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Effective Date	March 24, 2015



Code 840 Range and Mission Management Office

**National Aeronautics and Space Administration**

**Goddard Space Flight Center**

**Wallops Flight Facility**

**Range Services**

**Project Implementation Plan**

**NRW-5588 / 46.008 Koehler**

**RockSat-X 2014**



**Effective Date: March 24, 2015**



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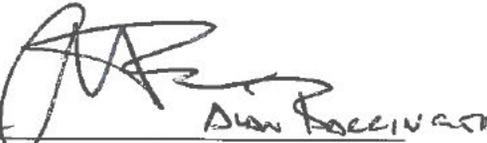
  
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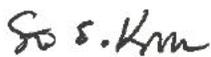
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**CHANGE RECORD SHEET**

ISSUE	DATE OF RELEASE	REASONS FOR REVISION
-	March 24, 2015	Baseline

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## 1.0 OVERVIEW AND OBJECTIVES

### 1.1 Project Overview

The 46.008 Rocksat-X mission is the 4th in the series of Rocksat-X payloads which provide expanded flight opportunities beyond the RockOn University-level Sounding Rocket experiment series. 46.008 was originally scheduled for launch in August 2014, but due to the SubTEC-6, 46.007 Motor mishap, it was rescheduled for Spring 2015. This payload provides experimenters from five Universities the opportunity to fly a payload of their choosing to be exposed to the space environment, the paradigm for the Rocksat-X series. The selected Universities are as follows:

- University of Puerto Rico
- Northwest Nazarene University
- University of Colorado at Boulder
- Virginia Tech University
- University of Nebraska at Lincoln

This payload (see Figure 1.0) will also include an Attitude Control System (ACS) Magnetically Assisted NSROC Inertial Control System (MaNIACS), Next Generation ORSA recovery circuit, and a Forward Recovery Section (FIRMA) flotation aid system. This will be the first flight of the Solar Sensor package for sounding rocket attitude determination. These sensors are expected to dramatically improve the fidelity of the solution and enhance the capabilities over the current sensor. The new sensors cost less and provide a 120 degree field of view with a 2 axis position error of less than 0.4 degrees and accuracy of less than 0.06 degrees. The 46.008 payload will fly on a Terrier Mk 12 boosted Improved Malemute launch vehicle from Wallops Flight Facility currently scheduled for Spring 2014. The payload is designed for recovery.

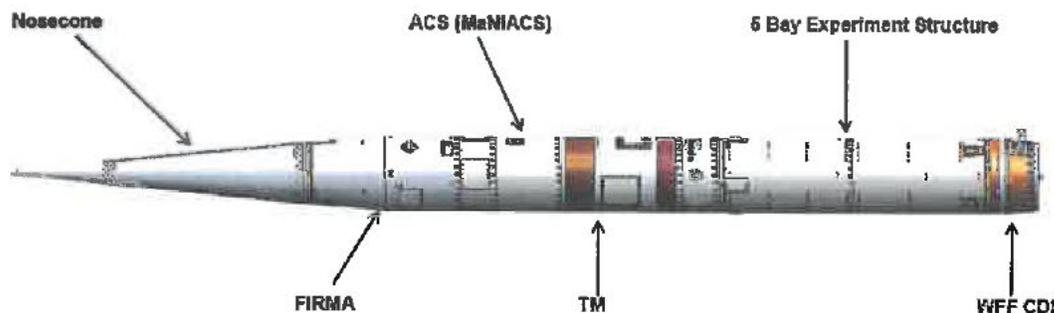
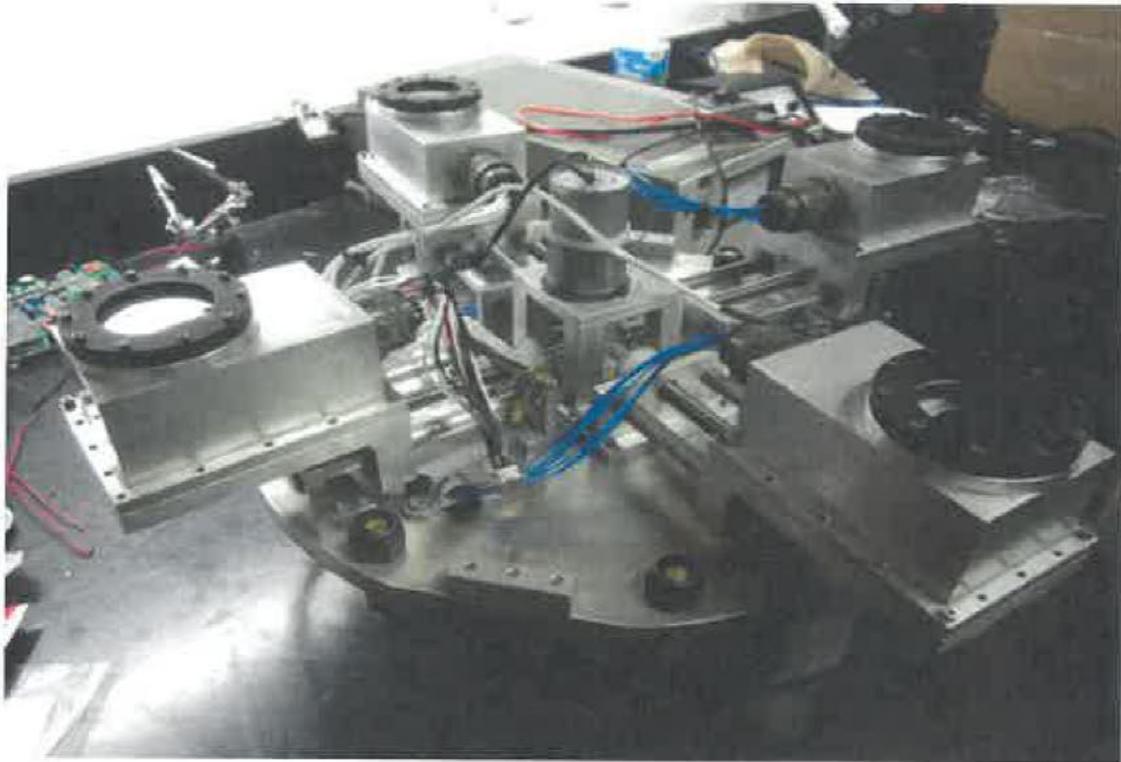


Figure 1.0: 46.008 Payload Configuration



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Figure 1.1 Video Camera Deck #1



The #1 deck mount is designed by the RockSat-X COSGS Team. It will be configured and built with 6 Video Cameras, 2 horizontally mounted and 4 mounted to look aft. Figure 1.1 shows the deck components.



