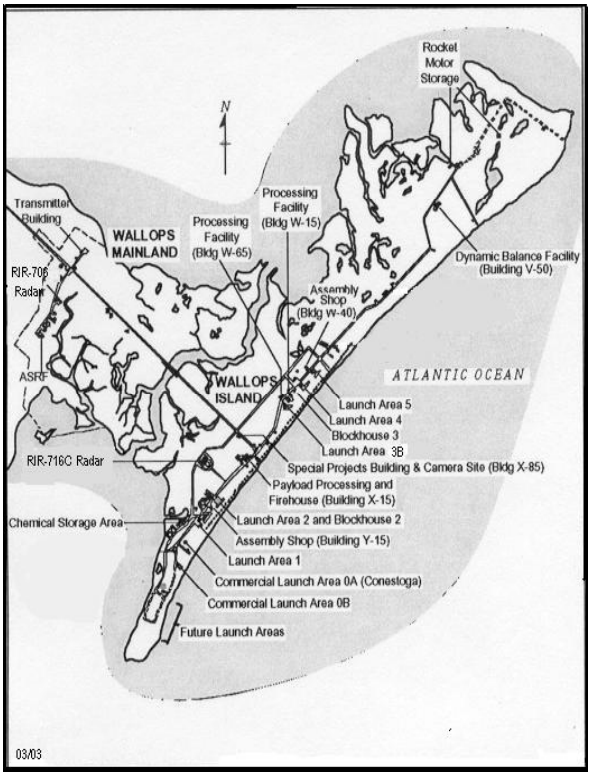
Range instrumentation is operated by the Near Earth Network Services (NENS) contractor. See the *Wallops Flight Facility Range User's Handbook* for more detailed discussion of instrumentation systems.

Processing Facilities

The Wallops Research Range has facilities for the receipt, inspection, assembly, checkout, and storage of rocket motors and other pyrotechnic devices. A new multifunctional processing facility, due to open Summer 2004, is located outside Wallops Main Gate behind the MSC. The facility will have a high bay that measures 80 feet x 40 feet x 70 feet high, a Class 100K clean room, and other support amenities. Refer to the *Wallops Flight Facility Range User's Handbook* for descriptions of all assembly and payload processing facilities available at Wallops.

Other facilities available to customers include clean rooms, aircraft hangar space, blockhouses, and furnished office space. Telephone service, fax machines, and LAN access for email and Internet services are available for a fee (see 2.6.9). Wallops operational facilities are linked by fiber optic and telephone cable to allow routing of data from tracking sites to user instrumentation.

The drawing to the right depicts Wallops Mainland and Wallops Island Research Range launch facilities showing location of support facilities and launch pads.



Liquid Fueling Facilities

Wallops Research Range can support spacecraft operations using monopropellant hydrazine. SCAPE[1] suits are available for hydrazine fueling operations. The suits are certified and come equipped with all hardware, air lines, communications, and portable, hand-held monitors. A cart is available for fuel transfer and contains a catch tank for inline waste product and a scrubber.

The WFF Liquid Fueling Facility (LFF), due to come online in Fall 2004, was conceived as a flexible, expandable, modular, and transportable launch service to accommodate emerging launch companies (ELCs) utilizing the VCSFA launch infrastructure on Wallops Island. Initial operating capability supports liquid oxygen/kerosene, hybrid suborbital, and small orbital vehicles. See the *Wallops Flight Facility Range User's Handbook* for a more detailed description of the LFF.

2.3.2 Research Airport

The WFF Research Airport is located on the Main Base. There are three runways, two taxiways, three ramps, and one hazardous cargo loading area in active service. The runway dimensions are as follows:

- 04-22 – 8,750 feet by 150 feet
- 10-28 – 8,000 feet by 200 feet
- 17-35 – 4,820 feet by 150 feet

The taxiways that service these runways are parallels of 04-22 and 10-28 and are the same length as their respective runways. Two ramps adjoin the two active hangars, and a third ramp adjoins the Crash Fire and Rescue building. The hazardous cargo loading area adjoins the approach end of runway 17.

Runways 10 and 17 are configured with FAA-approved circling and straight-in approaches. Runway 04-22, the primary research runway, has a test section with a variety of surface textures and materials for runway research projects. Runway features include the following:

- Grooved section for runway friction research
- Water test section for aircraft water ingestion tests
- Runway-to-taxiway high speed turnoff
- E-28 arresting gear
- Global Positioning System (GPS)

Examples of previous aeronautical research projects include runway friction, water ingestion, terminal area traffic control, GPS landing, wake vortex, new aircraft testing and pilot proficiency testing, and uninhabited aerial vehicle (UAV) operations.

Precision approach path indicators (PAPI) are installed on all runways. C-band radar and control tower support are available.

[1] Self-Contained Atmospheric Protective Ensemble.

