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SUBORBITAL AND SPECIAL ORBITAL PROJECTS DIRECTORATE

Wallops Flight Facility Range User's Handbook

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Signature on File
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Change History Log

Revision	Effective Date	Description of Changes
1	11/1996	Rewrite of all sections in handbook.
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C	03/10/2003	Rewrite of all sections in handbook; added Appendix B. Replaces previous Range Users Handbook, 840-RUH-1996, Revision 2.
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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 technology and aeronautical research aircraft. In support of these activities, WFF operates a research range consisting of a rocket range and research airport. Because of unique scientific requirements, WFF also maintains capabilities to conduct mobile launch activities. Wallops users represent NASA, other United States Government agencies, and foreign and commercial organizations. The *Wallops Flight Facility Range User's Handbook* summarizes Wallops' policies and procedures for facility use and provides a description of general capabilities.

The *Wallops Flight Facility Range User's Handbook* can be viewed online at http://www.wff.nasa.gov/.

Abbreviations and acronyms in the handbook are listed in Appendix A. References are listed in Appendix B.

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This version of the *Wallops Flight Facility Range User's Handbook* replaces all previous versions of this document.

Table of Contents

Page
Change History Log 2
Preface 3
Section One: Introduction 9
1.1 Purpose 9
1.2 Geography 9
1.3 Wallops Research Range 9
1.4 Operational History 10
1.5 GSFC/WFF Missions 10
1.6 GSFC at WFF 11
1.7 Virginia Space Flight Center 12
1.8 Other Wallops Organizations 14
Section Two: Wallops Research Range Support 15
2.1 Introduction 15
2.2 Key Range Personnel 15
2.2.1 WFF Test Director 15
2.2.2 Project Manager 15
2.2.3 Range Safety Officer (RSO) 15
2.2.4 Operations Safety Supervisor (OSS) 15
2.3 Policies 16
2.3.1 Safety, Reliability and Quality Assurance Policy 16
2.3.2 Frequency Utilization and Management 16
2.3.3 Scheduling 16
2.3.4 Environmental Requirements 16
2.4 Project Approval and Interface Procedures 17
2.4.1 United States Government Agencies 17
2.4.2 Commercial Organizations and Foreign Governments 17
2.4.3 Commercial Space Launch Act (CSLA) Organizations 17
2.4.4 Operational Interface 17
2.5 Technical Data Requirements 18
2.5.1 Program Requirements Document (PRD) 18
2.5.2 Safety Data 18
2.5.3 Operations and Safety Directive (OSD) 18
2.5.4 Documentation Schedule 18
2.5.5 Operational Reviews 19
2.6 Funding Information 19
Section Three: Wallops Flight Facility and Research Range 20
3.1 Introduction 20
3.1.1 Wallops Main Base 20
3.1.2 Mainland 20
3.1.3 Wallops Island 20
3.1.4 Authorized Space 21
3.1.5 Trajectory Options 21
3.1.6 Wallops Weather 23

3.2 Research Range Facilities 25
3.2.1 Launch Facilities 25
3.2.2 Liquid Fueling Facilities 28
3.2.3 Radar Systems Facilities 29
3.2.4 Telemetry Facilities 31
3.2.5 Command, Control, and Communications Facilities 35
3.2.6 Data Systems 36
3.2.7 Command Systems 36
3.2.8 Frequency Monitoring 36
3.2.9 Timing 38
3.2.10 Research Airport 38
3.2.11 Range Control Center (RCC) 40
3.2.12 Meteorological Facilities 43
3.2.13 Wallops Geophysical Observatory (WGO) 44
3.2.14 Optical and Television Facilities 45
3.2.15 Recovery Facilities 47
3.2.16 Uninhabited Aerial Vehicles (UAVs) 47
3.2.17 Fabrication Facilities 48
3.2.18 Environmental Testing Facilities 48
3.2.19 Metrology 48
3.2.20 Hazardous Material Storage 48
3.2.21 Mobile Range Systems 49
Section Four: Wallops Research Range Administration 50
4.1 General 50
4.1.1 Access 50
4.1.2 Working Hours 50
4.1.3 Visiting Aircraft 50
4.1.4 Cafeteria and Dormitories 50
4.1.5 Communication Services 50
4.1.6 Smoking 51
4.1.7 Industrial Safety 51
4.1.8 Fire Protection 51
4.1.9 Medical Facilities 51
4.1.10 Shipping 51
4.1.11 Motor Freight Truck Service 52
4.1.12 Air Cargo 52
4.1.13 Airfreight Services 52
4.1.14 Hazardous Material 52
4.1.15 Material Handling Equipment 52
4.1.16 Customs 53
4.1.17 Post Office 53
4.2 Foreign Nationals 53
4.3 Public Affairs Support 53
4.4 NASA Visitors Center 53
Section Five: Range Safety Policies 55
5.1 Range Safety Organization 55

5.2 Ranger User's Pre-arrival Requirements 55
5.3 Ground Safety 55
5.4 Flight Safety 55
Appendix A: Abbreviations and Acronyms 56
Appendix B: References 60

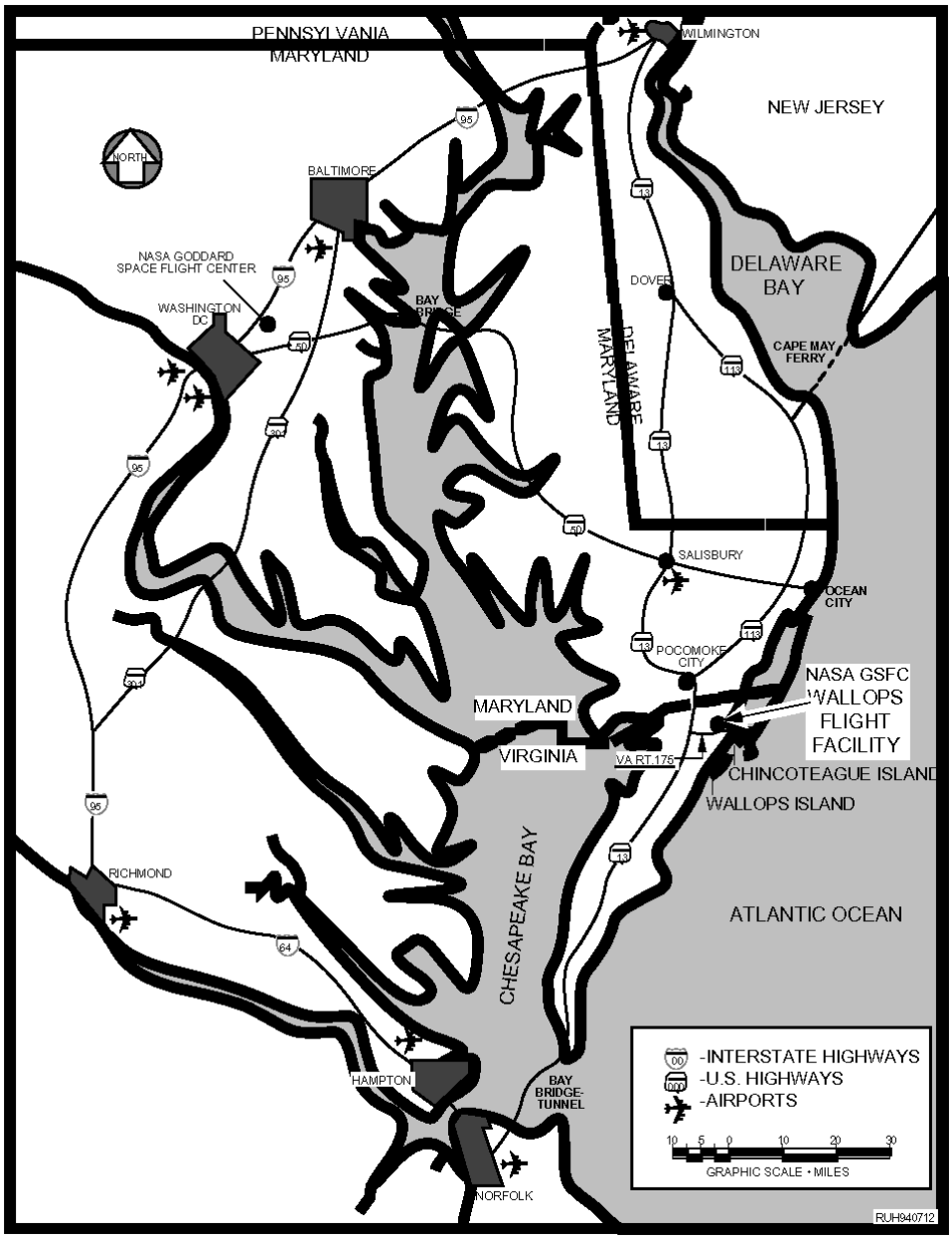
List of Figures

Road Map to NASA/GSFC/Wallops Flight Facility 8
Figure 1-1. Wallops Flight Facility 9
Figure 1-2. GSFC/WFF Organization Chart 13
Figure 3-1. Aerial View of Wallops Main Base 20
Figure 3-2. Aerial View of the Wallops Mainland 20
Figure 3-3. Aerial View of Wallops Island 21
Figure 3-4. Wallops Research Range Authorized Space 22
Figure 3-5. Operational Impact Area 22
Figure 3-6. Orbital Trajectories 22
Figure 3-7. Annual Precipitation and Temperature Plot for Wallops Flight Facility 23
Figure 3-8. Average Surface Wind Speed at Wallops Flight Facility 23
Figure 3-9. Wind Roses for Wallops Flight Facility by Month, All Speeds Inclusive 23
Figure 3-10. Wallops Mainland and Island Research Range Launch Facilities 25
Figure 3-11. Multifunctional Processing Facility (Summer '04) 25
Figure 3-12. WFF Research Range Liquid Fueling Facility Process Flow 28
Figure 3-13. RIR-706 Radar 29
Figure 3-14. NPOL 29
Figure 3-15. TOGA 29
Figure 3-16. Range TM Facility and WOTS 31
Figure 3-17. TOTS 31
Figure 3-18. WFF Research Airport with Associated Facilities 39
Figure 3-19. RCC MCR 40
Figure 3-20. Layout of RCC Mission Control Room 41
Figure 3-21. Mission Controller Station 41
Figure 3-22. Data Interfaces 41
Figure 3-23. RCC 4th Floor Aeronautical Projects Control Room 42
Figure 3-24. ASRF and SPANDAR 44
Figure 3-25. Optical Tracking Stations 45
Figure 3-26. UAV Runway on Wallops Island 47
Figure 3-27. Range Equipment at Woomera, Australia 49
Figure 4-1. Wallops Visitor Center and Gift Shop 54

List of Tables

Table 3-1. Assembly and Payload Processing Facilities 26
Table 3-2. Launch Systems 27
Table 3-3. Wallops Flight Facility and Airborne Radar Systems 30
Table 3-4. Range Telemetry Systems 32

Table 3-5. Wallops Orbital Tracking Station 33
Table 3-6. Transportable Telemetry Systems 34
Table 3-7. Transportable Van Summary 35
Table 3-8. TRADAT V Telemetry System 35
Table 3-9. Command Systems 37
Table 3-10. Mobile Command Systems 37
Table 3-11. GSFC/WFF Photo Optical Systems 46
Table 4-1. Material Handling Equipment 53



Road Map to NASA/GSFC/Wallops Flight Facility

Section One: Introduction

1.1 Purpose

The *Wallops Flight Facility Range User's Handbook* is a guide for planning operations at the Wallops Research Range. It provides a summary of the policies, procedures, and capabilities of the range. Included are procedures for obtaining authorization for range use and for efficient project coordination between the range user and Wallops personnel.

This handbook prescribes the information to be provided by the range user that will enable the Research Range to effectively plan for and support the range user's project. In addition, this handbook describes the facilities and systems available at WFF for supporting aeronautical research, balloons, and suborbital and orbital research projects.

Visit the WFF home page at http://www.wff.nasa.gov/ for additional information.

1.2 Geography

The WFF Main Base is located on Virginia's Eastern Shore 5 miles west of Chincoteague, Virginia, approximately 90 miles north of Norfolk, Virginia, and 40 miles southeast of Salisbury, Maryland. See previous page for a road map to the Wallops Flight Facility.

WFF consists of three separate parcels of real property: the Main Base, the Mainland, and the Wallops Island Launch Site. The Mainland and the Wallops Island Launch Site are approximately 7 miles southeast of the Main Base. Figure 1-1 shows WFF and the relationship of the three properties.

1.3 Wallops Research Range

The Wallops Research Range is part of WFF 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. Scientists and engineers from NASA, other United States Government agencies, colleges and universities, commercial organizations, and the worldwide scientific community have conducted experiments at the range.

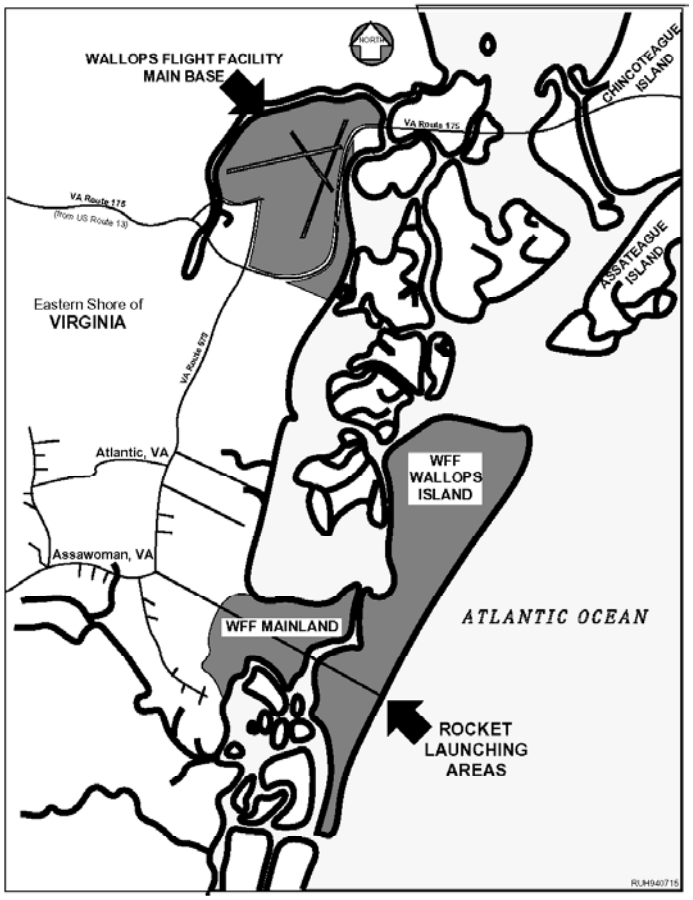


Figure 1-1. Wallops Flight Facility

1.4 Operational History

In 1945, NASA's predecessor agency, the National Advisory Committee for Aeronautics (NACA), established a launch site on Wallops Island under the direction of the Langley Research Center. This site was designated the Pilotless Aircraft Research Station and conducted high-speed aerodynamic research to supplement wind tunnel and laboratory investigations into the problems of flight.