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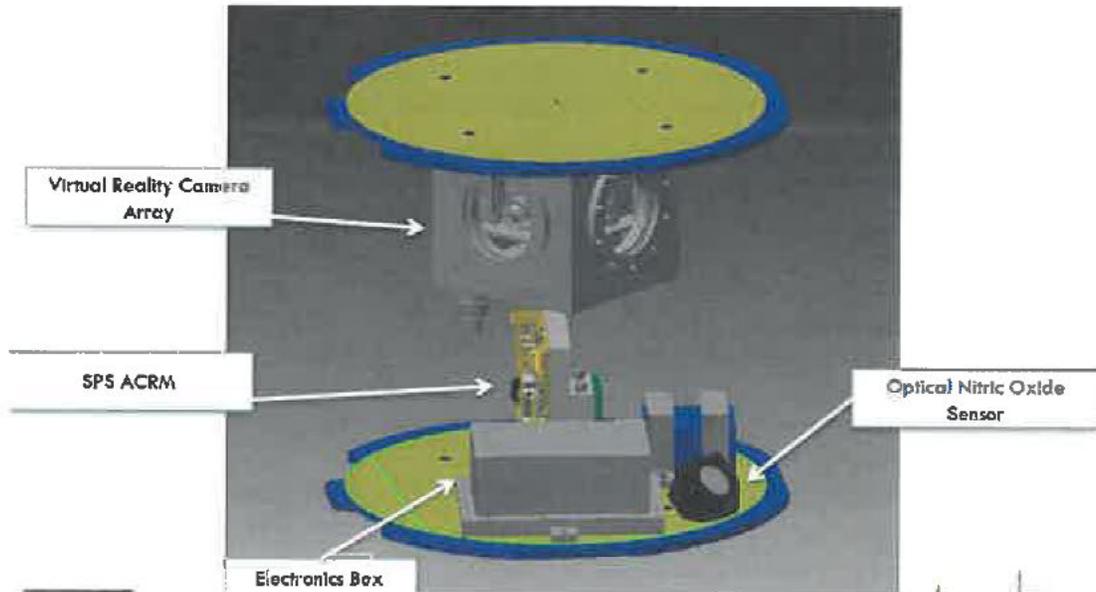


Figure 1.2 VT Experiment Deck #2

The #2 Deck Mount is designed by the Virginia Tech (VT) team. This deck mount will consist of the following experiments:

- Test deployment of the Space Pressure Sensor (SPS) Aperture Cover Release Mechanism (SPS ACRM)
- Utilize Optical Nitric Oxide Sensor (ONS) for NO concentration data collection in high altitudes
- Record panoramic video for virtual reality simulation (VRE)

Figure 1.2 shows the #2 deck components



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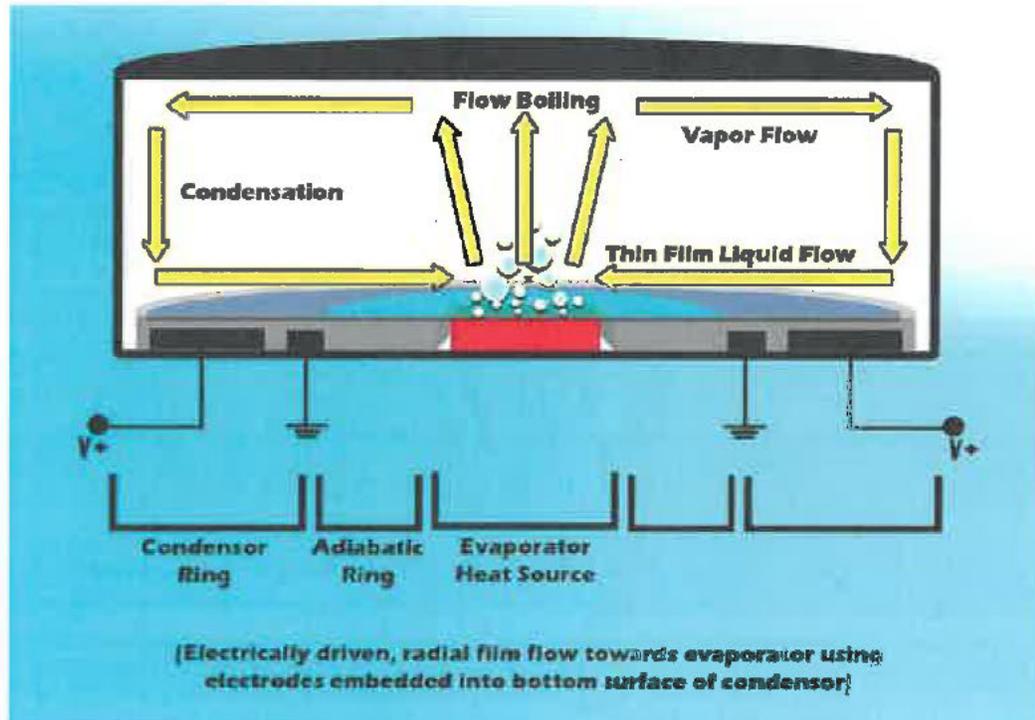


Figure 1.3 UN Experiment Deck #3

The #3 Deck Mount is designed by the University of Nebraska (UN) at Lincoln. Experiment goals for UN are as follows:

Minimum Success Criteria:

- Collect EHD temperature data for half the microgravity time
- Collect temperature data from 3D circuit throughout microgravity
- Comprehensive Success Criteria:
- Collect temperature data from EHD power-on until controls power-down
- Collect temperature data from 3D circuit throughout microgravity
- Collect strain data from PCB and 3D circuit

Figure 1.3 shows an illustration of overall UN system design.

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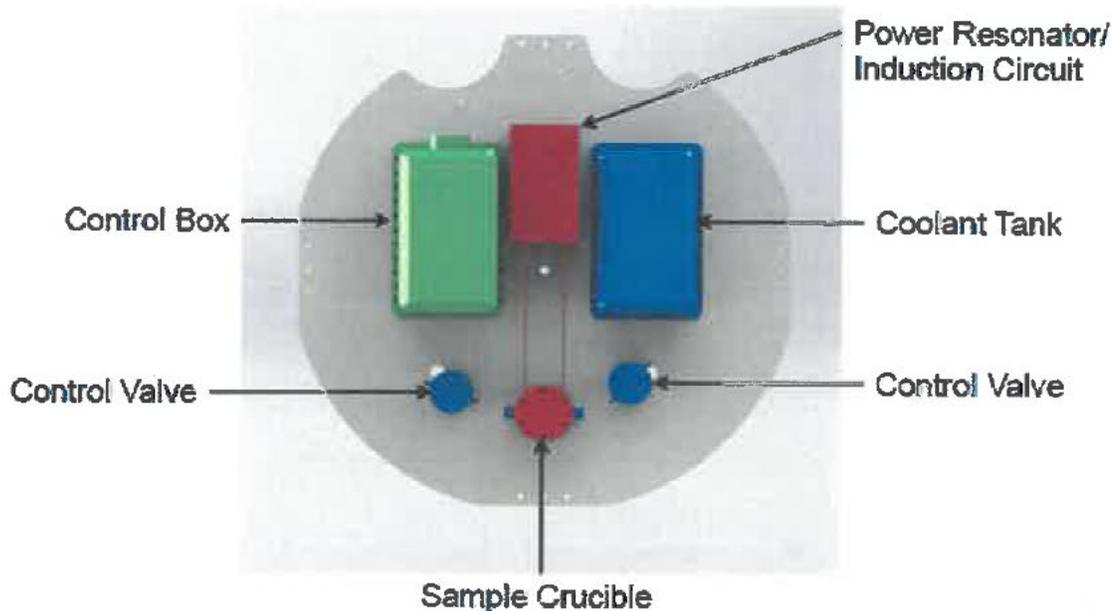


Figure 1.4 UCB Deck Mount #4A

The #4A Deck Mount the University of Colorado at Boulder (UCB) will experiment with creating an immiscible alloy from Aluminum and Indium. A 0.5cm<sup>3</sup> sample of granulized Aluminum and Indium will be heated to 600C and contained in aluminum nitride ceramic dual walled crucible with a melting temperature of 2000C.