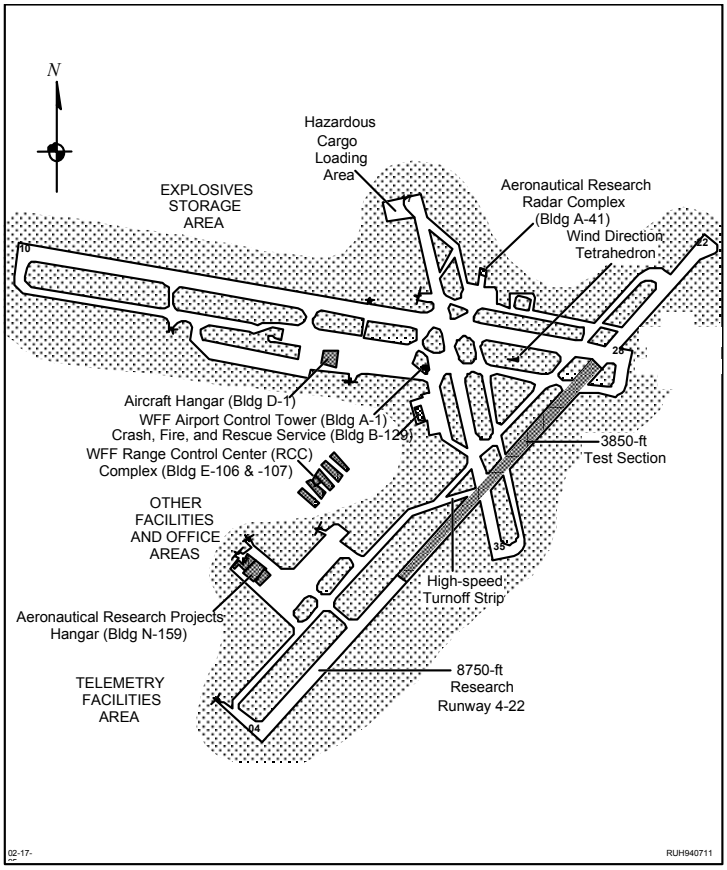
The following support and services can be provided at the Research Airport with prior arrangement:

- Hangar space
- Minor and temporary repairs
- Fuel services for JP-5
- Ground power units
- Aircraft towing
- Rollaway stairs
- Oxygen service, liquid and gaseous
- Local and national meteorological information
- Flight planning support
- First aid and emergency treatment
- Hazardous cargo handling
- Night operations support
- Support for aircraft carrying combat ordnance

Hangar, office, and shop space is available for approved aircraft projects and varies in size and location. Since Wallops is equipped to effect only minor or limited repairs to transient aircraft, project and R&D aircraft should be accompanied by maintenance personnel when engaged in flight operations at Wallops. Limited assistance may be provided for minor repairs.

Fuel services are available for U.S. Government program aircraft during normal working hours and at other times by prior arrangement. Fuel is dispensed from trucks equipped with single point refueling fittings.

Additional information regarding airport use is in 830-AFOH-0001, *Airport Facility and Operations Handbook* and on the Wallops Web site at http://www.wff.nasa.gov.



WFF Research Airport with Associated Facilities

2.3.3 Orbital Tracking

The Wallops Orbital Tracking Station (WOTS) provides continuous ground station receive and transmit capabilities for NASA low-Earth orbiting spacecraft. WOTS facilities are flexible and can be used for range telemetry and share resources with the range telemetry systems. WOTS has metric tracking and command uplink.

In addition to the fixed systems, Wallops has transportable telemetry capabilities for use at other locations. Transportable telemetry systems have metric tracking (Doppler and angles)

and command uplink. The Transportable Orbital Tracking Station (TOTS) was developed to provide a multi-mission transportable low-Earth orbit spacecraft tracking capability. TOTS can also support vehicle and payload telemetry. The TOTS operates at S-band and can be upgraded to operate at X-band.

Operations and maintenance of both the WOTS and TOTS are provided through NENS. The technical characteristics of orbital tracking systems are detailed in the *Wallops Flight Facility Range User's Handbook*.

Transportable Orbital Tracking Station (TOTS) at Poker Flat Research Range

2.4 Laboratories and Facilities

2.4.1 Fabrication Facilities

Wallops has a fully equipped machine shop that can provide electronic, electrical, and mechanical support. The 26,000 square foot machine shop includes a large selection of Computer Numerically Controlled (CNC) mills and lathes, manual machines, sheet metal fabrication, welding, and heat treating facilities. Capabilities include full CAD/CAM implementation in developing and fabricating mechanical systems, optical instrumentation, and payload components for flight research.

The fabrication area is used for such tasks as sounding rocket launcher refurbishment, and design and fabrication of mobile telemetry and mobile radar support vans and antenna systems. The machine shop includes mechanical technician laboratories for assembly of scientific sounding rocket payloads. While the facility primarily supports the Sounding Rocket Program, it regularly supports other NASA and reimbursable projects. A more comprehensive description of mechanical and electrical fabrication capabilities is available in the *Sounding Rocket Program Handbook*.

2.4.2 Environmental Test Facilities

Environmental testing of complete payloads, subassemblies, and components verifies flight readiness when exposed to an intended flight environment. Specialized facilities for environmental testing are available at Wallops in the Environmental Testing Laboratory in building F-10, adjacent to the Payload Integration Laboratory for convenience in payload handling and logistics. Additional engineering test facilities are available in the Balloon R&D Laboratory and Multi-port Payload Processing Center in building F-7. The Magnetic Calibration Facility is in building F-23, and the EMI/RFI chamber is in building N-134. The Dynamic Balance Facility is on Wallops Island in buildings V-45, V-50, and V-55. Various test requirements are briefly described below. A detailed discussion of environmental testing policies and considerations for sounding rockets is included in the *Sounding Rocket Program Handbook*.