In 1958, Congress established the National Aeronautics and Space Administration (NASA), which absorbed Langley Research Center and other NACA field centers and research facilities. At that time, the Pilotless Aircraft Research Station became a separate facility - Wallops Station - operating directly under NASA Headquarters in Washington, D.C.

In 1959, NASA acquired the former Chincoteague Naval Air Station, and engineering and administrative activities were moved to this location. In 1974, the Wallops Station was named Wallops Flight Center. The name was changed to Wallops Flight Facility in 1981, when it became part of Goddard Space Flight Center, Greenbelt, Maryland.

In the early years, research at Wallops was concentrated on obtaining aerodynamic data at transonic and low supersonic speeds. Between 1959 and 1961, Project Mercury capsules were tested at Wallops in support of NASA's manned space flight program before the astronauts were launched from Cape Canaveral, Florida. Some of these tests using the Little Joe Booster were designed to flight-qualify components of the Mercury spacecraft, including the escape and recovery systems and some of the life support systems. Two rhesus monkeys, Sam and Miss Sam, were sent aloft, acting as pioneers for the astronauts; both were recovered safely.

Since 1945, the Wallops Research Range has launched thousands of research vehicles in the quest for information on the flight characteristics of airplanes, launch vehicles, and spacecraft, and to increase the knowledge of the Earth's upper atmosphere and the near space environment. The launch vehicles vary in size and power from the small Super Loki meteorological rockets to orbital class vehicles.

Wallops Flight Facility continues to be a small, fast response, matrix organization that can accomplish rocket and balloon projects, spacecraft orbital tracking, airborne science support, and aeronautical research.

1.5 GSFC/WFF Missions

Wallops' key mission elements support all NASA's enterprises: Earth Science, Space Science, Biological and Physical Research, Aerospace Technology, Education, and Space Flight.

- **Suborbital Flight Projects**—Wallops manages and implements NASA's sounding rocket, balloon, and scientific aircraft programs. New technologies, such as the 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 integrated with 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, Department of Defense (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.

This handbook addresses only those missions related to the Wallops Research Range.

1.6 GSFC at WFF

There are six GSFC directorates located wholly or in part at WFF. These organizational elements combine to form the Wallops Flight Facility and perform all the functions for the operation of the facility.

- Suborbital and Special Orbital Projects Directorate (Code 800). Code 800 elements supporting the range include:

  - Resources Management Office (Code 801), which plans and monitors execution of all budgets including research and development (R&D), institutional, reimbursable, manpower, and travel.
  - Policy and Business Relations Office (Code 802), which plans and manages space launch commercialization activities.
  - Safety Office (Code 803), which develops and monitors ground and flight safety procedures for all launches managed by Code 800.

  Other offices associated with Code 800 are the Sounding Rockets Program (Code 810), Balloon Program (Code 820), Aircraft (Code 830), Range and Mission Management (Code 840), and University Class Projects (Code 850). The International Space Station Research Program Office (Code 804) and Shuttle Small Payloads Projects Office (Code 870) are located at GSFC/Greenbelt.

- Office of the Director (Code 100). Human Resources Operations (Code 113), Equal Opportunity Programs (Code 120), Office of Public Affairs (Code 130), and WFF Fiscal Operations (Code 157) maintain facilities at Wallops.

- Management Operations Directorate (Code 200). Code 200 elements that maintain offices at Wallops include Environmental (Code 205) and Security (Code 205.1); Procurement (Code 218); Facilities Management (Code 228); Logistics (Code 231); and Information Services and Advanced Technology (Code 296), which includes the Information Technology Center and the Wallops Technical Library.

- Flight Programs and Projects Directorate (Code 400). Mission Services Program Office (Code 450) is located at GSFC in Greenbelt, MD. The Ground Network Project Office (Code 453), collocated at Greenbelt and Wallops Island, monitors the Ground Network services under the Near Earth Networks Services (NENS) contract.

- Applied Engineering and Technology Directorate (Code 500). Code 500 maintains several divisions and branches at Wallops:

  - Mechanical Systems Division (Code 540)
  - Mechanical Systems Branch (Code 548)
  - Electrical Engineering Division (Code 560)
  - Wallops Electrical Engineering Branch (Code 569)
  - Information Systems Division (Code 580)
  - Wallops System Software Engineering Branch (Code 589)
  - Mission Engineering and Systems Analysis Division (Code 590)
  - Guidance, Navigation & Control and Mission Systems Engineering Branch (Code598)

- Earth Sciences Directorate (Code 900). The Laboratory for Hydrospheric Process (Code 970) and the Observational Science Branch (Code 972) are located at Wallops.

WFF supports the Poker Flat Research Range (PFRR) in Alaska and the National Scientific Balloon Facility (NSBF) in Palestine, Texas, with contract management, instrumentation, and other range support as required. PFRR is maintained and operated by The Geophysical Institute at the University of Alaska in Fairbanks. The NSBF is maintained and operated by the Physical Science Laboratory at New Mexico State University in Las Cruces.

The Goddard Space Flight Center/Wallops Flight Facility organization chart is below (Figure 1-2). A more detailed discussion of Wallops organizational elements can be found on the WFF Web site at http://www.wff.nasa.gov/.

1.7 Virginia Space Flight Center

The 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/.

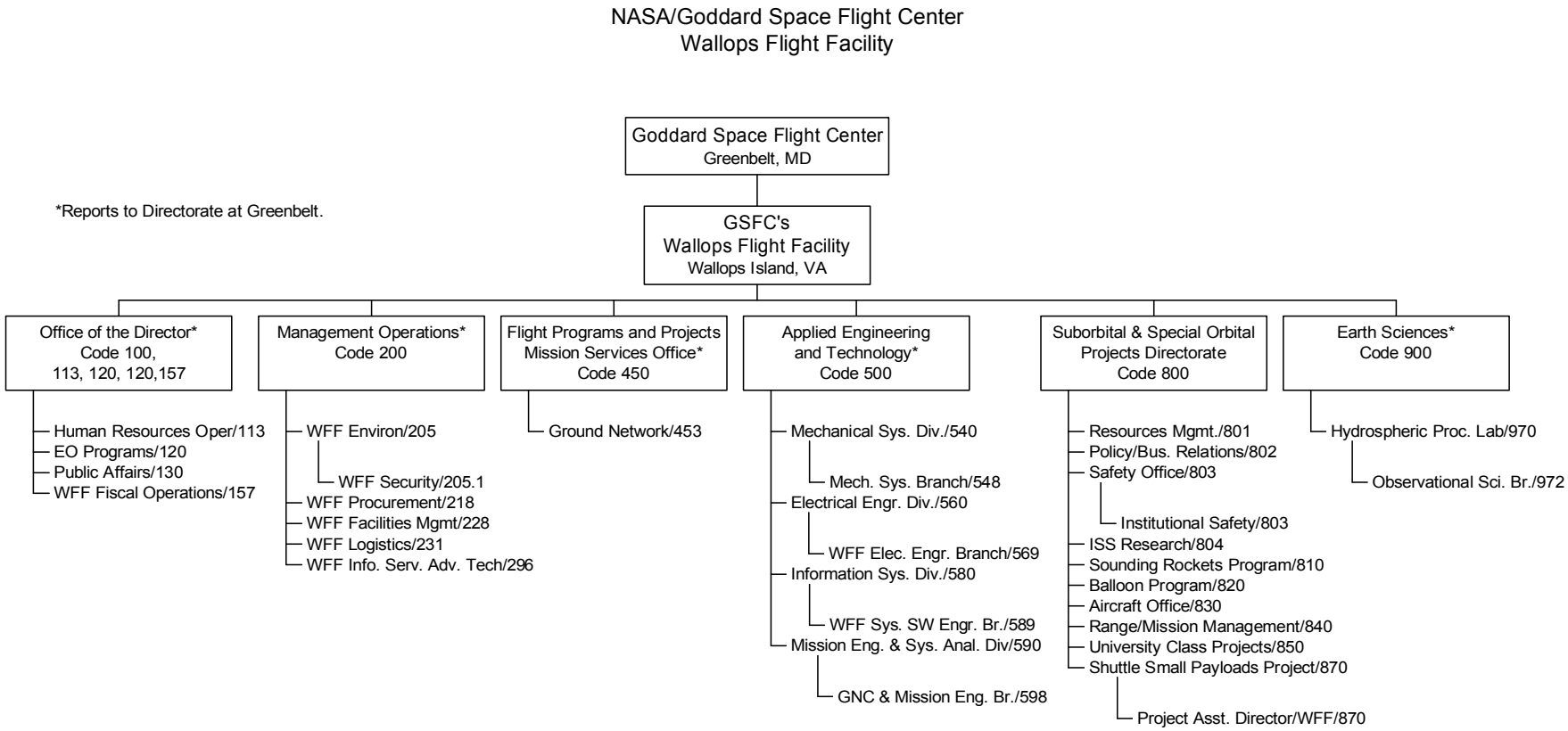


Figure 1-2. GSFC/WFF Organization Chart

1.8 Other Wallops Organizations

Several organizations maintain facilities at Wallops:

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.

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.

Section Two: Wallops Research Range Support Policies and Procedures

2.1 Introduction

The National Aeronautics and Space Act of 1958 (Space Act), as amended, charters NASA to plan, direct, and conduct space activities. The Space Act authorizes NASA field installations to establish policies and operational interface procedures for users of NASA resources. Activities under the Space Act are to be conducted to optimize America's scientific and engineering resources. NASA is authorized to enter into contracts, leases, cooperative agreements, and other transactions on such terms as it may deem appropriate with any person, firm, association, or corporation. NASA is also authorized to cooperate with public and private agencies in the use of Government-provided launch support, services, equipment, and facilities.

For policies and procedures specific to Wallops, please see 802-WFFCG-0001, *Doing Business at Wallops Flight Facility: A Customer Guide*, available at http://www.wff.nasa.gov/.

2.2 Key Range Personnel

All operations at the Wallops Research Range are conducted under NASA control. The following paragraphs define the functions, responsibilities, and authority of key range personnel.

2.2.1 WFF Test Director

The WFF Test Director has authority over all operations conducted on the Wallops Research Range. The Test Director is responsible for ensuring that all range policy, criteria, and external agreements are satisfied during the operations.

2.2.2 Project Manager

The Project Manager is the primary point of contact for the range user. The designated WFF Project Manager has the authority to plan, coordinate, and direct operational support for assigned projects conducted at the Wallops Research Range. The Project Manager also serves as Assistant Test Director.

2.2.3 Range Safety Officer (RSO)

The WFF RSO is responsible for assuring the Wallops Research Range safety policy, criteria, and procedures are not violated during operations and to ensure that risks are understood and are within acceptable limits. The RSO has authority to stop work, hold a launch, or terminate a mission in flight if necessary.

2.2.4 Operations Safety Supervisor (OSS)

The OSS is responsible for supervising all assigned potentially hazardous operations. The OSS is also responsible for implementation of ground safety plans and operating procedures. In some instances, the OSS may delegate responsibilities to other qualified personnel for specific operations.

2.3 Policies

2.3.1 Safety, Reliability and Quality Assurance Policy

WFF safety personnel will review all activities conducted on the Wallops Research Range. All range activities will be conducted in accordance with safety policy and criteria established in GMI 1700.2, *Goddard Space Flight Center Health and Safety Program*; NPG 8715.3, *NASA Safety Manual*; and RSM-2002, *Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility*. Reliability and Quality Assurance reviews may be required on a case-by-case basis.

2.3.2 Frequency Utilization and Management

The WFF Test Director is responsible for the operational control of the radio frequency (RF) spectrum at Wallops. Frequency utilization and management policies and procedures applicable to all range user activities at Wallops are detailed in 800-HDBK-0001, *Wallops Flight Facility Host/Tenant Frequency Utilization Management Handbook*.

2.3.3 Scheduling

The Office of the Test Director is responsible for establishing and maintaining the schedule of range activities. This includes publishing schedules and summaries, resolving scheduling conflicts between project requirements and resources, and acquiring required clearances from external organizations for programs conducted at the range.

The range user submits project scheduling information to the Project Manager, who relays potential conflicts as they are identified. Every effort is made to resolve conflicts between programs in a manner that permits each program to be successfully completed on an acceptable schedule.

Scheduling meetings are held monthly. As new information becomes available, activity schedules are updated and maintained on a computer database, which is accessible through remote terminals. The daily schedule is announced on the WFF paging system at 0830 and 1600 local time and is available online at http://wisdms.wff-wisdms.wff.nasa.gov/Schedule/dailyschedule.htm.

The Test Director acquires clearances required for airspace and oceanic impact areas from the Federal Aviation Administration (FAA), North American Aerospace Defense Command (NORAD), Fleet Area Control and Surveillance Facility (FACSFAC), and the U.S. Coast Guard. The range user must submit information for the clearances to the Project Manager at least 2 weeks in advance of the required time to facilitate approval and scheduling.

2.3.4 Environmental Requirements

The Wallops Environmental Office serves as the clearinghouse for National Environmental Policy Act (NEPA) compliance at Wallops. In most cases, Wallops has approved environmental documentation covering range users' activities at WFF. The *Wallops Flight Facility Environmental Resources Document (ERD)*, dated October 1999, provides the required environmental documentation for all Wallops "in-house" activities and also provides the required documentation for many range users' activities (see http://www.wff.nasa.gov/~code205/). Early in the project, the Project Manager will discuss environmental requirements with the range user to identify potential environmental issues. Wallops Environmental Branch personnel will make a determination of any formal documentation required.

2.4 Project Approval and Interface Procedures

The range user should confer with Wallops personnel prior to the submission of a formal request to determine the feasibility of conducting the proposed mission/project at the Wallops Research Range. The first point of contact can be the Policy and Business Relations Office (P&BRO) (Code 802); any of the Suborbital and Special Orbital Projects Directorate offices, including the Range and Mission Management Office (Code 840); or Virginia Space Flight Center, especially for commercial customers.

The initial contact will normally lead to a meeting between the range user and WFF technical personnel to exchange preliminary information and to reach a tentative position on the feasibility of conducting the mission or project at the range. The procedures to be followed subsequent to establishing feasibility depend on the range user's organizational affiliation as noted in the following paragraphs.

2.4.1 United States Government Agencies

After agreement on the feasibility of a project, the range user should send a letter requesting support to the Director, Suborbital and Special Orbital Projects Directorate (Code 800). The formal request should provide a brief overview of the support required, the safety aspects of the project, and the operation requirements.

WFF acceptance will normally take the form of a letter from the Director, Code 800, to the range user. The letter of approval will identify the Project Manager, project support conditions, and the estimated project support cost. Other documentation requirements are listed in 2.5 below.

Projects that require long-term user presence at WFF, multiple support efforts, or user-constructed facilities at WFF may require more formal documentation such as a Memorandum of Agreement (MOA).

2.4.2 Commercial Organizations and Foreign Governments

Procedures are similar to U.S. Government users, except that a MOA is always required.

2.4.3 Commercial Space Launch Act (CSLA) Organizations

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 sub-agreement with the Goddard Space Flight Center. Once these general agreements are in place, project-specific Individual Support Annexes (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 first contact for potential CSLA range users desiring access to the Wallops Research Range is the P&BRO. Alternatively, CSLA customers may opt to contract with the Virginia Commercial Space Flight Authority, which has the required agreements established with NASA.