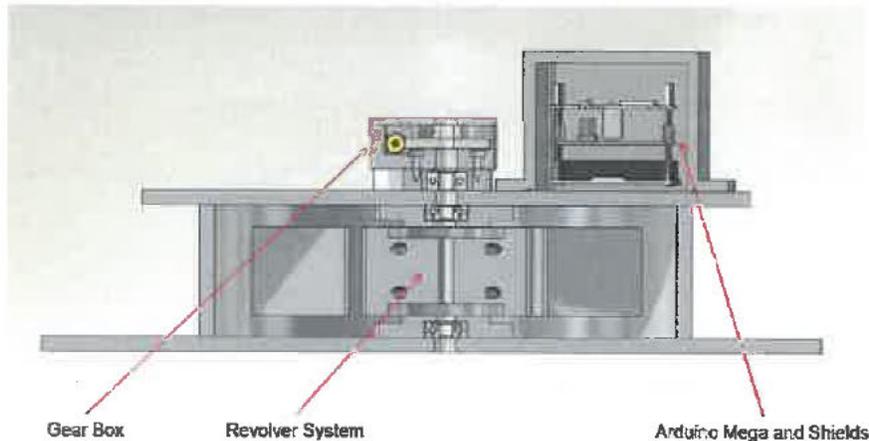
**Minimum Success Criteria**

- Successfully solidify the alloy sample in microgravity
- Obtain a homogeneous sample of the Aluminum-Indium alloy
- Sample must solidify before re-entry spin up



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Figures 1.5a, b: NNU Deck Mount #4B, and Airfoil diagram



The #4B Deck Mount from Northwest Nazarene University (NNU) will release several 3D printed airfoil shapes into space to test for flight stability in low atmospheric conditions. Airfoils will have flexible sensors and will retrieve the data through RFID communication. This data will be stored internally and downlinked for redundancy.

### Minimum Success Criteria:

- Deploy some airfoils into the upper atmosphere
- Retrieve video data of orientation
- Downlink one low resolution image of airfoil deployment

### Comprehensive Success Criteria:

- Video footage of airfoil orientation
- Data from sensors on internal memory and downlinked telemetry file
- Uninhibited deployment of airfoils
- Downlink several low resolution images

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The #5 deck mount from the University of Puerto Rico (UPR) is an experiment for the detection of micrometeorites at a distance, with the use of laser ranging technology (internal to the payload). The Piezo Electric Sensor will detect the number of particles at the moment of impact and the aerogel will capture them for future analysis. The experiment goal is to help benefit future space explorers and space travel companies by avoiding head-on collision of particles against their space vehicles which could jeopardize entire missions.

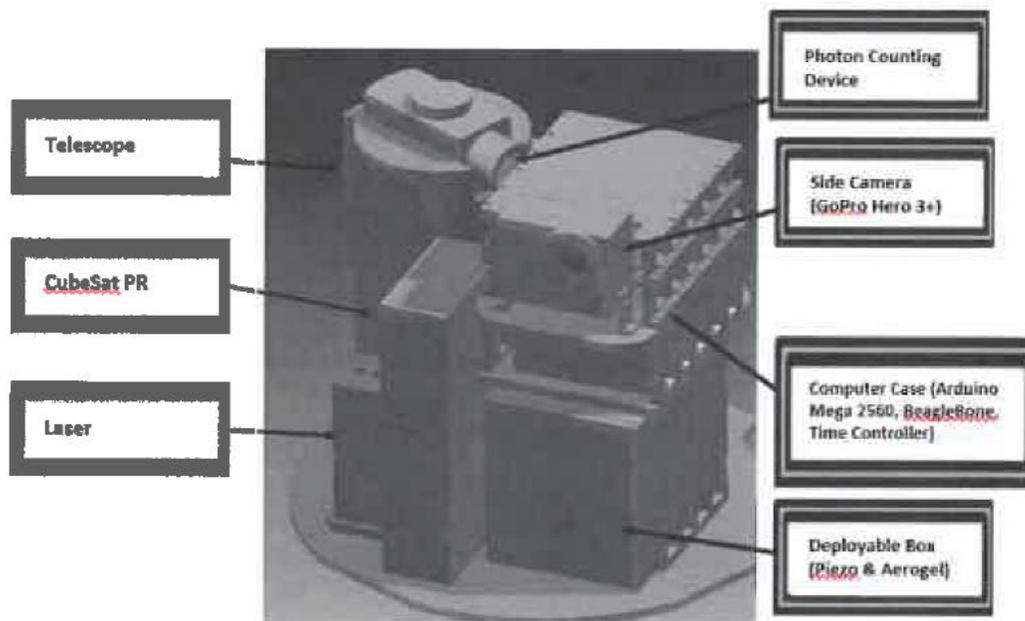


Figure 1.6: UPR Deck Mount #5

The customer for this program is NASA's Sounding Rocket Program Office (SRPO). Customer advocacy and concurrence with project activities throughout the life of the project are achieved through customer concurrence with this plan and associated project documents. The SRPO as well as the Principal Investigator (PI) will be asked to provide feedback. Lessons learned will be generated by the RMMO from feedback received.

The overall NASA WFF role in this project involves the provision of the motor and vehicle buildup facilities for vehicle preparation for Pad 2, ARC rail loading and launcher facilities. WFF will also provide range services, safety, photography, Crash-Fire-Rescue (CFR) and R-6604 airspace.

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This project and the range objectives support NASA strategic goals as outlined in the NASA Strategic Plan 2014 with direct traceability to:

- *NASA Strategic Goal 2, Objective 2.1: Enable a revolutionary transformation for safe and sustainable U.S. and global aviation by advancing aeronautics research.*
- *NASA Strategic Goal 3: Serve the American public and accomplish our Mission by effectively managing our people, technical capabilities, and infrastructure.*

### 1.2 Range and Mission Management (RMMO) Objectives

The RMMO is the principal source of project management for range support services at WFF. The RMMO objectives for services provided to the SRPO include:

1. Project management in accordance with NASA [NPR 7120.8](#) for Range functions supporting SRPO investigations launched at WFF. Project management services will ensure smooth integration of WFF efforts and responsiveness to customer needs. Provision of these services will include:
  - Requirements management of WFF RMMO responsibilities
  - Cost and budget tracking and reporting using WFF and/or SRPO defined formats
  - Development, maintenance and execution of integrated schedules which include NASA required reviews and milestones necessary for WFF test approval
  - Coordinate WFF Code 803 safety support for ground elements of the test sufficient to ensure the safety of the public, on-site personnel, and high value assets
  - Identification and mitigation of risks associated with the ground handling of the test article
  - Development and mitigation of risks associated with SRPO operations which are not identified within this plan as “accepted risks”
  - Ensuring the development of detailed range safety plans that assess risks and provide risk mitigation strategies
  - Evaluations of air and sea surveillance status to ensure required areas are clear for SRPO operations
  - Development (or facilitation) of agency or interdepartmental agreements from other entities for required services as applicable