Spin Deployment Bay (F-10) Can accommodate test articles up to 20 feet in length, 22 inches in diameter, and 1,500 pounds. 	Bend Test Apparatus (F-10) Can accommodate test articles up to 21 feet in length and can apply ±5,000-pound test load anywhere along the length of the test article. 	Static and Dynamic Balance Machine (F-10) Can accommodate a test article up to 20 feet in length, 22 inches in diameter, and 1,500 pounds.
Vibration Facility (F-10) Wallops has lateral and axial vibration equipment that can accommodate test articles with diameters up to 44 inches, lengths up to 20 feet, and weights up to approximately 2,000 pounds. 	Vacuum Chamber (F-10) Chamber is capable of achieving a pressure of $2x10^{-5}$ torr and can accommodate test articles with dimensions up to 7 feet in diameter and 12 feet in length. 	Thermal-Vacuum Chambers (F-10) Largest chamber can accommodate test articles with dimensions up to 2 cubic feet. The pressure can be reduced to $3x10^{-8}$ torr at temperatures between –73 and +125 degrees Centigrade.

Mass Properties Apparatus (F-10)
This system has a test article weight capacity of 5,000 pounds and a total length capacity of 20 feet.

Centrifuge (F-10)
The centrifuge is used for component acceleration tests. It is capable of achieving up to 1000-g acceleration at a radius of 10.5 inches. It has 8 inches of clearance between the 3-foot diameter rotary table and the cover.

Integration Labs (F-10)
The integration labs include an array of telemetry receivers, chart recorders, telemetry display terminals, frequency analyzers, and related equipment, and are dedicated to payload electrical testing and functional checks.

Balloon Research and Development Laboratory (F-7)
Membrane material testing includes uniaxial tensile, biaxial cylinder, low temperature, and long-term creep. Currently supports the Ultra-Long Duration Balloon (ULDB).

Thermal-Vacuum Chamber (F-7)
Stainless steel chamber with working area of 48 inches by 60 inches. Pressure at vacuum is 10^{-8} and can simulate altitude. Hot-cold shroud with 12 circumferential, front door and back end zones controllable to ±2°C within a range of ±100°C. Six ports and data collection system with 32 thermal couples.

Magnetic Calibration Facility (F-23)
The facility is capable of canceling the effects of Earth's gravitational field and then generating a test field in any direction. The facility can accommodate test articles with a total length of 20 feet and a maximum diameter of 10 feet.

EMI/RFI Chamber (E-134)
This anechoic chamber is used to test radiated emissions from a transmitting device, radiated immunity, or to characterize antenna radiation patterns. It provides an environment isolated from outside and reflected radiation.

Compact Antenna Range (F-7)
This anechoic chamber has the capability to blast a test object with radiated energy to see what effects ensue. It is lined with a material that absorbs radiated energy and isolates the test object from outside and reflected radiation.

Dynamic Balance Facility (V-45, V-50, V-55)
The facility supports sounding rockets, probes, re-entries, and orbital missions. Building V-45 contains one 10-ton bridge crane with a 23-foot hoist height. Building V-55 houses the Trebel FVD-3000 Aerospace Balancing Machine, which is the largest of its kind in the world. Turntable-workpiece standard adapters are available to fit the 48-inch diameter table. The building contains one 20-ton bridge crane with a 32-foot hoist height. The FVD-3000 is operated remotely from the Blockhouse Control Building, V-50.

Dynamic Balance Facility: Buildings V-45, V-50, and V-55

Three vertical Gisholt balancers are located in building V-45 and are remotely operated and monitored from V-50. The balancers are used primarily for small or medium test setups with restricted diameters. These displacement type machines are the soft bearing amplitude kind. The following table lists the capacities for all balancers.

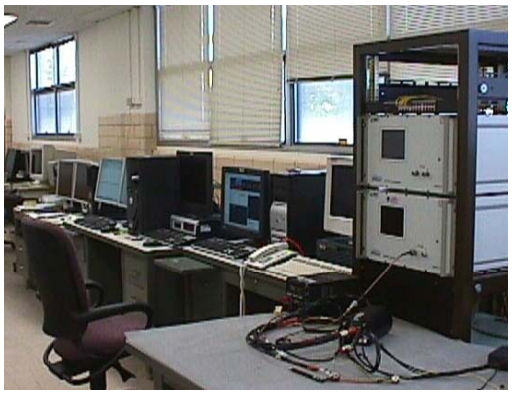
	Trebel FVD-3000 Balancer*	Vertical Gisholt Balancers
Test specimen weight	50 to 6,000 lb; 35,000 lb maximum at reduced speeds	10 to 300 lb, 40 to 2,000 lb, 50 to 3,300 lb
Balancing velocities	50 to 1,000 rpm	80 to 1,000 rpm
Maximum test specimen size	10-ft diameter (15 ft with modifications); maximum height 27 ft	46-inch diameter by 20-ft long

A variety of electronic scales are available to measure weight from 0.1 gram to 22,676 kilograms. The Toledo Scale Corporation Portable System determines weight and center of gravity (CG) of the various rocket motor components. The system specifications are below.