2.4.4 Operational Interface

After the necessary agreements are established, the primary interface between the range user and the Wallops Research Range will be the assigned Project Manager.

2.5 Technical Data Requirements

2.5.1 Program Requirements Document (PRD)

The range user's project description and technical requirements are often conveyed to the Wallops Research Range through use of a Program Requirements Document (PRD).

WFF has adopted a modified PRD format from the Universal Documentation System (UDS), which is the standardized documentation system accepted and used at ranges operated by the DoD. The primary UDS reference is the *Range Commanders Council-Documentation Group (RCC-DG) Document 501-97*, which can be found online at http://tecnet0.jcte.jcs.mil/RCC/UDS/index.htm.

Projects at the Research Range span a broad spectrum of complexity, and some flexibility in the application of PRD standards is necessary. However, the PRD provides an excellent checklist of information needed for projects conducted at the range. The PRD will normally contain all of the information needed.

A PRD is not the only acceptable format, however. A customer can provide data in any manner that provides for a detailed understanding of the project and customer requirements.

2.5.2 Safety Data

The range user must provide a safety data package with ground and flight safety information, specifications, performance, and procedures for safety related items. The detailed information that must be included in the safety data package is identified in RSM-2002, *Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility*. This document can be found online at http://www.wff.nasa.gov/~code803/pages/RSM20022.pdf.

2.5.3 Operations and Safety Directive (OSD)

The OSD is prepared by the Project Manager and is NASA's response to the range user's requirements. The OSD provides a description of the project and the detailed support configuration for all Wallops equipment, instrumentation, and facilities. A ground safety plan, flight safety plan, countdown, and special procedures, as appropriate, are included.

2.5.4 Documentation Schedule

WFF attempts to avoid excessive documentation wherever possible. Range users are required to provide a PRD or comparable document to aid WFF in defining support requirements. Only applicable sections need be provided. Required documentation with generalized publication dates for first-time projects are listed below:

- Program Requirements Document (PRD) — 90 days prior to arrival at WFF
- Preliminary Range Safety Data Package — T-120 days
- Final Range Safety Data Package — T-90 days
- Hazardous Procedures — T-60 days
- Trajectory Simulation Data — T-60 days
- Operations and Safety Directive (OSD) — T-21 days

Timelines can be compressed for small projects or expanded for orbital launch vehicles. Exact data requirements will be determined during the planning process based on schedule and

project-unique details. Earlier dates may be required if the range user begins processing at WFF earlier that 30 days prior to launch.

WFF encourages range users to provide documentation as early as possible to assure adequate time for review and approval. Failure to do so could require unnecessary redesigns or delays in schedule.

2.5.5 Operational Reviews

WFF conducts pre-mission reviews for all projects in order to assure that personnel are briefed on requirements and responsibilities and to assure that all necessary preparations have been satisfactorily completed. A synopsis of WFF reviews is included below:

- Range Readiness Review – Conducted for all major operations. A panel is established to review the WFF support preparations.
- Pre-mission Briefing – A mandatory briefing that serves to assure all key personnel are prepared to support the operation and that participants understand roles, responsibilities, and operational details.
- Operation Debriefing – A post-operation meeting intended to evaluate the operation and identify items requiring action prior to future operations.

Additional reviews may be required for large projects. In addition, it is highly recommended that range operations and safety personnel be invited to participate in project design reviews and technical interchange meetings to assure concerns are addressed early in the planning process.

2.6 Funding Information

Research Range facilities and operational support are available to support NASA projects, other U.S. Government agencies, CSLA projects, commercial organizations, and, under certain circumstances, foreign governments. WFF staff will provide a project cost estimate for requested support. The user will be required to pay actual costs. Funding should be received by WFF at least 6 weeks prior to start of work on the project. Work cannot proceed until funding has been processed. Charges are established by the following guidelines:

- NASA organizations – Charged for project-unique services.
- Other U.S. Government agencies – Full recovery of costs.
- CSLA projects – Charged for additive cost.
- Commercial organizations and foreign governments – Full recovery of costs.

Section Three: Wallops Flight Facility and Research Range

3.1 Introduction

Wallops Flight Facility includes three areas on the Eastern Shore of Virginia as shown in Figure 1-1. These are the Main Base, the Mainland, and the Wallops Island Launch Site. The Research Range is located across all three land parcels and is composed of the Wallops Island launch facilities, the Research Airport, supporting instrumentation, authorized space, authorized frequency spectrum, and operations and support personnel.

3.1.1 Wallops Main Base

Figure 3-1. Aerial View of Wallops Main Base

Figure 3-1 is an aerial view of Wallops Main Base, looking south. The Main Base is the location of many of the major functions and activities supporting the Research Range, including Research Airport; Range Control Center; Telecommunications Center; Wallops Orbital Tracking Station (WOTS); administrative offices; engineering support; technical service support shops; rocket inspection and storage area; and telemetry facility.

The Main Base also supports several other organizations (see 1.8).

3.1.2 Mainland

The Mainland site is a strip of land located west of Wallops Island and is the location for radar, optical, communications, and command transmitter facilities. The Wallops Geophysical Observatory (WGO), including the Atmospheric Sciences Research Facility (ASRF), is located on the Mainland. Figure 3-2 is an aerial view of the Wallops Mainland, looking north.

Figure 3-2. Aerial View of the Wallops Mainland

3.1.3 Wallops Island

Wallops Island, named for John Wallops, a 17th Century surveyor, is an Atlantic Ocean barrier island off the coast of Virginia approximately 7 miles southeast of the Main Base. The island is roughly 6 miles long and about one-half mile at its widest point. It is separated from the mainland by 2 miles of marsh and water. A causeway and bridge connect the island with the Wallops Mainland. Facilities located on Wallops Island include launch sites; assembly shops;

Figure 3-3. Aerial View of Wallops Island

blockhouses; dynamic balance facilities; radar facilities; rocket storage buildings; payload processing facilities; and the USN Surface Combat Systems Center.

Figure 3-3 is a northward view of Wallops Island with commercial launch facilities in the foreground.

3.1.4 Authorized Space

The authorized space includes the following restricted areas:

a. The GSFC/WFF Airport Control Zone: Airspace vertically to 2,500 feet in a 5-statute mile radius of the airport. The Control Zone has an arrival and departure corridor.
b. Restricted Area R-6604: Restricted airspace connecting WFF and offshore warning areas as shown in Figure 3-4.
c. Surface area and airspace extending from Restricted Area R-6604 into the offshore warning areas: The extended area varies with the particular mission/project activity and is limited to that area for which specific use has been cleared with the responsible agencies, e.g., the FAA and USN FACSFAC.

3.1.5 Trajectory Options

WFF offers a wide array of launch vehicle trajectory options. The coastline of Wallops Island is oriented such that a launch azimuth of 135˚ is perpendicular to the shoreline. In general, launch azimuths between 90˚ and 160˚ can be accommodated depending on impact ranges. For most orbital vehicles, this translates into orbital inclinations between 38˚ and approximately 60˚.

Trajectory options outside of these launch azimuths, including polar and sun-synchronous orbits, can be achieved by in-flight azimuth maneuvers. For example, wider northerly options are possible by maneuver around Assateague Island after passing 5 nautical miles (nmi) downrange. The North Carolina Outer Banks are generally the restricting landmass for southern launch azimuths. Specific trajectory options are determined through consultation with the Flight Safety Group. The operational impact area is shown in Figure 3-5, and trajectory options are illustrated in Figure 3-6.

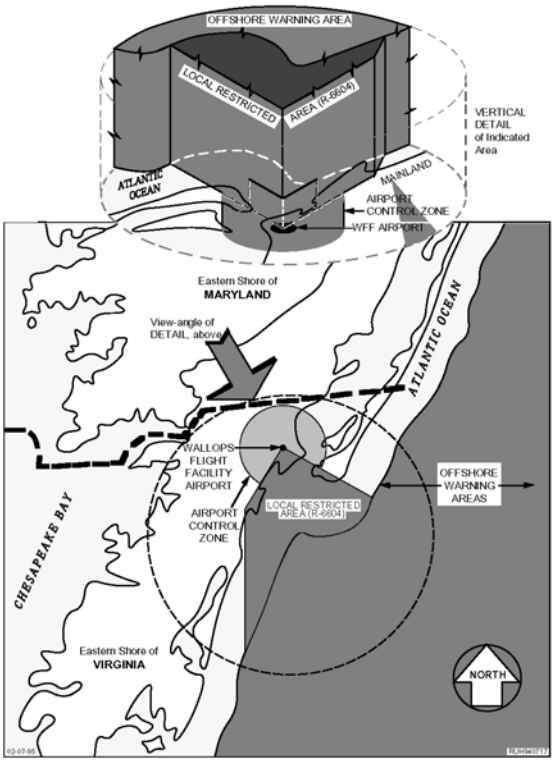


Figure 3-4. Wallops Research Range Authorized Space

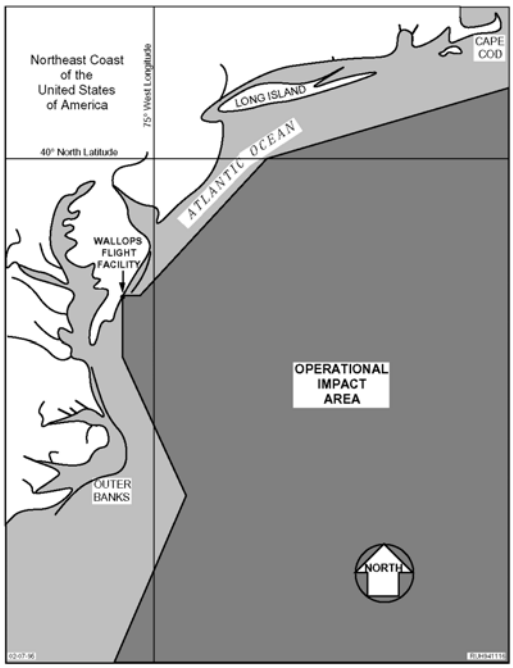


Figure 3-5. Operational Impact Area

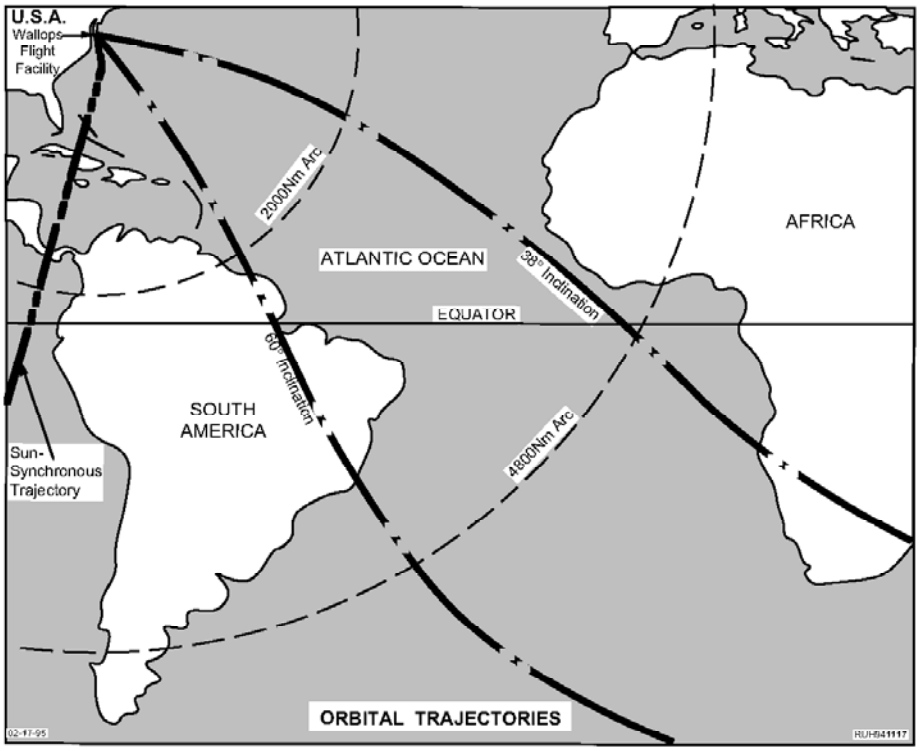


Figure 3-6. Orbital Trajectories

3.1.6 Wallops Weather

Wallops enjoys a temperate climate, and weather seldom interferes with launch and aeronautical operations. There are only a few months annually when cold weather can be a concern. In winter months, measures are taken to protect launch vehicles. As in most coastal regions, humidity can be relatively high; however, humidity is controlled in work areas and does not significantly affect operations at the Research Range.

Figure 3-7 shows annual temperatures and precipitation at WFF on a month-to-month basis. There are plots for mean high and mean low temperatures and annual variation. Extreme maximum and extreme low temperatures that have been experienced at WFF are noted. Also shown are average precipitation days and precipitation inches per month, including snow averages.

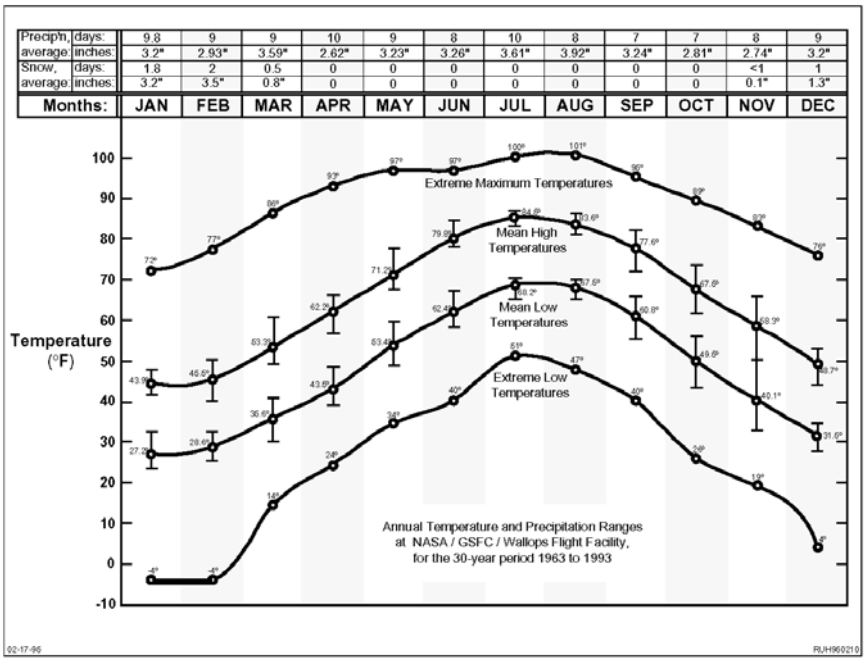


Figure 3-7. Annual Precipitation and Temperature Plot for Wallops Flight Facility

There are two figures depicting surface wind conditions at WFF. Figure 3-8 shows average surface wind speed by month and notes the predominately northwest winds between October and April and the predominately southerly winds between April and October. Figure 3-9 shows monthly wind roses depicting the various directions of the surface winds within concentric circles indicating occurrences at 5 percent, 10 percent, and 15 percent of the time.