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- Preparation of review products and conducting required reviews
  - Obtaining the required Approval to Proceed decision
  - Deliverables provided to the customer within the established timeframe
2. The Wallops Range reports a “green” status in supporting service areas in sufficient time for the customer to choose to launch in their desired window, excluding weather conditions that violate launch constraints
  3. Provide 98% availability of WFF launch range instrumentation/equipment in supporting service areas. Supporting service areas include, but are not limited to:
    - Range Surveillance and Recovery Operations
    - Radar Services
    - Optical Services
    - Telemetry
    - Launch Pad Operations
    - Runway/Tower Operations
    - Communications
    - Meteorological Services
    - Spectrum Management
    - Control Center Services
  4. Prime instrumentation/equipment performs without data loss, unplanned safety risks or missed surveillance targets for supported SRPO investigations
  5. Mission delays or unplanned safety risks do not occur as a result of launch range instrumentation/equipment
  6. Mission delays or unplanned safety risks do not occur as a result of operator errors
  7. Provide the customer/PI with reliable tracking, data acquisition, and command data sufficient to ensure a safe launch. These services include:
    - Provision of radar tracking services throughout flight.
    - Provision of mission-specific telemetry data acquisition throughout flight to the WFF RCC.
    - Provision of Range Control Center services for dress rehearsals, checkout activities, and flight operations.
    - Provision of weather data collection and forecasting services, including lightning and wind data to assess launch conditions and provide launch decision support data for the project team.
    - Provision of photo and video documentation services of all aspects of the mission to ensure appropriate documentation of progress and as a possible record of anomalies.

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- Provision of tracking and telemetry data and data analysis products to the customer following launch.
8. Provide local launch site services at Wallops Flight Facility. This includes but is not limited to:
- Access to, and successful use of, facilities and support systems required to ship, accept, integrate, transport, erect, and support the operation.
  - Access to required mission specific WFF work areas in a timely, unencumbered manner.
  - Timely access to cranes, lifts, and other equipment required to process the test article in a safe manner.
  - Timely access to functional workspaces (including data and communications capabilities) such as offices, labs, and other work areas for the onsite team. Tools, vehicles, and other assets specific to the test are provided by the customer.
9. Oversight and logistical support for SRPO operations team during lift, integration, and test preparation to ensure safe use of WFF facilities.
10. Provide safety support for flight and ground elements of the mission sufficient to ensure the safety of the public, on-site personnel, and high value assets. These services include:
- Identification and mitigation of risks associated with ground handling of the vehicle and payload.
  - Development of detailed flight and ground safety plans assessing risks and risk mitigation strategies.
  - Ensuring and verifying that operational plans are executed in a safe manner.
  - Evaluations of air and sea surveillance status to ensure required areas are clear.

### 1.2.1 Known Dependencies

The known dependencies for the successful implementation of range support services provided to the SRPO include, but are not limited to:

- Range schedule
- Instrumentation
- Meteorological
- Operational support
- Aging Equipment

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### 1.2.2 Customer Objectives

RockSat-X student experiments are developed with an objective of providing students with an enhanced experience of flying experiments exposed to the space environment. The students gain experience in the design, build, test and sub-orbital space flight of their experiments during this RockSat-X lifecycle.

The customer objectives listed above are the responsibility of the SRPO and are outside the scope of the RMMO and this plan.

## 2.0 TECHNICAL APPROACH

This is a portfolio investigation conducted as cross-program research in accordance with the Suborbital Research Program Plan. Result analysis and assessment against related research activities are completed by the SRPO in accordance with the program plan

Buildup and development activities are the responsibility of the SRPO and are outside the scope of the RMMO and this plan.

The SRPO and their support contractor under the NASA Sounding Rocket Operations Contract (NSROC), have provided the following documents to NASA WFF Code 840 Range and Mission Management Office:

- NSROC II Design Review, 46.008 UO/Koehler RockSat-X WFF 2014, 2/13/14
- Electrical Engineering Mission Telemetry (Ground Support) Requirements (MTR) for Mission 46.008 Koehler, EE106577, Revision Rev A. - Release Date 6/18/14

## 3.0 Performance

Range support services are measured by the PM through equipment and operator discrepancy reports, successful gate reviews, obtaining the Approval to Proceed and the 98% equipment availability metric provided post mission. Customer performance goals are listed below. Measurements against the goals and the associated success criterion are the responsibility of the SRPO.

Minimum Success Criteria:

- At least one hot count is conducted for the RockSat-X mission

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### Comprehensive Success Criteria

- Successful launch of the RockSat-X payload, including vehicle performance within 2 sigma of predictions.
- All experiments successfully exposed to the space environment above 150km altitude.
- A course attitude solution is provided for the exo-atmospheric portion of flight.
- All individual turn-on, deployment or ejection actuation impulses are sent to each of the experiments at the programmed times
- Payload Recovery
- Data collected from the majority of the participant built experiments.

## 4.0 Management Approach

### 4.1 Project Authority

NASA Goddard Space Flight Center (GSFC), Wallops Flight Facility (WFF) is the lead NASA Center for this project and is responsible for the implementation of range support services. WFF is the operational site for the project. The RMMO is responsible for project management services and is the developer of this plan. Permission to proceed with operations is approved by the Director of Wallops Flight Facility.

### 4.2 Governance Structure

This project shall be governed by the Project Management Council (PMC). Status may be communicated via monthly scheduling and status meetings, as well as informal communication and the Monthly Status Review (MSR) as requested. The PMC serves as the senior decision-maker body that baselines, assesses project performance, and ensures successful achievement of NASA strategic goals.

A diagram of the organizational structure and a brief list of the team duties are shown below.