Maximum weight capacity:	900 lb
Weight accuracy:	0.1% or 1 lb, whichever is greater
CG accuracy:	±3 in. over 250 lb, ±2 in. over 500 lb

2.4.3 GPS Simulator Facility

The GPS Simulator Facility is comprised of a 4-output Spirent GSS GPS simulator capable of reproducing the RF signal that would be received by a GPS receiver as it travels any trajectory at any time, with parameters such as signal strength, multipathing, antenna patterns controllable for testing of navigation and attitude receivers; a single output Spirent GSS GPS receiver programmable and transportable for use in the field; and a Navigation Laboratories Tapestry GPS/IMU simulator.



These simulators may be controlled remotely to produce hardware-in-the-loop, Monte Carlo simulations of GPS and IMU for satellites and launch vehicle trajectories. No other civilian installation has the capability to develop and test sensors in this

manner. Current users include the Sounding Rocket and Scientific Balloon programs and the Autonomous Flight Safety System. The GPS Simulator Facility, currently configured for stand-alone operation, will be available for use with the range and mobile range simulator in Summer 2005.

2.4.4 Observational Sciences

Observational Sciences Branch (OSB), working within the Laboratory for Hydrospheric Processes of the Earth Sciences Directorate at GSFC, conducts theoretical, experimental and applied research in the oceanic, atmospheric, and terrestrial sciences. Branch personnel design, fabricate and operate both remote and *in-situ* sensing instruments for aircraft, balloons, and rockets. They plan and conduct laboratory and field measurements to improve the fundamental knowledge of Earth sensing and to evaluate sensor systems as well as quantify and demonstrate system performance. Various instruments and systems available for experiments are discussed briefly below. More detailed discussion is available at http://osb1.wff.nasa.gov.

NASA Air-Sea Interaction Research Facility (NASIRF)
The primary objectives of NASIRF is to test theoretical results and to collect empirical data for the development of remote sensing techniques, in support of microwave remote sensor development and algorithms for air-sea interaction studies. The photo below depicts part of the 60-foot long wave tank.

Rain-Sea Interaction Facility
The goal of the Rain-Sea Interaction Facility is to improve measurements of rain, wind, and air-sea gas exchange over the oceans. Global measurement of these processes contributes to weather prediction and climate modeling.

Wave Tank

Airborne Oceanographic Lidar (AOL)
The AOL is a remote sensing instrument usually carried onboard a NASA P-3B or C-130 aircraft. The AOL platform incorporates several sensors including two active laser fluorosensors, several passive down- and up-looking spectrometers, and a thermal infrared temperature sensor.

Airborne Topographic Mapper (ATM)
The ATM is a scanning laser altimeter which has been carried onboard the NASA P-3B aircraft and on a smaller NOAA Twin Otter. The ATM platform incorporates the laser altimeter, GPS data, and inertial navigation packages.

Radar Ocean Wave Spectrometer (ROWS)
NASA GSFC's ROWS is an airborne remote sensor used to support the development and refinement of satellite radars that measure the ocean surface.

2.4.5 Weather Forecast Office

The Weather Forecast Office provides meteorological information in support of all WFF activities. The Forecast Office provides daily and special forecast support as required. National, regional, and local weather data are available. Data sources include the Advanced Weather Interactive Processing System (AWIPS); several lightning detection systems; field mills, which measure lightning potential; and a full complement of local surface instruments to measure wind, temperature, pressure, dew point and cloud height.

A daily forecast briefing covering the upcoming 12 hours is broadcast over the WFF closed circuit television. A forecast of the upcoming 36 hours is prepared in the afternoon and is available from the Weather Forecast Office. Weather briefings are available by telephone upon request, and the daily 12- and 36-hour forecasts are placed on a telephone recording (extension 2291) at 8 a.m. and 1 p.m.

Other weather and video switching network information is available on the WFF closed circuit television network:

- Weather radar display originating from the National Weather Service (NWS) radar
- Local weather conditions, including upper winds, based on sensors at WFF
- National Lightning Detection Network displays

The following meteorological facilities support launch operations:

- Fixed, balloon-borne, and optical sensors are available for obtaining atmospheric data.
- Current weather data from weather sensors on the Main Base and Wallops Island are continuously displayed on the local WFF closed circuit TV system, and the data can be made available remotely via modem interfaces.
- An Ionosphere Sounding Station provides detailed data on the ionosphere characteristics.
- Lightning detection systems display lightning conditions locally and over the United States.
- An Electric Field Measurement System aids in determining the probability of and detection of local lightning activity.
- Indigenous WFF radar data from the Atmospheric Sciences Research Facility and other Observational Sciences radars are also available in the Weather Office.

2.4.6 Atmospheric Radar

The Atmospheric Sciences Research Facility (ASRF), which is part of the Wallops Geophysical Observatory (WGO), houses the atmospheric radar installed on Wallops Mainland. The facility possesses unique capabilities for atmospheric data acquisition, processing, display, and recording. Past studies have contributed to the understanding of atmospheric turbulence, cloud and precipitation development and dynamics, lightning discharge characteristics and distribution patterns, as well as the effects of precipitation on the transmission of electromagnetic radiation. Permanent data acquisition systems available at the ASRF include two high power radar systems (one S-band and one UHF-band) and an Environmental Data Acquisition and Recording System (EDARS). Additional information on the ASRF and WGO can be found in the *Wallops Flight Facility Range User's Handbook*.