The Research Range is supported by meteorological and weather data and forecasting capabilities from the Weather Forecast Office, Meteorological Facilities, and the ASRF at the WGO (see 3.2.11, 3.2.12, 3.2.13).

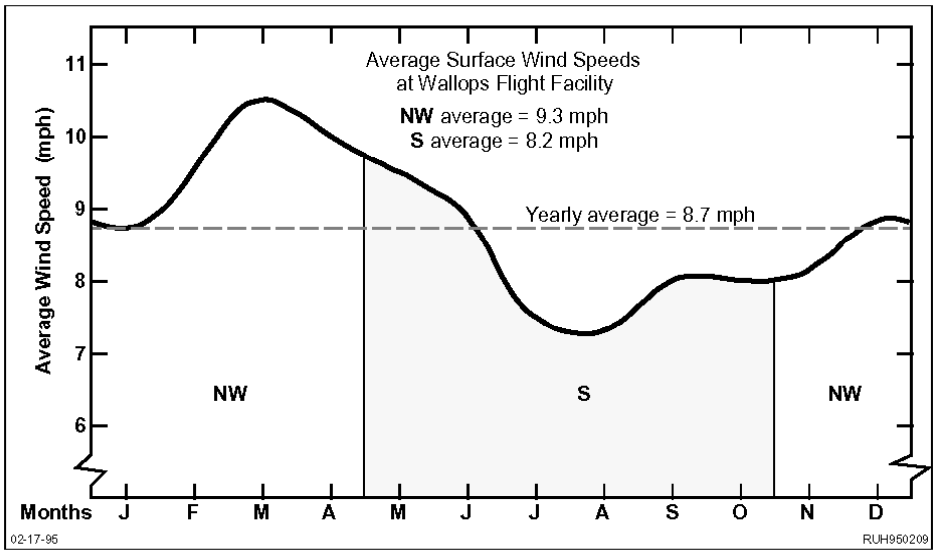


Figure 3-8. Average Surface Wind Speed at Wallops Flight Facility

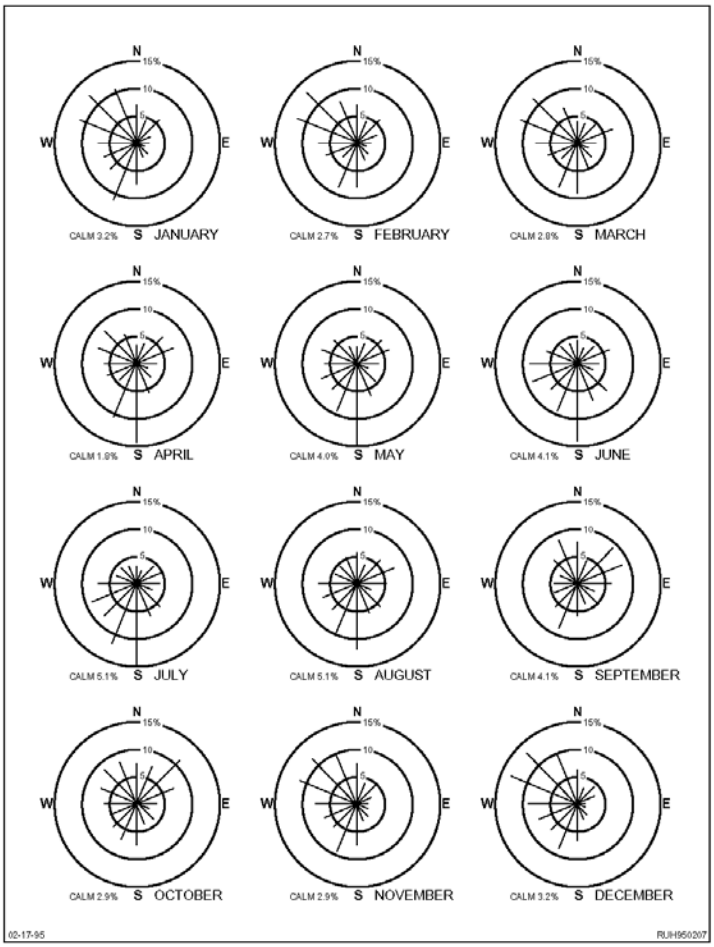


Figure 3-9. Wind Roses for Wallops Flight Facility by Month,
All Speeds Inclusive

3.2 Research Range Facilities

The Wallops Research Range has a variety of facilities supporting its operations. The major facilities are described in the following paragraphs.

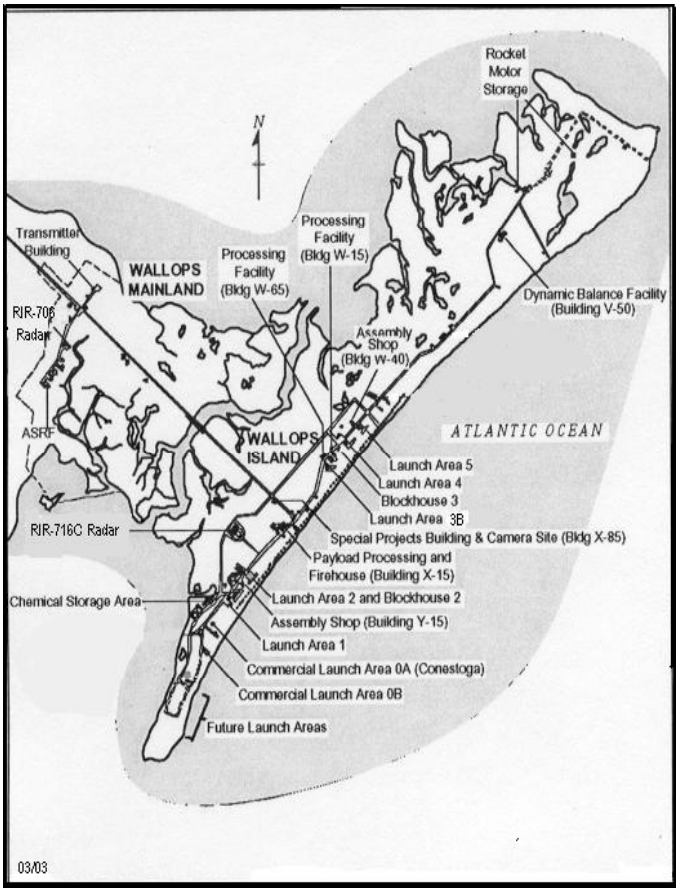


Figure 3-10. Wallops Mainland and Island Research Range Launch Facilities

3.2.1 Launch Facilities

WFF has facilities for the receipt, inspection, assembly, checkout, and storage of rocket motors and other pyrotechnic devices. The Wallops Island Launch Site is comprised of six launch pads, three blockhouses for launch control, and assembly buildings to support the preparation and launching of suborbital and orbital launch systems. Figure 3-10 is an annotated drawing of Wallops Mainland and Wallops Island showing the location of support facilities and launch pads.

Table 3-1 shows vehicle and payload processing facilities and some of their major features.

Launcher capacities listed in Table 3-2 indicate the maximum design loads under ideal circumstances. User-provided launch systems can be accommodated. WFF also has the capability to support launch operations worldwide with mobile range instrumentation and equipment (see 3.2.20).

Figure 3-11 is an artist's rendering of the new multifunctional processing facility due to open Summer 2004. Located outside Wallops Main Gate behind the MSC, the facility will have a high bay that measures 80 feet long by 40 feet wide by 70 feet high; a Class 100K clean room; lifting devices; personnel workspace and conference room; ground support equipment rooms; storage; visitor area; staging pad; and other support amenities.

Figure 3-11. Multifunctional Processing Facility (Summer '04)

Table 3-1. Assembly and Payload Processing Facilities

Wallops Island

Building	Function	Sq.Ft.	Special Features
W-15	assembly	5,165	• one 3,936 sq. ft. bay • door 13 ft high x 12 ft wide • 3-ton overhead crane with 10-ft hook height • approved for explosives
W-40	assembly	5,255	• Currently supports Vandal Program
W-65	assembly	13,255	• 6 bays •• 5 assembly bays •• 1 clean room in Bay 6 20 ft x 20 ft x 8 feet door 95 in high x 94 in wide • pyrotechnic storage rooms • approved for explosives Bay — Doors HxW — Crane(s) hook height (hh) Bay 1 — 17 ft 10 in x 23 ft 11 in — 2x10 ton bridge/20 ft hh Bay 2 — 18 ft x 23 ft 11 in 17 ft 10 in x 23 ft 11 in — 2x7.5 ton monorail/18 ft hh Bay 3 — 17 ft 10 in x 18 ft 11 in — 2x3 ton monorail/19 ft hh Bay 4 — 14 ft 11 in x 15 ft 11 in — none Bay 5 — 14 ft 11 in x 15 ft 1 in — 2x3 ton monorail/16 ft 5 in hh Bay 6 — 14 ft 11 in x 23 ft 11 in 14 ft 11 in x 23 ft 11 in — 2x3 ton monorail/16 ft hh
X-15	payload processing	5,740	• collocated optical and crash/fire/rescue facilities • door 19 ft 10 in high and 18 ft 10 in wide • 3-ton overhead crane with 19-ft hook height • laboratory and office space
Y-15	assembly	8,240	• one high bay (Bay 8) • seven other bays • approved for explosives Bay — Doors HxW — Crane(s) hook height (hh) Bay 1 — 9 ft 6 in x 17 ft 6 in Bay 2 — 6 ft 10 in x 8 ft Bay 3 — 6 ft 10 in x 8 ft Bay 4 — 6 ft 10 in x 8 ft — 3-ton monorail/7 ft 10 in hh Bay 5 — 6 ft 10 in x 8 ft Bay 6 — 6 ft 10 in x 8 ft — 3-ton monorail/7 ft 10 in hh Bay 7 — 6 ft 10 in x 8 ft Bay 8 — 13 ft 7 in x 10 ft 10 in — 2-ton bridge/15 ft 10 in hh

Wallops Main Base

Building	Function	Sq.Ft.	Special Features
M-16	payload processing	19,290	• two bays 38 ft deep x 35 ft wide x 14 ft high • both are Class 100,000 clean rooms •• each has Class 10,000 clean tent 23 ft x 19 ft x 12 ft high • door 12 ft high and 25 ft wide
M-20	assembly	11,585	• single bay • end door 15 ft high and 25 ft wide • side door 13 ft high and 25 ft wide • approved for explosives

Table 3-2. Launch Systems

Pad Number Launcher Name		Description
Pad 0A Commercial		The multilevel Conestoga launch complex for a commercial ELV can also support other launch vehicles up to 200,000 pounds maximum load.
Pad 0B VCSFA Launch Complex		Designed for small to medium class ELVs up to 500,000 pounds maximum load.
Pad 1 50K Launcher		The 50K launcher is rated as a 50,000-pound maximum design load launcher. It has a movable environmental shelter and a 45-foot, 6-inch overall boom length. It is shown with a base ring for the ARIES sounding rocket mounted under the rail.
Pad 2 Atlantic Research Corporation (ARC) Launcher		The ARC launcher is rated as a 20,000-pound maximum design load launcher. It has a movable environmental shelter and a 38-foot overall boom length.
Pad 2 North Astro Met Launcher (AML)		Rated as a 4,000-pound maximum design load launcher, the AML has a twin boom to accommodate single and multi-stage vehicles with an 18-foot, 8-inch overall boom length.
Pad 2 Improved High Altitude Diagnostic (HAD) Launcher		Rated as a 7,500-pound maximum design load launcher, the HAD has a 31-foot overall boom length.
Pad 3B 20K Launcher (AML)		Rated as a 20,000-pound maximum design load launcher, it has a movable environmental shelter and a 37-foot overall boom length. Here the launcher is shown with the rail mounted environmental shelter pulled away. A launcher ring for the ARIES sounding rocket is mounted on the launcher.
Pad 4 Tubular Launcher		Rated as a 20,000-pound maximum design load launcher, the tubular launcher has a 40-foot overall boom length (currently inactive).
Pad 5		Currently supporting the USN Vandal Program.

3.2.2 Liquid Fueling Facilities

Wallops Research Range is fully capable of supporting 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) (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. The system includes a flexible and expandable helium gas delivery system that can respond to a broad range of pressure feed system requirements. Tankage and control systems have standard interfaces and can support distinct fueling functions presented by various vehicles. The LFF is designed to operate at different locations on Wallops Island and other launch sites as defined by NASA. Figure 3-12 depicts the LFF process flow.

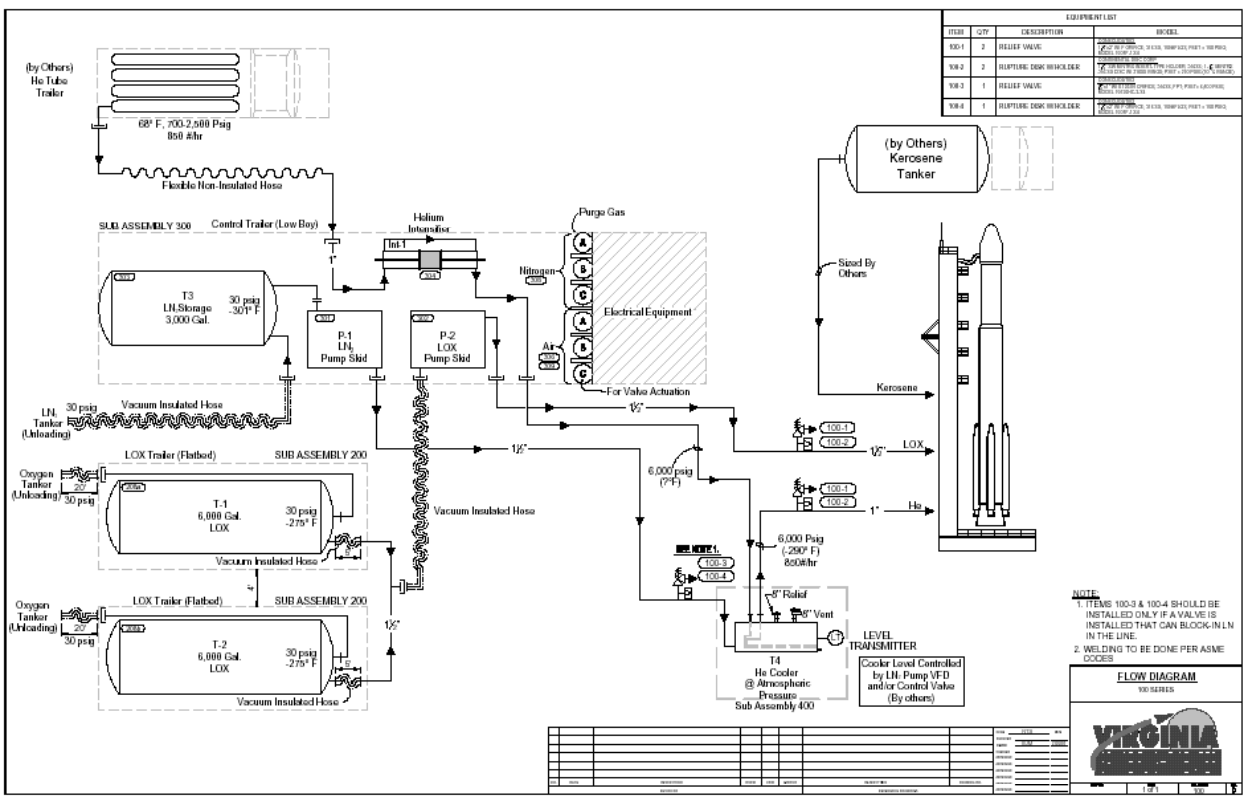


Figure 3-12. WFF Research Range Liquid Fueling Facility Process Flow

[1] Self-Contained Atmospheric Protective Ensemble.