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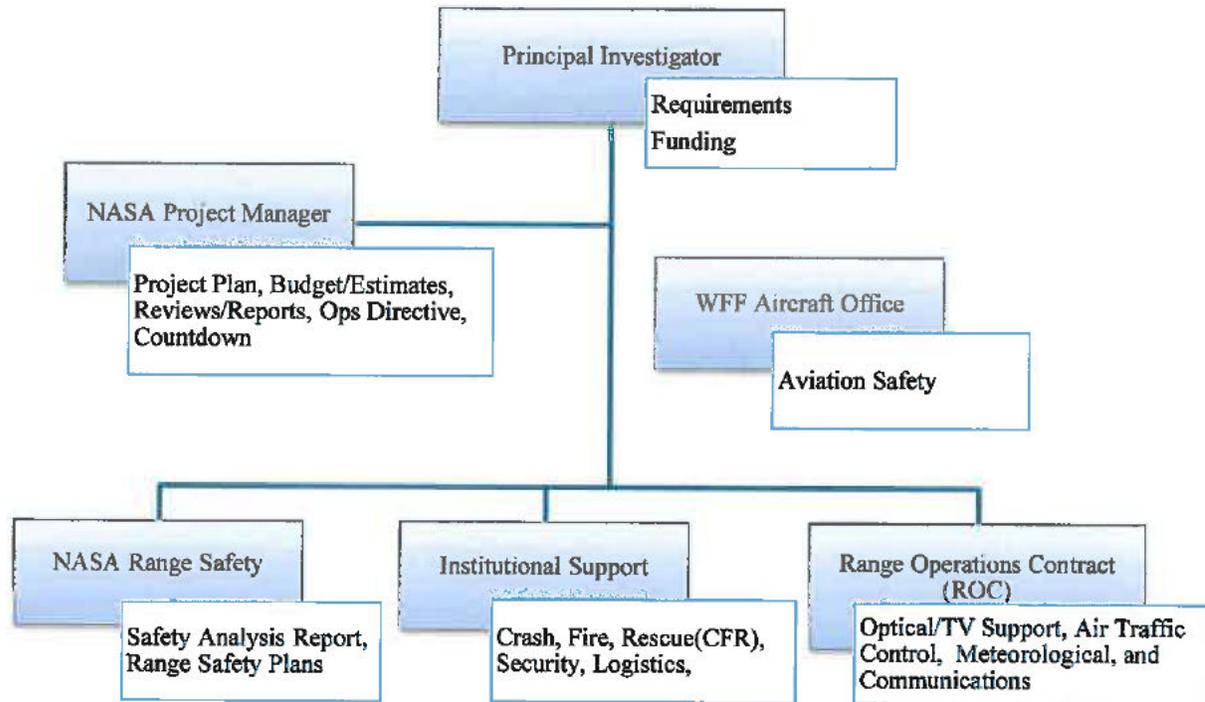


Figure 4.1 Organizational Structure

### 4.3 Organizational Roles and Responsibilities

The WFF Sounding Rocket Program Office (SRPO)/Code 810 is responsible for providing the following:

- Executive Management
- Funding
- Launch Vehicle (via NASA Sounding Rocket Operations Contract (NSROC) contractor)
- Payload Integration & Test (via NSROC contractor)
- Launch Support Services (via NSROC contractor)
- Provide overall requirements
- Provide science instruments for the payload
- Provide ground based science instruments

The WFF RMMO/Code 840 PM is responsible for providing the following:

- NASA Project Management
- Business Management Functions

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- Logistic Support Coordination
- Range Support Coordination

The WFF Safety Office/Code 803 is responsible for providing the following:

- NASA Flight Safety
- NASA Ground Safety
- NASA Operations Safety Specialist (OSS)
- Approved flight and ground safety risk analysis
- Approved flight and ground safety plans

### 4.4 Management Structure

The PM has full responsibility for the project and is responsible for its safe success in accordance with NASA procedures, guidelines, and directives. Such procedures, guidelines, and directives take precedence over all contractual and other guidelines under which individuals supporting the project may be employed.

Technical Authorities are in accordance to each supporting office and role. The WFF PM will respond to any dissenting opinions presented from others within WFF. In addition, anyone within WFF can share dissenting opinions with the Chief of RMMO, the WFF Director, or any higher level executive within NASA. If a dissenting opinion pertains to safety, anyone within WFF can also share their opinions with appropriate members of the NASA WFF Safety Office. Unresolved dissenting opinions within the project will be raised to the WFF Director for resolution.

Final approval to conduct operations for this project shall be granted by the Director of Wallops Flight Facility or his designee and will be documented using the Approval to Proceed form.

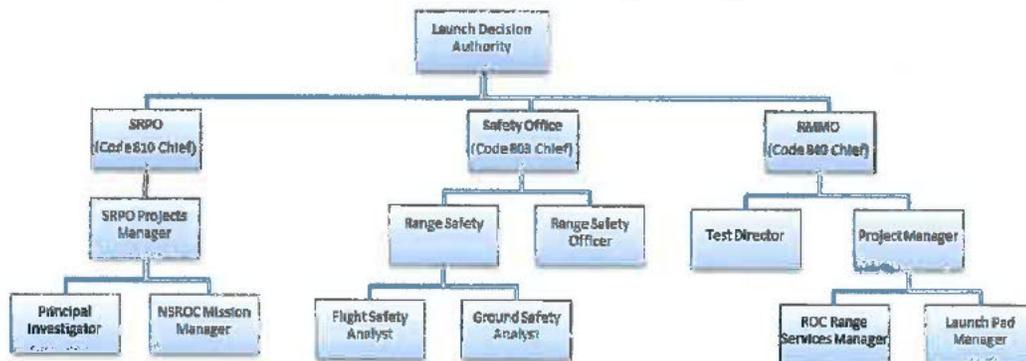


Figure 4.2 Launch Decision Authority

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### **Individual Assignments and Responsibilities at WFF**

The following definitions describe the roles and responsibilities of key personnel functionally reporting to the NASA Launch Decision Authority for approval to proceed:

**Launch Decision Authority (LDA)** –the Director of WFF or his designee, is responsible for the review of all project requirements, safety plans, and review proceedings, and to grant final approval to proceed into launch operations via the Approval to Proceed (ATP) Review.

**Sounding Rockets Program Office (SRPO) Chief or designee** - Is responsible for providing program level requirements to the project. This person will maintain insight and oversight of project activities and will provide the status of the mission from the perspective of that position. The SRPO chief will be polled and will sign the ATP. For this project the SRPO also acts as the customer.

**Safety Office Chief or designee** – Is responsible for all Safety Office elements and final approvals and for providing Code 803 confirmation of approval at the ATP Review.

**RMMO Chief or designee** –Represents the Range on issues of policy and, as required, provides confirmation of Range approval to enter key operational gates. The RMMO chief will be polled and will sign the ATP.

**NASA Test Director (TD)** – Has authority over all operations conducted on the Wallops Range. He/she is responsible for assuring that all range policy, criteria, and external agreements are satisfied during launch operations.

**NASA Project Manager (PM)** - Is responsible for the planning, coordinating and directing of operational Range Support Services for project activities and operations conducted at the Wallops Range. He/she is responsible for coordinating and directing activities as necessary during operations and establishing pre-operations clearance of Hazard Areas associated with WFF. He/she will apprise the TD and Range Safety Officer (RSO) of project status details and likewise keeps the project personnel properly informed of operational status. He/she also serves as Assistant TD.

**Launch Pad Manager (LPM)** –On the launch pad, the LPM is responsible for maintaining order and discipline and coordinates all activities. The LPM reports the status of pad activities to the PM/DPM.

**Range Operations Contract (ROC) Range Services Manager (RSM)** –is responsible for coordinating the planning of all aspects of ROC operational range support for the mission, and assisting the PM /DPM in various special tasks as assigned.

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**NASA Range Safety Officer (RSO)**– is responsible for assuring the test plan meets WFF safety policy and criteria, and assures that risks are understood and are within acceptable limits. He/she will establish Hazard Areas and mission criteria for project operations as defined in the project specific safety analysis documents. He/she has authority to stop the operation if necessary. The RSO also maintains safety program responsibility.