2.4.7 Metrology Laboratory

Wallops Flight Facility maintains a Metrology Laboratory equipped to perform repair and calibration of test instruments. Customer-furnished equipment is calibrated and certified at this facility. The equipment in the standards laboratory is traceable to the National Institute of Standards and Testing (NIST). These standards are part of a mandatory recall program for recalibration and certification.

2.4.8 Chemical Laboratory

Wallops Flight Facility maintains a chemical laboratory, which performs aviation fuel analysis in support of scientific aircraft and oil analysis in support of radar installations. The lab also performs wastewater analysis for the facility.

2.5 Engineering Services

2.5.1 Mechanical Engineering

The Mechanical Systems Branch provides mechanical systems mission design and implementation for suborbital and special orbital projects and for Earth and space science instrument design and development activities at the Wallops Flight Facility. Personnel serve in the Product Design Lead role on key projects and technology development efforts and also provide technical expertise and implementation of integration, testing and launch operations.

The Mechanical Systems Branch is responsible for the entire life cycle of payload carrier mechanical systems, including technical support services in structural analysis; mechanical design; thermal engineering; materials research and development; and assembly, integration and testing

The Mechanical Systems Branch provides management and technical oversight of mechanical engineering and technical support tasks under the Wallops Engineering Services Contract, and maintains responsibility for the development and management of world-class integration and testing facilities at WFF.

2.5.2 Electrical Engineering

The Wallops Electrical Engineering Branch is responsible for conception, analysis, design, development, validation, and implementation of electrical/electronic, RF, microwave, and millimeter wave components and systems, which include flight and ground instrumentation, communication, and radar components and systems. The branch supports Wallops ELVs, sounding rockets, aircraft, balloons, satellites, Shuttle payloads, ocean-borne payloads, and support systems.

2.5.3 Guidance, Navigation and Control (GNC)

The GNC and Mission Systems Engineering Branch provides skills, vision and leadership in guidance, navigation and control systems, engineering, GNC related operations, and mission analysis. Technical disciplines include flight dynamics, propulsion, flight mechanics, guidance, navigation and control engineering for space systems, experiments, suborbital missions, and launch vehicles. The branch also provides Mission Systems Engineering support for science missions and technology development efforts.

2.5.4 Software Engineering

The Wallops Systems Software Engineering Branch (WSSEB) is the GSFC Information Systems Divisions' engineering service provider at Wallops. The WSSEB develops integrated systems for real-time mission support; performs prototyping in collaboration with other NASA and government organizations, universities, and commercial partners; and develops test beds/simulators to provide proof of concepts in an operational environment. The WSSEB analyzes, designs, tests, develops, and integrates unique software, hardware, commercial off-the-shelf (COTS), and data systems solutions to meet customer needs.

2.5.5 Safety

The Safety Office plans, develops, and provides functional management of policies and procedures for ground and flight safety, and mission assurance. In addition to its responsibilities for programmatic, operational, and institutional safety, the Safety Office performs engineering analyses of ground and flight safety systems, environmental conditions, and operating activities to assure safety, reliability, and flight worthiness. The Safety Office establishes and approves safety precautions for protection of personal property and the public from hazards generated by ground and flight systems. Safety personnel provide preflight and post-flight analyses for flight missions.

These services are provided for all Wallops-managed projects, both locally and at remote locations. The Safety Office implements the Wallops institutional safety program and manages the base fire department.

A more in-depth discussion of safety policies and procedures can be found in RSM-2002, *Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility*.

2.6 Services

2.6.1 Shipping/Receiving

Various shipping services are available, including United Parcel Service, Federal Express, and the U.S. Postal Service. The nearest commercial airfreight service is at the Salisbury-Wicomico County Regional Airport, Salisbury, Maryland. The range user should use the following information when mailing correspondence or shipping equipment for official project business:

Mail Address:	Name/GSFC Code Number NASA Goddard Space Flight Center Wallops Flight Facility Wallops Island, VA 23337 USA
Freight Destination Address:	Name/GSFC Code Number C/O Receiving Officer NASA Goddard Space Flight Center Wallops Flight Facility Wallops Island, VA 23337 USA

Hazardous materials require special handling. See 2.6.14 below for instructions and references.

2.6.2 NASA Federal Credit Union

The NASA Federal Credit Union maintains an office on Wallops Main Base. Personnel employed at GSFC may become members of the credit union. There is an ATM open 24 hours a day. More information on credit union services can be seen at http://www.nasafcu.org.

2.6.3 Cafeteria and Dormitories

The Wallops Exchange and Morale Association (WEMA) manages the cafeteria and dormitories. The cafeteria serves breakfast and lunch Monday through Friday, except holidays. Dormitory rooms are rented on a space-available basis. Morale activities can be viewed on base at http://wwr.wff.nasa.gov/mac/mac.html.

2.6.4 Medical Facilities

The Health Unit located on the Main Base is available for limited medical services in the event of an emergency during working hours. Emergency medical technicians from the fire station are available 24 hours a day. Ambulance services are also available. The Northampton-Accomack Memorial Hospital is approximately 40 miles south in Nassawadox, Virginia. The other local hospital is the Peninsula Regional Medical Center located approximately 40 miles north in Salisbury, Maryland.

2.6.5 Fitness Facility

Wallops maintains a fitness facility, which includes a gymnasium, weight room, Nautilus equipment room, locker rooms, and saunas. Guest memberships are available. The Morale Activities Committee (MAC) manages the fitness facility.