3.2.3 Radar Systems Facilities

Radar systems perform tracking and surveillance functions. Table 3-3 lists the significant characteristics of tracking radar systems and ground-based and airborne surveillance radar systems.

Figure 3-13. RIR-706 Radar

Tracking Radar Systems

Tracking radar systems provide accurate velocity and positional data of launch vehicles, balloons, satellites, and aircraft. The Research Range has three fixed (permanently installed) and four mobile (transportable) tracking radar systems. The fixed radar systems are the RIR-716C (Research Airport), RIR-706 (Mainland), and RIR-716C (Wallops Island). Figure 3-13 shows the RIR-706 radar system installed on the Mainland.

Surveillance Radars

Surveillance radars provide range surveillance to detect water surface and airborne targets. The Mariners Pathfinder on Wallops Island and the ASR-7 are fixed surveillance radar systems that support operations on the Research Range. The AN/APS-143 is an airborne surveillance radar system that is installed on contract aircraft in partnership with NAS Patuxent River.

Weather Radars

Figure 3-14. NPOL

The NASA Polarimetric Radar (NPOL), developed by a research team from Wallops Flight Facility, is an ultra-modern flat panel radar antenna that is fully portable and self-contained. Hexagonal in shape and 18 feet (5.5 meters) across, it requires no special site preparation and can be set up on a generally flat area anywhere in the world. The system can operate continuously, 24 hours a day, 7 days a week, measuring both rainfall amounts and physical characteristics of raindrops, such as size (see Figure 3-14).

Another weather radar, the TOGA (Tropical Ocean-Global Atmosphere) radar (Figure 3-15), is used by NASA's Tropical Rain Measuring Mission (TRMM) to provide ground validation data for the TRMM satellite. The TOGA radar has also been deployed in a variety of experiments, including installation on research ships in the mid-Pacific Ocean and South China Sea, collecting data on severe storms and tornadoes in Texas, the TRMM-LBA experiment in the Brazilian rain forest, and tracking migratory birds.

Figure 3-15. TOGA

For more information on the NPOL and TOGA radars, contact the Observational Science Branch (Code 972) at (757) 824-1000.

Table 3-3. Wallops Flight Facility and Airborne Radar Systems

WFF ID No.	Radar	Wave Length Band	Peak Power Output (Watts)	Pulse Rate Frequency (pps)	Beam-width (deg.)	Antenna Size (Meters)	Antenna Gain (dB)	Max-Range (KM)	1-m^2 Skin Track (KM)	Range Precision (Meters) (rms)	Angle Precision (mils rms)	Tracking Velocity (deg/sec) AZ EL
UHF	ASRF	UHF	8 M	320-960	2.9	18.29	36	n/a	1480	n/a	2.0	8 8
4	ASRF (SPANDAR)	S	5 M	160, 320, 640, 960	0.39	18.29	52.8	480 K	2200	5	1.0	15 15
n/a	ASR-7	S	400 K	713, 1200, others available	1.5 (AZ) csc^2 (EL)	5.33 x 2.74	34	110 K	75 (Aircraft)	1%	n/a	n/a
	AN/TPX-42[2]	L	2 K	4:1 countdown to ASR-7	2.4 (AZ) csc^2 (EL)	8.33 x 0.46	21	463 K	n/a	1%	n/a	n/a
5	RIR-706 (Mainland)	C	3 M	160,320,640,1280	0.39	8.84	51	60 K	1496	3	0.05	20 20
3	RIR-716 (Island)	C	1 M	160,320,640	1.23	3.66	43	60 K	473	3	0.15	45 28
18	RIR-716 (Airport)	C	1 M	160,320,640	0.71	4.88	46	60 K	630	3	0.1	31 28
2	RIR-778C (mobile)	C	1 M	160, 320, 640	1.5	2.38	38	60 K	224	5	0.24	34 34
8	RIR-778C (mobile)	C	1 M	160, 320, 640	1.5	2.38	38	60 K	280	5	0.24	34 34
10	RIR-778C (transportable)	C	1 M	160, 320, 640	1.0	3.66	43	60 K	473	3	0.15	34 34
11	RIR-778C (transportable)	C	1 M	160,320,640	1.0	3.66	43	60 K	473	3	0.15	34 34
n/a	Mariners Pathfinder	X	20 K	900, 1800, 3600	0.9@ 3 dB (H)	3.67 x 0.15	32	118	n/a	n/a	n/a	n/a
n/a	AN/APS-143B(V)3[3] (airborne)	X	8 K (min.)	395, 750, 1513, 2491	3.1 (H) 7.0 (V)	.635 x 0.305	31	250	n/a	1% max. range	n/a	n/a

[2] A subsystem of the ASR-7.
[3] This airborne surveillance radar is available through AirTec, Inc., at NAS Patuxent River.

3.2.4 Telemetry Facilities

Telemetry (TM) facilities at the Research Range include a variety of antennas, receivers, and display instrumentation systems. Command uplink and metric tracking capabilities are also available.

Post-flight telemetry data can be distributed via magnetic tape, CD-ROM, and magneto-optical disks.

Fixed Telemetry Systems

Telemetry systems consist of fixed range TM facilities and the WOTS (Wallops Orbital Tracking Station) collocated in building N-162 on Wallops Main Base. Figure 3-16 is a view of the fixed TM facilities, including the WOTS.

The WOTS primarily supports low-Earth orbit spacecraft; however, the WOTS facilities are flexible and can be used for range TM and share resources with the range TM systems. The WOTS has metric tracking and command uplink.

Tables 3-4 and 3-5 list the technical characteristics of the fixed TM systems.

Figure 3-16. Range TM Facility and WOTS

Transportable Telemetry Facilities

WFF has transportable TM capabilities for use at other locations. Transportable TM systems have metric tracking (Doppler and angles) and command uplink. Tables 3-6 through 3-8 list the technical characteristics of transportable TM systems available at Wallops (see following pages).

The Transportable Orbital Tracking Station (TOTS) was developed to provide a multi-mission transportable low-Earth orbit spacecraft tracking capability. The TOTS can also support vehicle and payload telemetry. The TOTS is S-band and can be upgraded to X-band. The Research Range owns two TOTS. One system is located at WFF and the other is located at Poker Flat Research Range near Fairbanks, Alaska (Figure 3-17).

Figure 3-17. TOTS

Table 3-4. Range Telemetry Systems

Receiving Characteristics

Antenna Diameter/Type	Frequency Range	Polarization	G/T* (Minimum)	Noise Temp. @ Degrees K	Receiver Type	Gain	Tracking Modes	Pedestal Type
LGTAS 2.4M/8ft 2 Parabolic[4]	1435-1540 MHz 1650-1710 MHz 2200-2300 MHz	RHC/LHC	5.18 dB/K @ 2.25 GHz	400 @ S-Band	Microdyne 1100-AR	L-Band: 28 dB 1680 Band: 29 dB S-Band: 32 dB	Autotrack Slave Manual Computer	EL/AZ
MGTAS 7.3M/24ft 2 Parabolic[5]	1400-2400 MHz	RHC/LHC	16 dB/K @ 2.2 - 2.4 GHz 13 dB/K @ 1.4 - 2.2 GHz	200 @ 1.4-2.1 GHz 250 @ 2.2-2.3 GHz	MFR S/A 410 DEI 74 Microdyne 1100-AR	39 dB @ 2250 MHz	Autotrack Slave Manual Programmed	EL/AZ

* G/T - Gain/System Noise Temperature or Figure of Merit.

[4] The LGTAS (Low Gain Telemetry Antenna System) antennas reside atop building N-162.
[5] MGTAS (Medium Gain Telemetry Antenna System) is located in antenna field near building N-162. The MGTAS antennas are listed here with range telemetry systems and on Table 3-5, Wallops Orbital Tracking Station.

Table 3-5. Wallops Orbital Tracking Station

Receiving Characteristics

Antenna Diameter/Type	Frequency Range	Polarizations	G/T (Minimum)	Receiver Type	Up/Down Con. Freq.	Tracking Modes	Pedestal Type
11M	2.2-2.4 GHz 8.0-9.0 GHz	RHC/LHC div	23 dB/K @ 2300 MHz 35 dB/K @ 8500 MHz	SA-930	P-Band 375 MHz	Auto, Program, Slave (TOTS/7.3M)	EL/AZ Train
9M Parabolic[6]	2.2-2.3 GHz	RHC/LHC div	24 dB/K @ 2250 MHz	MFR	400-500 MHz P-Band	Auto, Slave, and Program	X-Y
7.3M (STDN) 2 Parabolic[7]	1.4-2.3 GHz	H/V or LHC & RHC div	16 dB/K @ 2.2-2.4 GHz, 13 dB/K @ 1.4-2.2 GHz,	MFR, 700-MR, 1200-MR	400-500 MHz P-Band	Auto, Slave, Manual, Program	EL/AZ
8M TOTS #3	2200-2400 MHz	RHC/LHC div	21 dB/K @ 2250 MHz	SA-930	P-Band 400-500 MHz	Auto, Manual, Program	EL/AZ
SATAN	136-138 MHz	Linear Diversity	-8 dB/K @ 137 MHz	MFR	400-500 MHz	Manual, slave	X-Y
7.3M METEOSAT Parabolic (dedicated)	1690-1700 MHz	Linear Diversity	19.6 dB/K @ 1690 MHz	1100-AR	400-500 MHz	Manual	EL/AZ Kingpost
5M LEO-T	2200-2300 MHz	RHC/LHC div	16.7 dB/K @ 2250 MHz	700-MR	N/A	Program	EL/AZ Train

Transmitting Characteristics

Antenna Diameter/Type	Frequency Range	Polarizations	Transmitter Type	Power	EIRP	Tracking Modes	Pedestal Type
11M	2025-2120 Mhz	RHC/LHC	Solid State Amplifier	200 W	97 dBmi	Auto, Program, Manual	EL/AZ
9M Parabolic	2025-2120 MHz	RHC/LHC	S-Band Exciter/Solid State Amplifier	200 W/16 W	96 dBmi	Auto, Slave, Program	X-Y
8M TOTS	2025-2120 Mhz	RHC/LHC	Solid State Amplifier	200 W	94.5 dBmi	Auto, Program, Manual	EL/AZ
6M Command Parabolic	2025-2120 MHZ	RHC/LHC	S/Band Exciter/Solid State Amplifier	200 W/16 W	92 dBmi	Manual, slave	X-Y
5M LEO-T	2025-2120 MHz	RHC/LHC	Solid State Amplifier	200 W	89 dBmi	Program	EL/AZ Train
Array SATAN	147-152 MHz	RHC/LHC Linear	Linear	10 KW	92 dBmi	Manual, slave	X-Y
Array SCAMP	147-152 MHz	RHC/LHC Linear	Linear	10 KW	87 dBmi	Manual, slave	X-Y

[6] Tone Ranging capable.
[7] Also listed as MGTAS antennas on Table 3-4, Range Telemetry Systems.

Table 3-6. Transportable Telemetry Systems

Antenna Diameter/Type	Frequency Range	G/T (Minimum)	Tracking Modes	Pedestal Type	Trailer	Van	Remarks
Antenna #1 3 M/10 ft 4 Section Parabolic	1435–1540 MHz 1650–1710 MHz 2200–2300 MHz	7.1 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ	n/a	SVAN1	Skid-mounted with 20-ft. Condex
Antenna #2 3 M/10 ft Solid Parabolic	1435–1540 MHz 1650–1710 MHz 2200–2300 MHz	7.1 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ	Antennas 2, 3, and 4 have been transferred to White Sands Missile Range in New Mexico.		
Antenna #3 2.4M/8 ft Solid Parabolic	1435–1540 MHz 2200–2300 MHz	5.18 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ			
Antenna #4 2.4M/8 ft Solid Parabolic	1435–1540 MHz 2220–2300 MHz	5.18 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ			
Antenna #5 2.4M/8 ft Parabolic Reflector	1435-2300 MHz (includes 1680)	5.18 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ	n/a	n/a	Installed at Poker Flat Research Range. This is a fixed asset at the Alaska facility.
Antenna #6 4.8M/16 ft Parabolic Reflector	1435-2300 MHz (includes 1680)	11.0 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ	n/a	n/a	Installed at Poker Flat Research Range. This is a fixed asset at the Alaska facility.
Antenna #7 2.1M/6 ft "Minitracker" 2 Section Parabolic	2200–2300 MHz	2.9 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ	n/a; compact pedestal	n/a	Minitracker TM Systems Total Weight 1,000 lb. At building E-144; managed by Met Ops.
Antenna #8 2.1M/6 ft "Minitracker" 2 Section Parabolic	2200–2300 MHz	2.9 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ	n/a; compact pedestal	n/a	Minitracker TM Systems Total Weight 1,000 lb. At building N-162; managed by Met Ops.
Antenna #9 6.1M/20 ft 12 Section Mesh Parabolic	1435–1540 MHz 2200–2300 MHz	17.2 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ	12.8M/42 ft flatbed w/ enclosed shelter	ANT #9 Van	Antenna #9 can be shipped in a C-141 aircraft.
7-meter System 7M/23 ft 12 Section Fiberglass Parabolic (rad-scan prime focus feed)	1435–1540 MHz 2200–2300 MHz	20 dB/K @ 2.25 GHz	Autotrack Slave Manual	EL/AZ	40-ft flatbed	7-meter Control van + ISO hauler	System requires two 40-ft vans, one for the antenna and one for the control equipment.

Table 3-7. Transportable Van Summary

Van	Size	Function
Super Van SVAN1	14.8 meter (48 ft.)	Multipurpose telemetry van equipped to support 3-meter antenna systems individually and simultaneously.
ANT #9 Van	12.2 meter (40 ft.)	40-foot flatbed trailer with hydraulic erected 6.2-meter (20-ft.) tracker and 20-ft. long instrumentation shelter.
Condex Container	3 meter (10 ft.)	Supports mini-tracker system.
40-ft ISO Hauler and TOTS Control Van	12.2 meter (40 ft.)	Equipped to support pad-mounted 8-meter (26-ft.) TM antenna.
C-130 container for air, sea, land transport	12.2 meter (40 ft.)	Mobile Range Control System with redundant command transmitters for command and flight termination, UPS, Range Safety Display System, real-time computer processors, communications.