**Range Safety Office** –is responsible for the supervision of personnel in the Ground and Flight Safety Groups. The Range Safety Office reports to the Safety Chief the current status of both Ground and Flight Safety.

**Flight Safety Analyst (FSA)** – Is responsible for conducting all pre-mission analysis regarding Flight Safety for the mission and generates the Flight Safety Risk Assessment and the Flight Safety Plan. The FSA reports to the Safety Chief the current status of Flight Safety.

**Ground Safety Analyst (GSA)** –Is responsible for conducting all pre-mission analysis regarding Ground Safety for this mission, and generates a Ground Safety Risk Assessment and the Ground Safety Plan. The GSA reports to the Safety Chief the current status of Ground Safety.

**SRPO Project Manager**–Is responsible for providing program level requirements to the PM. The SRPO PM will maintain insight and oversight of project activities and will report current status of the mission to the SRPO Office Chief.

**Principal Investigator (PI)** –Is responsible for providing mission specific requirements to the SRPO and is an integral partner in all pre-mission testing. The PI will provide a mission status from a scientist’s perspective to the SRPO Chief.

**NSROC Mission Manager (MM)** – The MM is responsible for assuring programmatic objectives levied by the PI are achieved. The MM reports payload and vehicle status to the SRPO PM.

### 4.5 Management Oversight

Management oversight of the project will be maintained through participation in RMMO weekly status meetings, Directorate Monthly Status Reviews (MSRs), and Center MSRs as required. After flight, a Code 840 Project Summary Record will be completed.

Problem reporting is accomplished using the WFF RMMO Range Operations Management System ([ROMS](#)) to report, track, and document discrepancies, lessons learned, and risks. The [ROMS](#) database is a baseline Range system that is utilized by all Code 840 RMMO managed projects to allow cross-project learning among project managers and the engineering support

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teams that utilize the range. Any vehicle specific issues will be managed by a closed loop problem reporting system through the NSROC Corrective Action Tracking System.

The Project Support Team (PST) supports the PM in accordance with NASA procedures and guidelines. The PST membership is formally described using standard form 840-PTALForm-1 (*Project Team Assignment List and Critical Staff List*) which identifies PST members by name with their roles.

Technical Authorities and details of operations are documented in a stand-alone Mission Operations Document (MOD). Operations will be conducted in accordance with this Project Plan, the MOD, and associated Safety Plans. The project will be monitored using [ROMS](#) throughout the life cycle of the project.

Systems engineering aspects of the project are not Wallops Range requirements. The Safety Office will develop a Safety Plan, which will specify the procedures and conditions required to effectively mitigate safety risks for the project. In the event of a mishap, the NASA WFF Research Range Mishap and Contingency Action Plan will be utilized to inform appropriate authorities, emergency response organizations and management. The PM will retain and manage relevant project documentation using both physical and electronic folders. Frequent meetings with the PI and key participants will ensure appropriate communication of documentation status. All documents will be maintained with version numbers and/or dates to ensure document configuration management. All changes to governing documents will be approved by the appropriate signatories of this plan.

#### 4.3 SAFETY AND MISSION ASSURANCE

Mission Assurance encompasses the unique safety plans and the Mission Operations Directive (MOD) which will be published for this project. This project will not utilize a stand-alone mission assurance plan.

The safety program development and implementation for this project is fully covered by NASA WFF Suborbital and Special Orbital Projects procedures and guidelines. Risk Analysis Reports (RAR) are prepared for both Flight and Ground Safety based on the overall project and submitted for review and approval. These RARs establish the safety program to be employed during various phases of the project. RARs describe any hazards involved during pre-launch and launch, document the safety criteria and preventative measures, and establish a risk level to be accepted by NASA/WFF.

NASA/WFF is responsible for all safety issues within this mission's lifecycle. Mission safety is divided into two organizational responsibilities; ground and flight safety. These programs cover the mission lifecycle from design, development, and assembly, to flight preparation, and launch.

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The WFF Safety Office manages the Ground and Flight Safety groups. The WFF Safety Office develops safety documentation in accordance with the WFF Range Safety Operations Process (800-PG-8715.5.1) that is specific to this project. The documents provide requirements that the project shall meet for the protection of public, workforce and property during aircraft operations. Safety personnel have authority delegated by the WFF Director to make decisions regarding interpretation of safety requirements as they apply to aircraft preparation and operations.

A NASA/WFF Mission Range Safety Officer is an integral part of the core project team and maintains safety program responsibility.

### 5. Resource Requirements

Baselines are established in terms of schedule, budget, and technical performance. The estimated schedule is listed in Section 6. Funding requirements are estimated in the Work Breakdown Structure in Section 7. The resources required for range support services were previously reviewed and agreed upon in technical interface meetings and are listed below. Approval is documented through the signatures on this plan.

The status of RMMO range support requirements will be tracked by the PM. SRPO manages their resources and requirements in accordance with SRPO organizational procedures. RMMO range support requirements are listed below:

- Trajectory data (latitude, longitude, altitude, and velocity) shall be provided from launch Through LOS.
- Radar trajectory data shall be available no later than 10 days after launch.
- Range shall provide standard operational support for radar and communications.
- Range shall provide standard surveillance services for launch.
- Range shall provide standard services for water recovery of payload.
- Range shall provide fixed surveillance cameras.
- Range shall provide fixed high speed video of rail egress, to record retraction of the umbilical during liftoff.
- Range shall provide optical trackers & radar bore-sight video.
- Range shall provide 2 lift off cameras, and 2 tracking cameras.
- Range shall provide Met-Ops support for wind weighting balloons.
- Test Rockets shall be provided for radar proficiency.
- Range shall provide RCC services for checkout activities and flight operations.
- Range shall provide a Control Tower Operator (CTO) to conduct surveillance air communications.
- Range shall provide radar support for wind weighting.

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- Radar is required to support the mission from a range tracking and surveillance perspective. Two C-band radar systems are required to provide tracking support.
- Documentary photographic coverage is required (Pad Still pictures if time permits).
- Still pictures, surveillance video, video tracks and high speed data shall be edited and recorded to DVD/CD to be provided 5 duty days after completion of the mission.
- Forecaster on duty Weather briefing for forecasting launch operations. Special forecasts may be required for lightning and wind warnings/advisories issued for the range during vehicle build-up/launch operations.
- The range control center and data reduction group shall have both real time computer systems and the PCGDS available for launch operations.
- Quick Look Best Select radar data shall be available at the post flight briefing
- The final POSDAT data ASCII file at 10 pps shall be emailed to the PM for distribution to range users.
- Range intercom support is required. Radio communication with the surveillance aircraft, recreational, and commercial boaters is also required.
- NASCOM support is required to patch radar data in the Range Control Center (RCC).
- Provision of NASA 36 and IRIG-B timing.
- Program Time required for blockhouse 2 & the RCC.

## 6. Schedule

The schedule for operations will be posted on the [Wallops Operations Scheduling System](#). Project preparation is monitored and reported to NASA management and the customer via the Wallops Operations Schedule on a daily basis and via the Project Summary Report upon completion of the mission.