2.6.6 Security

Wallops Flight Facility maintains 24-hour security for all its property. Personnel without current security badges will not be allowed on the Main Base, the Mainland, or the Island. All visitors must check in with Security at the Main Gate. Foreign nationals must obtain prior approval to visit at least 20 working days in advance of a visit of 30 days or less and 2 calendar months in advance for an assignment over 30 days. More information regarding security requirements can be found in NPR 1620.1, *Security Procedures and Guidelines.*

2.6.7 Environmental

The Wallops Environmental Office is responsible for environmental concerns at Wallops. Services and responsibilities include hazardous waste management; pollution prevention; oil spill prevention and response; storage tank management; air pollution control; water pollution control; historical and archeological preservation; and environmental consulting.

2.6.8 Fire Department

There are two fire stations at Wallops, one on the Main Base and one on Wallops Island. Both stations are manned 24 hours a day by fully trained firefighters and emergency medical technicians. Each station is equipped to meet Wallops emergency response requirements.

2.6.9 Communications

Telephone service is provided through the Federal Telecommunications System (FTS-2000) for official U.S. Government business. Long-distance billing can be supported by telephone credit cards or prorated FTS accounts for non-Government projects. Modem support for range user computers may be provided through the digital PBX system. Pay phones are located in front of the cafeteria and in the dormitories. The Outsourcing Desktop Initiative for NASA (ODIN) contractor can provide Internet access on a month-to-month basis. There are no restrictions on pagers and cell phones. Teleconferencing and video teleconferencing services are available through the customer's sponsor. Portable audio conferencing equipment is also available.

2.6.10 Library

NASA maintains a scientific and technical library in Building E-105, Main Base. Local and national newspapers and periodicals are available on site, as well as computers with access to the Internet. The library is open from 8:00 a.m. to 4:30 p.m. Monday through Friday.

2.6.11 Print Shop

The Print Shop features a variety of duplicating equipment that produces a wide range of products from door signs to Braille documents. The state-of-the-art high-speed duplicator produces copies quickly and with special features such as storing documents for reprints and simultaneous mail merging. Customers can transmit their documents electronically rather than providing a "camera ready" hard copy. Moreover, there is a wide range of binding options for documents. Not all services are available at Wallops, but the Print Shop can arrange to have those services performed at the Greenbelt location. Information on services offered can be viewed at http://tisb.gsfc.nasa.gov/Svcs/dupl.htm.

2.6.12 Photo Services

Photo Services supports technical, scientific, and administrative organizations at Wallops. The newly established Digital Imaging Facility complements the traditional photographic services and provides many new capabilities in-house. Photo Services also offers a videotaping capability, including video production and tape duplication, as well as distribution and life cycle management of finished programs. Many more services and areas of support provided by the Photographic Services Team, such as photographic stills and high-speed video tracking, can be found at http://tisb.gsfc.nasa.gov/default.htm.

2.6.13 Material Handling Equipment

A variety of material handling equipment is available at Wallops, including forklifts, overhead hoists, cranes, basket trucks, and material moving equipment. Additional information on types of material handling equipment can be found in the *Wallops Flight Facility Range User's Handbook*.

2.6.14 Warehousing and Hazardous Materials Storage

Warehouse space is available on a limited basis. The customer should notify the Wallops point of contact in advance of the type and amount of storage required, including chemical, explosive, and inert hardware storage. All hazardous material must be packaged to conform to applicable Department of Transportation regulations. A Material Safety Data Sheet (MSDS)

must accompany all hazardous materials shipped to Wallops. For more information regarding hazardous materials shipment and storage, see the *Sounding Rocket Program Handbook,* the *Wallops Flight Facility Range User's Handbook,* and GHB 1860.1B, *Radiation Protection – Ionizing Radiation*, which defines procedures and provides the needed forms.

Part III: Policies and Procedures

3.1 Initial Contact Process

The Policy and Business Relations Office (P&BRO) is the primary resource for initial contact with Wallops Flight Facility. The P&BRO serves as the focal point for external organizations desiring to conduct business with WFF. The P&BRO can address most preliminary questions and can organize any further discussions or meetings. Once a project becomes accepted, the P&BRO hands off to a designated point-of-contact (POC) or Project Manager, who then becomes the customer interface for the duration of the project. The P&BRO continues to serve as a customer advocate and is available should the customer have issues concerning our support. The P&BRO can be reached from the WFF Web page or from the address and phone number listed in 3.11 below. If you have an established contact at Wallops, that person can direct you to the appropriate organization to meet your needs.

3.2 Policy on Support to Non-NASA Customers

While NASA's primary mission at WFF is the support of NASA science and technology programs, we can, and do, support other government agencies, commercial industry, or educational institutions on a cost reimbursable basis. Non-NASA support is a substantial portion of our workload and is accepted on a non-interference basis with our core NASA projects. The only major restriction is that we cannot compete with private industry for support on commercial projects.

3.3 Options for Conducting Work at WFF

There are several ways a customer may conduct activities at WFF. These options include:

- Direct agreement with NASA/WFF
- Agreement through the Virginia Commercial Space Flight Authority or our U.S. Navy tenants
- Agreement through our contractors

A direct agreement is the most frequent path for arranging NASA/WFF support. The process for establishing an agreement is described in 3.4 below.