Table 3-8. TRADAT V Telemetry System

Antenna Type	Frequency	Remarks
TRADAT V Trajectory Data System One single 10-turn helix antenna for ranging and command	Primarily 550 MHz PCM/FM	• PCM ranging system provides trajectory data for vehicles such as sounding rockets or balloons. • The command antenna is normally attached to the telemetry antenna and interfaced with the host's autotrack controller system; it transmits to an airborne PCM receiver/transmitter.

3.2.5 Command, Control, and Communications Facilities

The communications systems at the Research Range consist of the following components:

- HF/VHF/UHF radios
- Local area network (LAN), Internet, E-mail
- Telephone
- Frequency shift tone keying
- NASCOM 2000 network terminal
- Cable plant
- High-speed data circuits
- Data transmission systems
- 12-channel intercom
- 40-channel intercom in the RCC
- Closed-circuit television systems
- Administrative Message Service (AMS)

The cable plant supporting communications systems includes extensive telephone, coaxial cable, and fiber optic cables interconnecting WFF facilities. Varied combinations of multimode and single mode fiber optic cable connect launch pads and blockhouses. Copper twisted pair cable is available for telephone, intercom, timing, and data transfer. All major buildings contain coaxial TV cable for the RF distribution system.

The frequency shift tone keying system provides remote control of events and devices such as cameras and command transmitters.

The communications systems are flexible and can be configured to fit user requirements. These systems provide the means for managing operations at the Research Range and communicating and coordinating with related operations in other geographic areas.

3.2.6 Data Systems

Data are acquired during mission operations from radar, telemetry, optical, meteorological, and timing systems. A variety of data systems acquire, record, and display information in real time for science, control, and monitoring flight performance. Wallops has the capability to provide data in processed parameters and formats specified by the user. Data can be recorded on disk and magnetic tape in various formats. Optically derived data are available on videotape and film. Videotapes of real-time displays in the RCC can be provided.

Tracking data can be transmitted to remote locations in two formats: Minimum Delay Data Format (MDDF) and Launch Trajectory Acquisition System (LTAS) format. MDDF data are raw radar data (range azimuth/elevation versus time of day relative to radar pedestal). LTAS data are smooth radar data relative to the center of the Earth.

Inertial Navigation System (INS) and Global Positioning System (GPS) on-board flight system data can be received at Wallops by telemetry and can be converted to LTAS format.

3.2.7 Command Systems

UHF command systems provide control of airborne vehicle (rocket, balloon, or aircraft) functions for on-board experimental devices. The systems also provide flight termination capabilities for range safety purposes. There are fixed and mobile system capabilities. Omni, single-helix, and quad-helix antennas are used, and antennas are selected based on mission requirements. Command systems feature failover redundant transmitters and antennas. A typical configuration has 20 IRIG (Inter-Range Instrumentation Group) tones available for modulation.

The fixed command system at the Research Range can be controlled by the Range Safety Officer in the RCC or from building U-55 on the Mainland (Table 3-9). The mobile system is controlled from the RCC or from a Mobile Range Control Center (Table 3-10). An Instantaneous Impact Prediction/Command Destruct (IIP/CD) System is deployed with the Mobile Range Control Center.

Building U-55 also houses various systems that support U.S. Air Force Eastern Range (ER) high inclination launches. Among these systems are two 4-kilowatt transmitters that can be modulated with WFF IRIG encoders or with ER-provided SECOM (Secure Command) modulators. The transmitters use WFF quad-helix antennas and are remotely controlled from the ER Range Operations Control Center (ROCC) via two communications links.

3.2.8 Frequency Monitoring

Communications are supported by frequency monitoring equipment and frequency spectrum allocation management and coordination capabilities. The Frequency Monitoring System is used to monitor the frequency spectrum and for the detection and location of radio-frequency interference (RFI) sources. The Research Range is capable of monitoring frequencies to 22 gigahertz.

Table 3-9. Command Systems

Fixed Command System (Building U-55)

Transmitters			Antennas		
Type	**Frequency**	**Power**	**Type/Control**	**Gain**	**Polarization**
(2) ALEPH CTS-100 1 KW	406-450 MHz FM IRIG Tones	• Commercial AC • 2 generators and UPS for redundant system	(2) Orbit quad-helix; radar slaved or manual control	18 dB	LHC
			(2) Omni	0 dB	Vertical
(2) Collins FRW-2A 1 KW	406-450 MHz FM IRIG Tones	• Commercial AC • 2 generators and UPS for redundant system	(2) Orbit quad-helix; radar slaved or manual control[8]	18 dB	LHC
			(2) Omni	0 dB	Vertical
(2) Zeta System 1048 4 KW[9]	406-450 MHz FM IRIG Tones SECOM	• Commercial AC • 2 generators and UPS for redundant system	(2) Orbit quad-helix; radar slaved or manual control	18 dB	LHC

Table 3-10. Mobile Command Systems

Mobile Range Control System #1					
Transmitters			**Antennas**		
Type	**Frequency**	**Power**	**Type/Control**	**Gain**	**Polarization**
(2) Commtech PST 1 KW	406-450 MHz FM IRIG Tones	UPS	(2) Single-helix, pneumatic mast to 45 feet, radar slaved or manual control	15 dB	LHC
Mobile Command System #1A					
(2) Ophir RF XRF-232 1 KW	406-450 MHz FM IRIG Tones	UPS	(2) Single-helix, pneumatic mast to 45 feet, radar slaved or manual control	15 dB	LHC
Mobile Range Control Center #2					
(2) Ophir RF XRF-232 1 KW	406-450 MHz FM IRIG Tones	UPS	(2) Single-helix, pneumatic mast to 45 feet, radar slaved or manual control	15 dB	LHC

[8] Only one antenna can be connected real-time through coaxial switch.
[9] This system is currently used only to support Eastern Range launches.

3.2.9 Timing

The Master Timing Station (MTS) provides time synchronization and coordination of range activities. The system provides for the distribution of time codes, reference signals, and Program Time (countdown) information to all required locations. The Time-of-Year (T.O.Y.) system is synchronized to the GPS. The GPS time transfer unit is used to synchronize the MTS and the remote sites. The codes are received and amplified at the various remote user sites for a variety of functions, including use with recorders, oscillographs, camera sites, and for driving remote timing displays. Program Time provides a visual count status and programmable function control for events. Synchronous generators and translators at sites provide for fail-safe operations, propagation delay correction, and translation of received time codes to other codes (e.g., IRIG-A) and reference signals.

The following time codes are available:

NASA 28-bit	IRIG-B
NASA 36-bit	IRIG-E
	IRIG-H

3.2.10 Research Airport

The WFF Research Airport is located on the Main Base. See Figure 3-2 for an aerial view of the Wallops Main Base, including the Research Airport. Figure 3-17 shows the Research Airport and associated facilities. There are three runways, two taxiways, three ramps, and one hazardous cargo loading area in active service. The runway dimensions are

- 10-28 – 8,000 feet by 200 feet
- 04-22 – 8,750 feet by 150 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:

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

Instrumentation and Facilities

To provide precision tracking for airborne research programs, a RIR-716C C-band radar (Radar 18) with an integrated laser tracking system (LTS) is located on the airport at the Aeronautical Research Radar Complex (building A-41). This radar can provide an aircraft with Instrument Landing System (ILS) reference data to any WGS-84 point within 50 nautical miles

of the Research Airport. Precision approach path indicators (PAPI) are installed on all runways. Control tower support is available. Annotations on Figure 3-18 indicate the locations of facilities at the Research Airport. For more detailed descriptions, consult 830-AFOH-0001, *Airport Facility and Operations Handbook* at http://www.wff.nasa.gov/~apb.

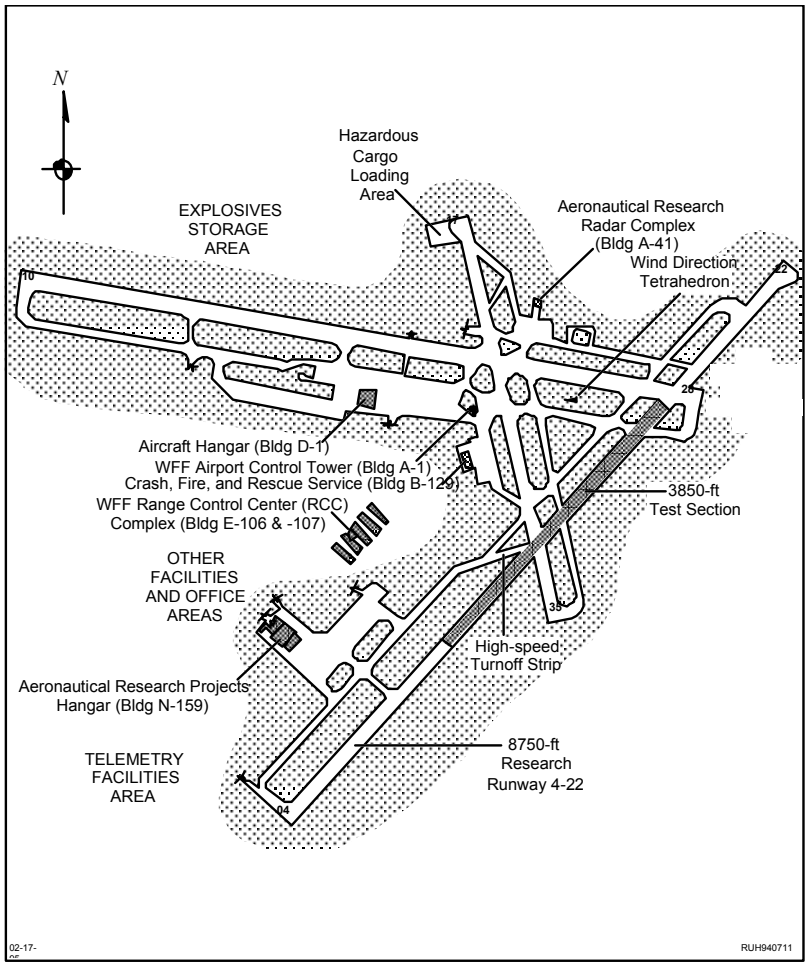


Figure 3-18. WFF Research Airport with Associated Facilities

Support and Services

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, both 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 are available for approved aircraft projects and vary in size and location. Since Wallops is equipped to effect only minor or limited repairs to transient aircraft, maintenance personnel should accompany project and R&D aircraft 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 available on the Wallops Web site at http://www.wff.nasa.gov.

3.2.11 Range Control Center (RCC)

The focal point for all Research Range operations is the RCC located in building E-106 on the Main Base. Data from the range support instrumentation (e.g., closed circuit TV, radar and TM 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 WFF missions. The Range Data Acquisition and Computation (RADAC) System supports the RCC with redundant real-time data support, including impact prediction, for range safety and other Research Range requirements. The RADAC System provides a quick and flexible selection of data sources and displays. The video switching network is the primary means of distributing data in the RCC. Critical instrumentation is supported by uninterruptible power supplies (UPS) and a backup power generator.

The RCC is composed of collocated rooms devoted to range control functions:

- Mission Control Room (MCR)
- Data Acquisition and Processing Room
- Range Safety Room
- Secure Room
- Surveillance and Downrange Communications Room
- MCR Observation Areas
- Aeronautical Projects Control Room
- Automatic Data Processing Room
- Instrumentation Room
- Weather Forecast Office

The Project Manager can provide information on the RCC communications, data systems, and other capabilities available to support a project at the Research Range.

RCC Mission Control Room

Figure 3-19. RCC MCR

The MCR is two stories high and features large screen video displays, eight generic mission controller consoles, a raised Test Director area, and a VIP area. Figure 3-19 is a panoramic view of the MCR from the Test Director's console; Figure 3-20 is the layout of the MCR.

Typically, mission controller stations 1 through 4, 6 and 8 are available to support range user functions. Additional console space can be made available for some missions in the adjacent Surveillance and Downrange Communications Room and/or the RCC Secure Room.

The eight mission controller stations have a standard configuration for video and data display; however, the selection of information and data displayed is very flexible. The configuration and selection of the displays and data sources can be pre-selected and changed during an operation, if required. Various consoles have Silicon Graphics workstations and/or PCs to provide additional real-time data displays.

Figure 3-21 is a typical mission controller station with video display and communications and control devices. The video displays are shown in the background.

Figure 3-22 illustrates the data and communications available at each station.

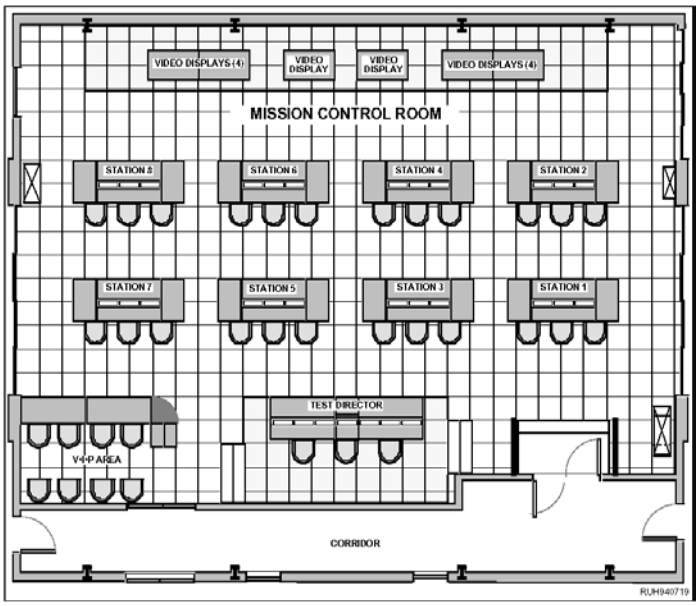


Figure 3-20. Layout of RCC Mission Control Room

Figure 3-21. Mission Controller Station

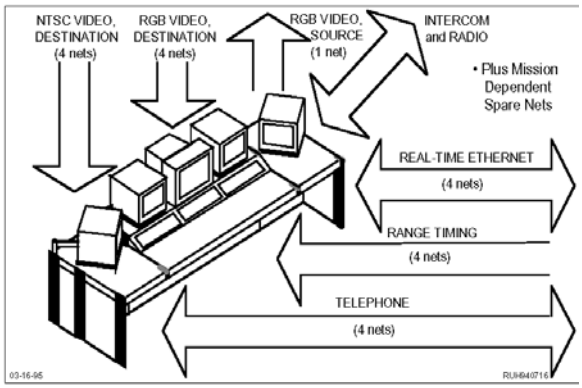


Figure 3-22. Data Interfaces

Data Acquisition and Processing Room

The Data Acquisition and Processing Room is adjacent to the MCR. Radar, TM, and other range data are checked for quality and selected for display from this room. The room is separated from the MCR by a glass wall with sliding glass doors.

Range Safety Room

The Range Safety Room is adjacent to the MCR and is the focal point for ground and flight safety operations. The functions performed in the Range Safety Room are wind weighting, monitoring of preflight and flight parameters, and control of the Flight Termination System. The room is separated from the MCR by a glass wall with sliding glass doors.

Secure Room

The Secure Room is adjacent to the Range Safety Room and the MCR. A secure environment can be established for encrypted communications systems, if required. User-provided equipment can be accommodated.