The estimated schedule/timeline is provided below:

Task	Scheduled	Notes
Monthly/Weekly Reviews	Weekly/Monthly	For the duration of mission
Requirements Review	L-6 months	
Project Plan	L-3 months	
Technical Interchange Meeting	As Req'd	
Missions Operations Directive (MOD)	L-30 days	
Ground Safety Plan	L-30 days	
Instrumentation Support Briefing	L-21 days	
Flight Safety Plan	L-16 days	

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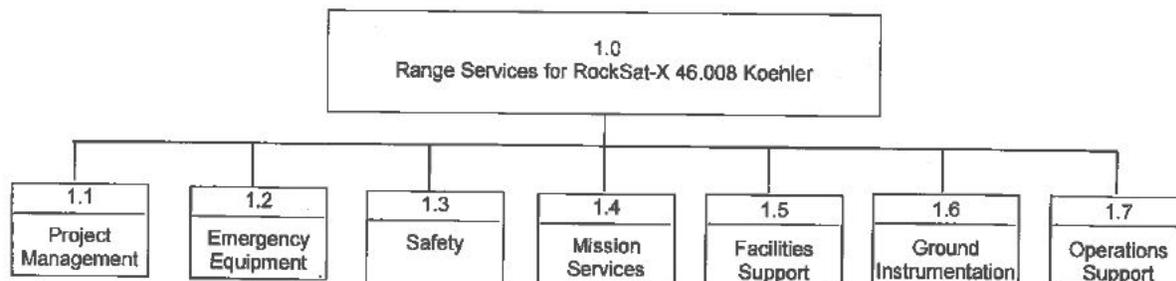
Scheduling Credibility Review	L-15 days	
Mission Readiness Review	L-14 days	
NASA Range Readiness Review	L -7 days	
Dress Rehearsal	L - 1 day	
NASA Pre-Mission Briefing	L - 1 day	
Approval to Proceed (ATP)	L - 1 day	
Launch Crew Briefing	L-0	Duration: 2 days
<b>Launch Window</b>	<b>L-0</b>	Duration: 6 days
Mission Summary Report	L + 1 day	
Mission Closeout	L + 60 days	

## 7. Work Breakdown Structure

The Project Life Cycle Cost (LCC) estimate is based on the Work Breakdown Structure (WBS) and funded by the SRPO. Personnel estimates are based on historical data from similar operations. The estimates include labor, travel, and procurements for a specific fiscal year (FY).

Civil Service labor charges will be tracked by the WFF Resources Analyst in each office. Charges will be applied to unique labor WBS numbers. Contractor support will be charged to a unique WBS as required. Institutional range services, which include such services as preventative maintenance of instruments and surveillance services, are provided under the RMMO Range Operations Contract (ROC). ROC contractor charges will be applied to a unique WBS charge number, tracked by the contractor and reported to the RMMO PM. Sounding Rocket (NSROC) costs will be tracked by the SRPO.

The RMMO PM may revise the WBS in coordination with the supporting resource analyst as necessary to reflect approved changes to the scope of work for range services provided. Revisions to the WBS are managed and reported in accordance with NASA financial procedures and will not require an update to this plan.



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1.0 Range Support Services (total project)	This element is a roll-up segment level of the project, which includes project management, safety, Platform reviews, ground and air safety review/planning, and operations support as appropriate.
1.1 Project Management	This element includes the management and administrative planning, organizing, directing, coordinating, controlling and approval actions designated to accomplish overall project objectives.
1.2 Emergency Equipment Fire/Rescue	This element includes the effort to track and analyze flight risk response requirements, to include flight emergency hardware and personnel; fire trucks, first responders.
1.3 Safety	This element includes the effort of directing and controlling the safety elements of the project such as: safety assessment, review, and verification of practices and procedures. This element <u>excludes</u> mission and product assurance efforts other than as a review/oversight function.
1.4 Mission Services	This element includes the geographic water ingestion test area and directly related services to provide airspace and airport control as applicable.
1.5 Facilities Support	This element includes all facilities support associated with providing the customer with the facilities and services required to integrate and test prior to, during, and after project operations.
1.6 Ground Instrumentation	This element includes the suite of equipment, hardware, software, networks, and mission-unique facilities required to conduct mission operations. This element also includes camera full motion video of test subject during water ingestion evaluation.
1.7 Operations support	The Operations & Support (O&S) element includes the management of the development and implementation of personnel, procedures, documentation and training required to conduct project operations.

## 8. Data and Knowledge Management

The PM will provide the data deliverables requested by the customer. Data and knowledge management, planning and distribution are the responsibility of the SRPO in accordance with their organization procedures and the Suborbital Research Program Plan.

The PM is responsible for identification of lessons learned and their inclusion in the RMMO lessons learned library in accordance with [NPR 7120.6, Knowledge Policy on Programs and Projects](#). The PM will use the RMMO Lessons Learned database for knowledge capture and communication. Previous experience obtained on similar investigations will be applied where applicable. The Lessons Learned Database is located at <https://roms.wff.nasa.gov/III>.

The RMMO manages the identification, control and disposition of records associated with the project in accordance with [NPD 1440.6 NASA Records Management](#), [NPR 1441.1 Records Retention Schedule](#) and organizational procedures.

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### 9. Risk Management

The Risk Management Plan is comprised of the following safety documents. A stand-alone Risk Management Plan is not required.

Risk management strategies are applied following the guidelines of [NPR 8000.4, Agency Risk Management Procedural Requirements](#). The RMMO reports identified risks in NASA's 5x5 format as required/requested.

The project is excluded from [NPR 8705.4, Risk Classification for NASA Payloads](#) in accordance with the Suborbital Research Program Plan. Accepted risks by the program include, but are not limited to:

- ❖ Launch abort;
- ❖ Failure of the science mission or carrier;
- ❖ Failure of flight support equipment or instrumentation;
- ❖ Failure of science equipment or instrumentation;
- ❖ Damage to, or loss of, the science payload, provided no safety violations were experienced

Through approval of this plan, the SRPO and stakeholders understand and agree that the accepted risks documented above, and any subsequent accepted risks identified, are accepted and agreed upon and that further specific mitigations may be applied, however are not required.

The SRPO and the PM manage known and subsequent risks respectively in accordance with their procedures, the requirements of [NPR 7120.8](#) and as documented in the Suborbital Research Program Plan. The SRPO establishes mission success criteria, documents additional accepted risks, and identifies what risks may require mitigations at a level commensurate with the cost, complexity and risk of the mission. The SRPO shall communicate additional known risks and open items that may affect range support services to the PM.

Risk mitigations are implemented through Safety and Mission Assurance support provided by the Wallops Safety Office. The PM is responsible for the coordination of ground and flight safety support provided by the Wallops Safety Office in accordance with the WFF Range Safety Operations Process ([800-PG-8715.5.1](#)). Aircraft operations safety is included in the Surveillance and Recovery Plan.