Often an organization may have reason to establish a relationship with a WFF tenant organization such as the Virginia Commercial Space Flight Authority or U.S. Navy. WFF can indirectly support this organization through an agreement with the tenant organization. Under these circumstances, NASA is officially supporting the tenant. The cost to the customer for NASA support should generally be the same as through a direct relationship.

For Commercial Space Launch Act (CSLA) projects, there may be advantages to contracting with the Virginia Commercial Space Flight Authority for its services, as well as those provided by NASA. VCSFA has established CSLA agreements with NASA. This relationship allows NASA and VCSFA to quickly establish a project-specific Individual Support Annex (ISA), and eliminates the requirement to establish an Agreement and Subagreement as discussed in 3.4. VCSFA also offers additional services and business incentives not available through NASA.

NASA/WFF also encourages resident contractors to develop new business for WFF. Contractors may either refer potential customers to NASA, or may contract directly with the customer to supply services that may include those provided by the contractor and/or NASA. Under these circumstances, the contractor would establish an agreement with NASA to supply services.

3.4 Acceptance Processes

The process for accepting new projects depends on the nature of the customer and the project proposed. The process generally starts with a letter of request to WFF. The letter should be sent to

Director of Suborbital and Special Orbital Projects Directorate
NASA/GSFC/Wallops Flight Facility
Wallops Island, VA 23337

For NASA or other U. S. Government organizations requesting a well-defined, relatively short-term task, WFF will respond with an acceptance letter, establishing the WFF POC, a cost estimate, and any terms of acceptance. For more complex or ongoing activities, a Memorandum of Agreement may be more appropriate, providing more explicit details of the agreement.

For commercial or educational organizations, a Space Act Agreement is the appropriate process. A Space Act Agreement is similar to a Memorandum of Agreement but contains additional language addressing legal concerns such as liability.

NASA can agree to support commercial launch service providers through a series of CSLA documents. The first is an Agreement established with NASA Headquarters. This is followed by a Subagreement with the Goddard Space Flight Center. Once these general agreements are in place, project-specific ISAs can be established with WFF. The multi-tiered agreements are required because the CSLA requires federal agencies to set aside some expenses that would otherwise be passed along to the customer.

The P&BRO or the designated POC will assist in establishing any necessary agreements.

3.5 Single Point-of-Contact Concept

NASA/WFF operates on a single point-of-contact (POC) concept. Once WFF accepts a request for support, a POC is assigned, normally a project manager. While customer activities may involve support from numerous Wallops organizations, the POC will serve to assure that there is a single person to coordinate all customer services. This includes administrative, technical, and operational support. While WFF encourages the establishment of close working relationships between our customers and WFF supporting organizations, customers will always have a focal point for their business.

3.6 Financial Processes

As a federal organization, NASA/WFF financial processes must comply with federal law. The following policies apply to our financial practices:

- For NASA customers, some of our expenses may be covered by NASA funding and may not be passed on to our customers.

- WFF cannot make a profit. We can only recapture our actual expenses in supporting a customer.
- According to federal law, NASA must recoup actual expenses, regardless of any cost estimate provided.
- NASA cannot support projects without adequate funding in place. We cannot begin work until funding is established, and we cannot continue work if available funding has been expended.
- For commercial projects, NASA cannot compete with commercial entities offering similar services.
- For projects accepted according to the Commercial Space Launch Act, certain NASA expenses cannot be passed along to customers.

The P&BRO will be glad to provide a cost estimate for any prospective activity. The quality of the estimate will be dependent on our experience with similar activities and the level of detailed assumptions provided by the customer.

NASA accepts a number of funding mechanisms, depending on the customer type. For NASA projects, a budget guideline change to reallocate funding to GSFC is the normal approach. For DoD organizations, a Military Interdepartmental Purchase Request (MIPR) can be provided. For commercial activities a corporate cashier's check can be used. All funding should be provided to

Office of the Chief Financial Officer
Goddard Space Flight Center
Greenbelt, MD 20771

For extended projects, the POC can provide periodic financial status reports. Upon completion of a project, a final accounting of expenses will be compiled. The customer will receive a letter from the Comptrollers Office detailing final expenses and providing a refund for leftover funds, or requesting additional payment for any shortfall. The POC will address any financial issues the customer may have.

3.7 Safety Processes

NASA has ultimate safety authority for all activities conducted at WFF. WFF, however, also strives to provide a customer-friendly safety program while carrying out its responsibilities. Safety Office personnel must review and approve all projects prior to their initiation. For flight projects this typically involves review of mission plans, vehicle and payload design, and operational procedures. WFF safety requirements are defined in RSM-2002, *Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility*, available from key WFF personnel or on the WFF Web site. The Safety Office works with customers to define documentation requirements and to establish operational plans that assure that safety requirements are satisfied while minimizing the burden to the project. For projects previously conducted at other sites or otherwise subjected to safety review, WFF Safety Office personnel will take advantage of previous safety analyses, minimizing cost and impact to the project. It is a WFF practice to involve safety personnel early in a project's life in order to identify any potential problems that can be resolved without impacting schedule or cost.