Surveillance and Downrange Communications Room

This room is adjacent to the Data Acquisition and Processing Room. Surveillance consoles provide communications, computation, and displays for range surveillance and clearance functions. In addition, two remote radar consoles, one for the ASR-7 and one for the Mariners Pathfinder radar, provide radar control and range surveillance information. This room is separated from the MCR by a glass wall and sliding glass door.

MCR Observation Areas

There is a glassed-in balcony on the third floor between buildings E-106 and E-107, which overlooks the MCR. The balcony will accommodate approximately 30 visitors.

Aeronautical Projects Control Room (APCR)

The APCR on the fourth story between buildings E-106 and E-107 provides visual observation of the Research Airport, including research runway 04-22 and aeronautical project activities in the surrounding area. The APCR has mission controller consoles identical to those in the MCR, which provide communications and data display for monitoring and control of aeronautical projects. Figure 3-23 shows the layout of the APCR.

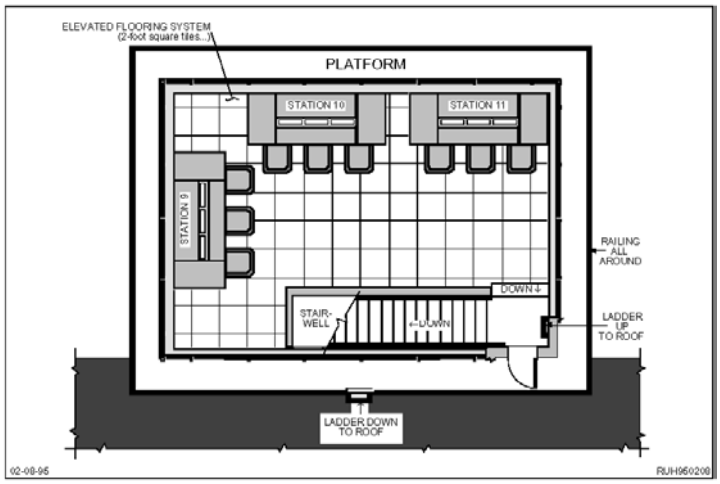


Figure 3-23. RCC 4th Floor Aeronautical Projects Control Room

Automatic Data Processing (ADP) Room

The ADP Room contains three Encore/Concept 32 super-mini computer systems: the Real-Time Computer System (RTCS), the Real-Time Backup System (RTBS), and the Data Reduction Computer System (DRCS). The RTCS and RTBS compose the RADAC, providing redundant real-time support to the RCC. The DRCS provides general ADP support, primarily data reduction.

The systems use the MPX-32 operating system, and there are C and FORTRAN 77+ compilers. WFF maintains libraries of applications to process user data. The super-mini computers are networked to share data and can provide access via RS-232 ports and modems.

These computers provide post-mission data analysis, general data reduction, and range operations support, such as real-time processing, local and remote multi-batch processing, interactive communications, and time-sharing.

RCC Instrumentation Room

The Instrumentation Room provides the primary interface with internal and external RCC communications, as well as the control for data distribution within the RCC. The primary support instrumentation based in the Instrumentation Room is listed below:

- Frame for twisted pair interface to external points and distribution of RCC data and communications. These pairs support telephone, range intercom, remote radio circuits, command remote, tone keying, timing data, radar data, and NASCOM.
- Fiber optic cable system interface, which supports video, high-speed data, and access to the WFF LAN.
- Video Switching Network, a two-level computer setup and control.
- NRSC: 50-source input by 120 destination output.
- RGB: 50-source input by 100 destination output.
- NASCOM access, which provides real-time voice and data communications with other locations through the NASCOM 2000 network.
- Programmable intercom for range communications, which provides patchable radio, telephone, SCAMA (Switching, Conferencing, and Monitoring Arrangement), and range operations channels.

Weather Forecast Office

The Weather Forecast Office provides meteorological information in support of all WFF activities, and provides daily and special forecast support as required. National, regional, and local weather data are available. Data sources include the Automated Weather Interactive Processing System (AWIPS); several lightning detection systems; field mills, which measure lightning potential; Digital Facsimile (DiFax) for charts and graphs; 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 8 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 recorded and accessible by telephone.

The following additional weather information is also 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.

3.2.12 Meteorological Facilities

Various 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 discussed in 3.2.12 display lightning conditions locally and over the United States.

3.2.13 Wallops Geophysical Observatory (WGO)

The Wallops Geophysical Observatory (WGO) allows scientists, principal investigators, and other experimenters to conduct measurements from ground-based test equipment. The WGO is intended to augment and enhance flight vehicle-based test equipment during scientific missions. Eventually, the facility will include a fully integrated network of devices accessible locally at the Range Control Center and through connectivity to the NASA Intranet and World Wide Web.

The Atmospheric Sciences Research Facility (ASRF) is included in the WGO. Additional capabilities will be available Spring 2004 with the installation of a DC (steady) magnetometer and high-frequency backscatter radar for ionospheric measurements.

The WGO supports the Coastal Zone Research Program.

Atmospheric Sciences Research Facility (ASRF)

The ASRF 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).

The following lightning characterization systems also support range operations:

- Lightning Detection and Ranging (LDAR) System is a time-of-arrival system that measures, locates, and displays intercloud, intracloud, and cloud-to-ground lightning discharges.
- National Lightning Detection Network (NLDN) is a magnetic direction finder antenna network that displays cloud-to-ground lightning strike locations within the continental United States.
- Extremely Low Frequency (ELF) Lightning Measurement System detects lightning activity at very long ranges.
- Electric Field Measurement System aids in determining the probability of and detection of local lightning activity.
- Sferics System measures electromagnetic radiation from lightning discharges at different frequencies.

Figure 3-24. ASRF and SPANDAR

The ASRF and SPANDAR (S-band space and range radar) are shown in Figure 3-24. Additional information on the ASRF is in *An Experimenter's Guide to the NASA Atmospheric Sciences Research Facility*, March 1994.

3.2.14 Optical and Television Facilities

The WFF Optical and Television Facilities provide operations and maintenance of photographic and television services for Wallops and other locations around the world.

Optical Section

The Optical Section performs five distinct functions:

- Still photography, using film or digital media. Controlled-environment photography is shot in a studio. Photographers are on call for any reporting or documentary coverage of range activities.
- Process and Printing Laboratory, which processes and reproduces black and white and color film and still photographs. Wet processing is currently in use, but is being phased out. Digital capture and printing of images is in use on a limited basis; this capability is being upgraded and will replace other means of capturing data.
- Aerial photography, which uses different film and filter combinations, either at ground stations or from aircraft, to produce a variety of images from motion picture, still, or video cameras.
- Tracking and instrumentation operations, which are based primarily at Wallops Island to support sounding rocket launches and aircraft and balloon programs. WFF camera domes enclose fixed and tracking cameras used to photograph launches and operations from Wallops Island. Mobile equipment, cameras, and lenses are transported to remote sites to track, photograph, and transmit coverage of projects. Digital timing can provide precision timing on 16-mm film data for range users at Wallops and remote locations. Figure 3-25 shows camera locations on Wallops Island and Mainland. Table 3-11 lists camera capabilities
- Archive, which is an electronic data management system for all still photographs created for all Wallops partners. Negatives, digital media, and proof prints are stored in-house or in a special records storage area. Retrieval of any image is possible within a short time.

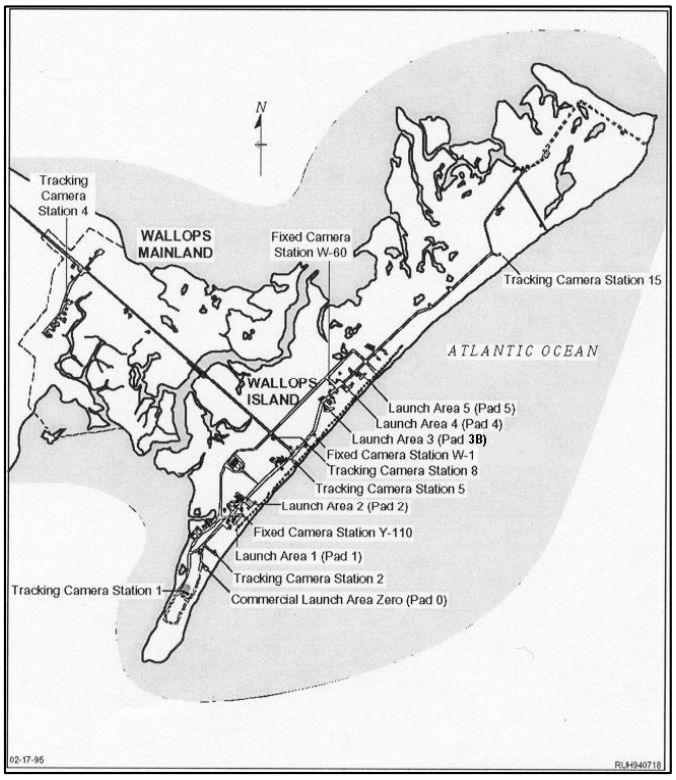


Figure 3-25. Optical Tracking Stations

Table 3-11. GSFC/WFF Photo Optical Systems

I.D. No.	Station	System Type	Track Modes	Tracking Rates	Camera Type	Film Type	Lens Focal Length	Environmental Control
#1	Tracking	IFLOT MK1	EL/AZ Manual	22°/sec	MP Film	16-mm	40-inch 80-inch	12-foot Astrodome shelter
#2	Tracking	SOT MK 51	EL/AZ Manual	Manual	MP Film TV	16-mm video	15-inch 12-inch	10-foot Astrodome shelter
#4	Tracking	IFLOT Mk 3A	EL/AZ Manual	30°/sec	MP Film TV	16-mm video	80-inch 40-inch	12-foot Astrodome shelter
#5	Tracking	SOT Mk 51	EL/AZ Manual	Manual	MP Film TV	16-mm video	10 - 20 inch ZOOM	10-foot shelter
#8	Tracking	IFLOT Mk 1	EL/AZ Manual	22°/sec	MP Film	16-mm	40-inch 40-inch	12-foot Astrodome shelter
#9	Tracking	IFLOT Mk 3 (Mobile)	EL/AZ Manual	32°/sec	MP Film	16-mm	40-inch 80-inch	N/A
#11	Tracking	IFLOT Mk1 (Mobile)	EL/AZ Manual	22°/sec	MP Film	16-mm	No camera or lens assigned	N/A
#12	Tracking	IFLOT Mk 1 (Mobile)	EL/AZ Manual	22°/sec	MP Film	16-mm	No camera or lens assigned	N/A
#15	Tracking	IFLOT MK 3	El/AZ Manual	32°/sec	MP Film TV	16-mm video	80-inch 80-inch	12-foot Fixed Shelter
W-60	Fixed	Stationary Mount	Fixed	N/A	MP Film Sequence Film	16-mm 70-mm	12-mm to 12-in 6- to 12-inch	10-foot Fixed Shelter
W-115	Fixed	Stationary Mount	Fixed	N/A	MP Film Sequence Film	16-mm 70-mm	12-mm to 12-in 6- to 12-inch	10-foot Fixed Shelter
Y-110	Fixed	Stationary Mount	Fixed	N/A	MP Film Sequence Film	16-mm 70-mm	12-mm to 12-in 6- to 12-inch	10-foot Fixed Shelter

Television Section

The Television Section provides two distinct functions:

- Video editing and reproduction, which produces videotapes and DVDs in support of WFF activities and special projects. The Television Section provides videotaping in four main formats for data capture. A television postproduction facility is available for prompt editing, broadcast, and reproduction of high quality data.
- Video distribution, which uses the multi-channel cable television system to distribute video from many diverse sources to Wallops facilities, including the Visitor Center, Management Education Center (MEC), U.S. Navy facilities, and the NOAA Weather Data Acquisition Center. Video sources from satellite, real-time range, or computer generation are directly linked to the cable system and, therefore, instantly available to the network.

3.2.15 Recovery Facilities

U.S. Government and contractors provide recovery services for ocean surface, subsurface, and land operations. Visual and electronic search techniques are employed to locate objects impacting on the ocean surface and land areas. Electronic search employs aircraft- or ship-mounted beacon receiving (homing) equipment in conjunction with homing transmitters attached to the objects to be recovered.

Subsurface recovery utilizes sonar pinger locating equipment in conjunction with sonar pingers (transmitters) attached to the object to be recovered. Side-scan sonar, underwater TV, and dragline equipment are also employed to locate subsurface objects for recovery. Retrieval of subsurface objects can employ scuba and hardhat divers and underwater remote control retrieval units.

3.2.16 Uninhabited Aerial Vehicles (UAVs)

The Aircraft Office at Wallops manages NASA's Low Altitude Airborne Science Project, which utilizes different aircraft assets, including UAVs, for science and surveillance projects. Commercial UAV manufacturers and other users are taking advantage of Wallops' UAV runway on the south end of Wallops Island (Figure 3-26) for product trials. The runway is 750 feet long with 50-foot wide asphalt and 20-foot wide grass landing strips. For more information on UAVs at Wallops, go to http://www.wff.nasa.gov/~apb/.

Figure 3-26. UAV Runway on Wallops Island

3.2.17 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 performs functions such 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. The facilities are managed through the NASA Sounding Rocket Operations Contract (NSROC). A more comprehensive description of mechanical and electrical fabrication capabilities is available in 810-HB-SRP, *Sounding Rocket Program Handbook* online at http://www.nsroc.com.

3.2.18 Environmental Testing Facilities

Environmental testing of complete payloads, subassemblies, and components verifies flight readiness when exposed to an intended flight environment. Specialized facilities for environmental testing available at Wallops include the following:

- Spin deployment bay
- Static and dynamic balance machines
- Vibration facility
- Thermal-vacuum chambers
- Anechoic chamber
- RFI/EMI chamber
- Bend test apparatus
- Magnetic calibration facility
- Vacuum chamber
- Mass properties apparatus
- Thin film testing facility
- Integration laboratories

For more information on environmental testing facilities, see *Doing Business at Wallops Flight Facility: A Customer Guide*. A detailed discussion of environmental testing policies and considerations is included in the *Sounding Rocket Program Handbook*.

3.2.19 Metrology

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.

3.2.20 Hazardous Material Storage

There are facilities located on Wallops Island for the temporary storage of hazardous liquids, such as propellants and purging gasses. There are also two rocket motor storage facilities on the Island, one for Class 1.1 rocket motor storage and an above ground facility for storage of all classes of rocket motors.

Wallops Main Base has above ground and earthen-covered storage magazines for storage of Class 1.3 and Class 1.4 explosives. There are also facilities for the non-destructive testing of ordnance and rocket motors.

3.2.21 Mobile Range Systems

Wallops has developed mobile radar, telemetry, and data systems that can be transported to offsite and remote locations. Campaigns have been conducted in Arctic and Antarctic regions, South America, Africa, Europe, Australia (Figure 3-27), and even at sea. WFF personnel have extensive experience in planning and conducting mobile campaigns and developing equipment and systems to support these operations. Mobile systems include the following:

- C-band radar
- Data acquisition and recording
- Payload processing
- Launchers
- Orbital tracking
- Communications
- Real-time data processing and display
- Range safety
- Flight termination system
- Telemetry
- Meteorology
- Power
- Timing
- Optical tracking
- Command
- Control center
- Recovery

Additional information on mobile capabilities can be found in the *Sounding Rocket Program Handbook*.