3.8 Environmental Processes

NASA/WFF has a number of existing environmental documents in place that address the impacts of its various flight projects and operations. In most cases WFF environmental documentation adequately addresses additional projects from new customers. Early in a new project, we will evaluate whether the existing WFF assessments adequately address the environmental concerns of a customer's project. Should a planned activity be outside the scope of our documentation, our environmental staff will work with the customer to define a plan of action. The customer's POC will coordinate dealings with the Wallops Environmental Office.

3.9 Frequency Utilization

Because WFF has a large number of instrumentation systems that radiate or receive radio frequency (RF) signals, frequency interference is a significant concern. WFF also regularly performs activities with ordnance systems that are susceptible to RF energy. To protect against frequency conflicts, the WFF Frequency Coordinator must approve all transmitting systems utilized at WFF. The customer's POC will coordinate frequency approvals.

3.10 ISO 9001

In November 1999, NASA/WFF became ISO 9001 certified. All flight projects, mission operations, and other major services have established practices designed to provide high quality, customer oriented support.

3.11 Customer Feedback

We constantly strive to provide the highest caliber of service to our customers. In order to identify areas of improvement, we need feedback from you. You may be requested to evaluate our performance by your WFF point of contact. If not, you may provide any comments to

Policy and Business Relations Office
NASA/GSFC
Wallops Island, VA 23337
(757) 824-1275
Lucille.J.Fox@nasa.gov

Your thoughts on our support are important to us and assure that we continue to provide quality service.

Appendix A

Abbreviations and Acronyms

AFOH	Airport Facility and Operations Handbook
AOL	Airborne Oceanographic Lidar
ASRF	Atmospheric Sciences Research Facility
ATM	Airborne Topographic Mapper; automatic teller machine
AWIPS	Advanced Weather Interactive Processing System
CAD	Computer-aided Design
CAM	Computer-aided Manufacture
CNC	Computer Numerically Controlled
C/O	Care of
COTS	Commercial Off-the-Shelf
CSLA	Commercial Space Launch Act
DoD	Department of Defense
EDARS	Environmental Data Acquisition and Recording System
ELC	Emerging Launch Company
ELV	Expendable Launch Vehicle
EMI	Electromagnetic Interference
ft	Foot; feet
FTS	Federal Telecommunication System
GAS	Getaway Special
GHB	Goddard Handbook
GNC	Guidance, Navigation and Control
GPS	Global Positioning System
GSFC	Goddard Space Flight Center
HB	Handbook
HDBK	Handbook
IMU	Inertial Measurement Unit
in.	Inch; inches
ISA	Individual Support Annex
ISO	International Organization for Standardization
LAN	Local Area Network
lb	Pound; pounds
LFF	Liquid Fueling Facility
MAC	Morale Activities Committee
MD	Maryland
MIPR	Military Interdepartmental Purchase Request
MSC	Marine Science Consortium
MSDS	Material Safety Data Sheet
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NASIRF	NASA Air-Sea Interaction Research Facility
NAWCAD	Naval Air Warfare Center
NENS	Near Earth Network Services
NESDIS	National Environmental Satellite, Data, and Information Service
NFCU	NASA Federal Credit Union

NIST	National Institute of Standards and Testing
NOAA	National Oceanic and Atmospheric Administration
NPR	NASA Procedural Requirement
NSBF	National Scientific Balloon Facility
NSROC	NASA Sounding Rocket Operations Contract
NWS	National Weather Service
ODIN	Outsourcing Desktop Initiative for NASA
OSB	Observational Science Branch
P&BRO	Policy and Business Relations Office
PAPI	Precision Approach Path Indicator
PBX	Private Branch Exchange
POC	Point of Contact
R&D	Research and Development
RCC	Range Control Center
RF	Radio Frequency
RFI	Radio Frequency Interference
ROWS	Radar Ocean Wave Spectrometer
rpm	Revolutions per minute
RSM	Range Safety Manual
SBFF	Scientific Balloon Flight Facility
SCAPE	Self-contained Atmospheric Protective Ensemble
SCSC	Surface Combat Systems Center
SEM	Space Experiment Module
SRP	Sounding Rocket Program
SSPP	Shuttle Small Payloads Project
STS	Space Transportation System
TOTS	Transportable Orbital Tracking Station
TV	Television
U.S.	United States
UAV	Uninhabited Aerial Vehicle
UHF	Ultra-high Frequency
ULDB	Ultra-Long Duration Balloon
USA	United States of America
USCG	United States Coast Guard
USN	United States Navy
VA	Virginia
VCSFA	Virginia Commercial Space Flight Authority
VSFC	Virginia Space Flight Center
WEMA	Wallops Employee and Morale Association
WFF	Wallops Flight Facility
WGO	Wallops Geophysical Observatory
WOTS	Wallops Orbital Tracking System
WSSEB	Wallops Systems Software Engineering Branch

Appendix B

References

(Listed in order of appearance.)

1. 810-HB-SRP, *Sounding Rocket Program Handbook*
2. 830-AOM-0001, *Aircraft Operations Manual*
3. 840-HDBK-0001, *Wallops Flight Facility Range User's Handbook*
4. 830-AFOH-0001, *Airport Facility and Operations Handbook*
5. RSM-2002, *Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility*
6. NPR 1620.1, *Security Procedures and Guidelines*
7. GHB 1860.1B, *Radiation Protection – Ionizing Radiation*
8. Commercial Space Launch Act, Public Law 98-575