Figure 3-27. Range Equipment at Woomera, Australia

Section Four: Wallops Research Range Administration and Logistics

4.1 General

This section describes applicable administrative and logistics policy and procedures.

4.1.1 Access

Wallops Flight Facility maintains 24-hour security for all facilities. Personnel without current security badges will not be allowed access to the Main Base, Wallops Island, or the Mainland complex. All visits to WFF should be coordinated with the Project Manager.

4.1.2 Working Hours

The normal workday for WFF is 0800 to 1630 Monday through Friday. There are work limitations established for safety purposes. Coordination of the work schedule with the Project Manager is necessary to ensure access to required facilities and the availability of necessary technical personnel.

4.1.3 Visiting Aircraft

A FAA-certified VFR control tower operates on 126.5/394.3 MHz. The Control Tower is manned from 0700 to 1730 Monday through Friday, excluding holidays, and at other times to support specific missions. Visiting aviators on official U.S. Government business are required to obtain a Prior Permission Request (PPR) number from the Wallops Airport Manager (or in his absence, from an approved Project Manager) prior to flying into WFF. The PPR should be obtained at least 24 hours before the scheduled arrival. Upon arrival in Wallops airspace, the visiting aircraft should contact the Control Tower operator, call sign "Wallops Tower". The pilot must provide the assigned PPR to the Control Tower operator before permission is given to land.

During non-tower hours, the visiting aviator must contact "Wallops UNICOM" and provide the assigned PPR. Wallops UNICOM is a service that operates on the Control Tower frequencies to provide information, services, and airport lighting to visiting aircraft. Non-FAA-ATC certified contract firefighters and rescue personnel provide this service from a remote location. *Traffic Advisory Practices at Airports without Operating Control Towers (FAA AC No. 90-42)* is in effect during non-tower operating hours because of safety and security considerations.

During tower and non-tower hours, the visiting aviator must contact "Wallops Tower" or "Wallops UNICOM" prior to engine start. All movement on the airfield must be pre-coordinated over the Control Tower frequencies 126.5/394.3 MHz.

4.1.4 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.

4.1.5 Communication Services

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. Fax service is available. 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 WFF operator is available during normal working hours at (757) 824-1000.

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.

4.1.6 Smoking

Smoking is prohibited in all WFF buildings, launch pads, aircraft, and aircraft support areas.

4.1.7 Industrial Safety

Industrial safety procedures are typical of those enforced at other U.S. Government facilities. In addition, personnel are expected to obey all control signals and roadblocks on the airfield and launch range.

4.1.8 Fire Protection

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

4.1.9 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.

4.1.10 Shipping

Various shipping services are available, including United Parcel Service, Federal Express, and the U.S. Postal Service. 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

4.1.11 Motor Freight Truck Service

Most cargo and freight are received at WFF Main Base, building F-19. However, construction material is delivered to the site, and commercial shipments may be received directly by commercial users.

Inbound shipments of Class "A" and "B" explosives and other designated hazardous materials require advance notice prior to arrival. The delivering carrier's representative should provide advance notice by telephone to the explosives handling personnel in building M-15 (757-824-1433). The explosives handling personnel will furnish onsite escort, unloading, inspection, and shipment acceptance.

Normal receiving hours are 0800 to 1430 (for truckloads) and 0800 to 1600 (for partial loads), Monday through Friday, excluding holidays.

4.1.12 Air Cargo

Air cargo deliveries require special consideration and must be discussed with the assigned Project Manager and/or the Airport Manager.

GSFC/WFF Airport Manager
Phone (757) 824-1654
Fax (757) 824-1373

4.1.13 Airfreight Services

The nearest commercial airfreight service is at the Salisbury-Wicomico County Regional Airport, Salisbury, Maryland.

4.1.14 Hazardous Material

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 WFF.

All hazardous materials shall be disposed of in accordance with the Virginia Department of Environmental Quality Regulations. The range user must provide a "Hazardous Waste Disposal Inventory," NASA Form WI-1550, to the WFF Environmental Office for disposal of all hazardous material.

Radioactive sources require approval from the Safety, Environmental and Security Office prior to arrival. The range user must provide the proper forms requesting the use of a radioactive material at WFF, including license information, to the Project Manager at least 90 days prior to the shipment/arrival of the source. GHB 1860.1, *Radiation Protection–Ionizing Radiation*, defines procedures and provides the needed forms.

4.1.15 Material Handling Equipment

A variety of material handling equipment is available. These include forklifts, overhead hoists, and material moving equipment. The range user should provide required information regarding the testing and certification of slings, fixtures, and other user-furnished lifting devices. Table 4-1 lists the primary material handling equipment available at WFF.

Table 4-1. Material Handling Equipment

Quantity	Material Handling Equipment
1	60-ton hydraulic truck crane with 118-foot main boom
1	28-ton hydraulic truck crane with 70-foot main boom
1	95-foot basket truck
1	65-foot basket truck
Several	Electric fork lifts
Several	Forklifts under 8,000 pounds
6	8,000-pound forklifts
1	10,000-pound forklift
2	18,000-pound forklifts
2	Stakeside truck with 2,000-pound hydraulic lift gate
1	Lowboy trailer with hydraulic tail deck
1	Van truck
3	Truck tractors
Several	Handtrucks
Several	Pallet jacks

4.1.16 Customs

International shipments should clear U.S. Customs before arrival at WFF. Arrangements for shipments directly from overseas into WFF must be coordinated and approved by U.S. Customs prior to shipment.

4.1.17 Post Office

A United States Post Office is located in building E-7 on the Main Base. The address is Wallops Island, VA 23337 USA.

4.2 Foreign Nationals

Foreign nationals must obtain prior approval from NASA before a visit. The individual must provide a visit request to the Project Manager at least 20 working days (4 weeks) in advance for a visit of 30 days or less and 2 calendar months in advance for an assignment over 30 days. A list of required information to be provided for the visit can be obtained from the Project Manager.

4.3 Public Affairs Support

The Wallops Public Affairs Office (PAO) is available to support range users with media and guest relations operations. The PAO can set up Web casts of missions and can accommodate groups that want to transmit broadcasts from Wallops using a small local radio station that provides launch commentary for local listeners. Initial requests for PAO support can be made through the Project Manager.

4.4 NASA Visitors Center

Wallops Flight Facility Visitor Center and Gift Shop are located on Virginia Route 175 about 1 mile east of the Wallops Main Gate. The Visitor Center, Gift Shop, and Teacher Resource Lab are part of the Robert L. Kreiger Education Center (see Figure 4-1). A collection of spacecraft and flight articles as well as exhibits about the United States space flight program are on display. Special movies and video presentations can be viewed, and special events such as model rocket

launches are scheduled. There is no admission charge. The Visitor Center auditorium may be used for media and guest relations activities.

Figure 4-1. Wallops Visitor Center and Gift Shop

Section Five: Range Safety Policies

5.1 Range Safety Organization

The Suborbital and Special Orbital Projects Directorate (Code 800) is responsible for implementing safety policies and criteria for the Wallops Research Range as defined in RSM-2002, *Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility*.

5.2 Ranger User's Pre-arrival Requirements

Range users should design vehicle and payload systems to fully implement and conform to the safety policies and criteria established by Wallops Flight Facility.

Range users must identify vehicle or payload systems and/or operational requirements that cannot meet the NASA/GSFC/WFF safety policies and criteria.

Range users must provide a safety data package containing the data defined in RSM-2002, and according to the documentation schedule listed in 2.4.5 of this document.

5.3 Ground Safety

Specific policies and criteria, such as radiation exposure limits, power switching, multiple operations, electro-explosive circuit requirements, electrical storm criteria, RF restrictions, personnel requirements, radioactive sources, and pressure vessels, are provided in RSM-2002. Radiation protection requirements are detailed in GHB 1860.1. All hazardous procedures must certify personnel or approve the certification of range user personnel.

The Ground Safety Group will prepare a ground safety plan and publish it as part of the OSD before any range user operations are conducted at the Research Range.

5.4 Flight Safety

Specific flight safety policies and criteria for impacts, land overflights, and ship and aircraft hazard areas are also defined in RSM-2002. All flights will be planned to minimize the risks involved while enhancing the probability for attaining mission objectives.

The Flight Safety Group will prepare a flight safety plan and publish it as part of the OSD prior to launch operations. The flight safety plan will include the specific flight limits, impact limits, ship and aircraft hazard areas, and mission-unique requirements.

APPENDIX A

Abbreviations and Acronyms

ADP	Automatic Data Processing
AML	Astro Meteorological Launcher
AMS	Administrative Message Service
APCR	Aeronautical Projects Control Room
ARC	Atlantic Research Corporation
ASRF	Atmospheric Sciences Research Facility
AWIPS	Automated Weather Interactive Processing System
AZ	azimuth
CAD/CAM	Computer Aided Design/Computer Aided Manufacture
CD-ROM	Compact Disk – Read Only Memory
CNC	Computer Numerically Controlled
csc^2	$cosecant^2$
CSLA	Commercial Space Launch Act, Public Law 98-575
dB	decibel
dBmi	decibels milli-isotropic
D.C.	District of Columbia
DC	direct current
DiFax	digital facsimile
DoD	Department of Defense
DRCS	Data Reduction Computer System
DVD	Digital Video Disc
EDARS	Environmental Data Acquisition and Recording System
EIRP	effective isotropic radiated power
EL	elevation
ELC	emerging launch company
ELF	Extremely Low Frequency
ELV	expendable launch vehicle
ER	Eastern Range
ERD	Environmental Resources Document
FAA	Federal Aviation Administration
FACSFAC	Fleet Area Control and Surveillance Facility
Fax	facsimile transmission
FM	frequency modulation
ft	foot or feet
FTS	Federal Telecommunication System
G/T	Gain/System Noise Temperature or Figure of Merit
GHB	Goddard Space Flight Facility Handbook
GHz	gigahertz
GMI	Goddard Space Flight Center Management Instruction
GPS	Global Positioning System
GSFC	Goddard Space Flight Center

Abbreviations and Acronyms (cont.)

H	height
HAD	High Altitude Diagnostic (Launcher)
HF	high frequency
HH	hook height
IIP/CD	Instantaneous Impact Prediction/Command Destruct
ILS	Instrument Landing System
in	inch(es)
INS	Inertial Navigation System
IRIG	Inter-Range Instrumentation Group (U.S. Government Agency)
ISA	Individual Support Annex
ISO	in support of
kg	kilogram
KW	kilowatt
LAN	local area network
lb	pound or pounds
LDAR	Lightning Detection and Ranging System
LFF	Liquid Fueling Facility
LGTAS	Low Gain Telemetry Antenna System
LHC	Left Hand Circular
LTAS	Launch Trajectory Acquisition System
LTS	laser tracking system
M	meter
mm	millimeter
MCR	Mission Control Room
MDDF	Minimum Delay Data Format
MEC	Management Education Center
MHz	megahertz
MOA	Memorandum of Agreement
MSC	Marine Science Consortium
MSDS	Material Safety Data Sheet
MTS	Master Timing System
NACA	National Advisory Committee for Aeronautics
NASA	National Aeronautics and Space Administration
NASCOM	NASA Communications
NEPA	National Environmental Policy Act
NIST	National Institute of Standards and Testing
NLDN	National Lightning Detection Network
nmi	nautical mile
NOAA	National Oceanic and Atmospheric Administration
NORAD	North American Aerospace Defense Command
NPG	NASA Procedures and Guidelines
NPOL	NASA Polarimetric Radar
NSBF	National Scientific Balloon Facility
NSROC	NASA Sounding Rocket Operations Contract

Abbreviations and Acronyms (cont.)

NWS	National Weather Service
ODIN	Outsourcing Desktop Initiative for NASA
OSD	Operations and Safety Directive
OSS	Operations Safety Supervisor
P&BRO	Policy and Business Relations Office
PAO	Public Affairs Office
PAPI	precision approach path indicators
PBX	Private Branch Exchange
PCM	pulse code modulation
PFRR	Poker Flat Research Range
PPR	Prior Permission Request
PRD	Program Requirements Document
R&D	research and development
RADAC	Range Data Acquisition and Computation
RCC	Range Control Center
RCC-DG	Range Commanders Council-Documentation Group
RF	radio frequency
RFI	radio-frequency interference
RHC	Right Hand Circular
ROCC	Range Operations Control Center
RSM	Range Safety Manual
RSO	Range Safety Officer
RTBS	Real-Time Backup System
RTCS	Real-Time Computer System
SCAMA	Switching, Conferencing and Monitoring Arrangement
sec	second
SECOM	Secure Command
SPANDAR	Space and Range Radar
sq	square
T.O.Y.	Time-of-Year
TM	telemetry
TOGA	Tropical Ocean-Global Atmospheric Radar
TOTS	Transportable Orbital Tracking System
TRADAT	Trajectory Data System
TRMM	Tropical Rainfall Measuring Mission
TRMM-LBA	Tropical Rainfall Measuring Mission-Large Scale Biosphere-Atmosphere
TV	television
UAV	Uninhabited Aerial Vehicle
UDS	Universal Documentation System
UHF	ultra high frequency
UPS	Uninterruptible Power System
U.S.	United States
USA	United States of America

Abbreviations and Acronyms (cont.)

USCG	United States Coast Guard
USN	United States Navy
VA	Virginia
VCSFA	Virginia Commercial Space Flight Authority
VFR	Visual Flight Rules
VHF	very high frequency
VIP	very important person or people
VSFC	Virginia Space Flight Center
W	wide
WEMA	Wallops Employee and Morale Association
WFF	Wallops Flight Facility
WGO	Wallops Geophysical Observatory
WI	Work Instruction
WOTS	Wallops Orbital Tracking Station

APPENDIX B

References

(Listed in order of appearance.)

1. National Aeronautics and Space Act of 1958 (Space Act)

2. 802-WFFCG-0001, *Doing Business at Wallops Flight Facility: A Customer Guide*

3. GMI 1700.2, *Goddard Space Flight Center Health and Safety Program*

4. NPG 8715.3, *NASA Safety Manual*

5. RSM-2002, *Range Safety Manual for Goddard Space Flight Center/Wallops Flight Facility*

6. 800-HDBK-0001, *Wallops Flight Facility Host/Tenant Frequency Utilization Management Handbook*

7. *Wallops Flight Facility Environmental Resources Document (ERD)*, dated October 1999

8. Commercial Space Launch Act, Public Law 98-575

9. *Range Commanders Council-Documentation Group (RCC-DG) Document 501-97*

10. *An Experimenter's Guide to the NASA Atmospheric Sciences Research Facility*, March 1994

11. 830-AOM-0001, *Aircraft Operations Manual*

12. 810-HB-SRP, *Sounding Rocket Program Handbook*

13. *Traffic Advisory Practices at Airports without Operating Control Towers (FAA AC No. 90-42)*

14. GHB 1860.1, *Radiation Protection–Ionizing Radiation*