The PM will ensure that a Ground Safety Plan is approved and released by the Wallops Ground Safety Group. The Wallops Ground Safety Group is responsible for ensuring the plan complies with the WFF Range Safety Operations Process ([800-PG-8715.5.1](#)). The plan will identify the hazardous systems associated with an investigation and identify the GSFC/WFF safety category for each hazardous system. The Ground Safety Plan will address assembly operations, launch pad operations, personnel restrictions, and other unique. Supporting personnel are responsible

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for ensuring that industrial safety and Range Safety requirements are adhered to during vehicle preparation and launch activities. Range Safety Personnel from the Ground Safety Group have authority delegated by the Code 800 Director to make decisions regarding interpretation of safety requirements as they apply to vehicle preparation and launch activities.

The Range Safety Officer is responsible for implementing the flight safety program in accordance with the WFF Range Safety Operations Process ([800-PG-8715.5.1](#)).

**10. Project Evaluation and Optional Key Decision Points (KDP)**

As a component project conducting research under the Suborbital Research Program, the project is currently in the implementation phase when range services support and project management services are requested from the RMMO and a PM is assigned. The SRPO is responsible for the Pre-formulation and Formulation phases, project evaluations, feasibility, technical/science requirements and formulation reviews in accordance with SRPO procedures and the Suborbital Research Program Plan.

Independent reviews, gate reviews and range support services are provided in accordance the Suborbital and Special Orbital Projects Directorate Reviews PG ([800-PG-1060.2.1G](#)), the Suborbital Research Program Plan, and applicable SRPO and RMMO procedures.

The PM is responsible for the reviews in order to obtain the Approval to Proceed authorization. Review team members and review content for these reviews are identified, selected and approved by the PM in accordance with RMMO procedures. Review team action items are reported to the PM and the RMMO Chief, both of whom must certify disposition of action items prior to requesting the documented Approval to Proceed with the operation.

**11. Relationship to Other Projects and Organizations**

This is a portfolio investigation project within the Sounding Rockets Program Office (SRPO). The SRPO and Wallops Range Services are uncoupled projects identified in the Suborbital Research Program Plan (SRPP), baseline version, April 2014. Per the SRPP, the Sounding Rockets Project Office (SRPO) maintains a separate funding and management structure and the SRPO has full responsibility for conducting Sounding Rocket portfolio activities. The RMMO provides project management and launch support services to the SRPO. Program authority and oversight/insight of the project is delegated from the NASA-HQ SMD AA through the Heliophysics Division Director to the Sounding Rockets Program Office Chief at Wallops Flight Facility (WFF) and the Chief of the Range and Mission Management Office. The relationships of the component projects are as documented in the SRPP.

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Component projects of the Suborbital Research Program enter into internal and external agreements in accordance with NASA procedures, the Suborbital Research Program Plan, [800-PG-1310.1.1](#) and [810-PG-1310.1.1](#). If required for range services support, the internal/external agreements and their projected approval dates need to be established and communicated. Updates to this information is provided through subsequent Wallops Range, RMMO reporting paths and will not require a revision to this plan. The PM may assist the customer and/or develop the agency or interdepartmental agreements from other entities for required services as applicable.

**12. Security Plan**

For range support services and operations, the RMMO maintains and implements the Wallops Range Instrumentation Systems (WRIS) System Security Plan CD-840-H-GSF-8401 and the Wallops Range Multi-Program/Project IT (WRMPPIT) System Security Plan CD-840-L-GSF-8402 which ensure the security and protection of information technology for range support compliant with the IT security requirements of NPR 2810.1 Security of Information Technology.

The Security Requirements for the 46.008 are of an unclassified nature. The Security Plan for SRPO activities is outside of the scope of this plan and is documented in SRPO procedures as applicable.

The Range team located at WFF and all subcontractors are to comply with Government requirements for industrial, physical, personnel, counterintelligence, counterterrorism, and information/information technology security and asset protection during all project phases and at all locations where project work is performed. WFF and their support contractors are responsible for security training and refresher briefings to all civil servant and support contractor personnel working on the Project.

Access to all areas in which aircraft hardware, software, technical data, IT facilities, operations areas, and operations products reside will be limited to personnel working the project and cleared per project and/or contractor requirements. Institutional security is provided 24 hours a day, 7 days a week by a trained security force. Infrastructure elements are protected with a variety of security systems, such as, but not limited to, a roving patrol, controlled access entry points and security cameras. Foreign National access to information or facilities will require approval in accordance with NASA requirements.

Emergency response for SRPO investigations launched at WFF will comply with the Continuity of Operations Implementation Plan ([803-Plan-0005](#)). This plan is deemed Sensitive but Unclassified (SBU). Access information can be obtained by contacting WFF Institutional

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Safety. For emergency response requirements the WFF Emergency Operations Plan ([803-GS-PLN-EM-01](#)) will be utilized.

### 13. Waivers

The PM will make deliberate and considered attempts to minimize the use of the waiver process. Waivers submitted after the effective date of this plan will be consistent with the Waiver approval authority of [NPR 7120.8](#). The PM will maintain a current log of all waivers granted.

Applicable waivers currently in the approval process per the Suborbital Research Program Plan, Baseline Version, dated April 2014 are:

1. Earned Value Management System waiver for Suborbital research missions utilizing aircraft, scientific balloons, and sounding rockets and implemented under [NPR 7120.8](#). The decision to do EVM on other projects (such as Cubesats or ISS instruments) will be delegated to the director of the sponsoring division.

### 14. Change Log

This document is under change control as mandated by Configuration Management ([800-PG-1410.21D](#)). Changes to this document will be reflected in the change record sheet located at the beginning of this document. The change record sheet will capture document revisions and administrative edits as appropriate. Non-administrative changes will be implemented by the PM, identified by revision number, concurred to by the signatories and recorded on the change record sheet.

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## 15. APPENDICIES

### (APPENDIX A - DEFINITIONS)

#### Terms of Reference

##### Project:

For use within this plan, the word “project” does not comply with the definition of The word “project” as defined in NPR 7120.8. For the purpose of this document, the Range and Mission Management Office (RMMO) defines the word “project” as any mission(s), task(s), special study, or assignment that is in support of the Suborbital Research Program goals and objectives.

##### Investigation:

The Suborbital Research Program Plan (SRPP) baseline version, April 2014 defines the flight opportunities conducted by the Sounding Rocket Program within the Cross Program research as portfolio investigations. The words project, investigation, portfolio investigation and mission may be used interchangeably to refer to the NRW-5588 / 46.008 Koehler.



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**(APPENDIX B – ACRONYMS)**

AA	Associate Administrator	RCC	Range Control Center
ACRM	Aperture Cover Release Mechanism	RMMO	Range and Mission Management Office
ACS	Attitude Control System	ROC	Range Operations Contract
ATP	Approval to Proceed CFR Crash, Fire, and Rescue	ROMS	Range Operations Management System
CTO	Control Tower Operator	RRR	Range Readiness Review
EVM	Earned Value Management	RSM	Range Services Manager
FSA	Flight Safety Analyst	RSO	Range Safety Officer
FY	Fiscal Year	SBU	Sensitive But Unclassified
GSA	Ground Safety Analyst	SMD	Science Mission Directorate
GSFC	Goddard Space Flight Center	SPS	Space Pressure Sensor
HQ	Headquarters	SRP	Sounding Rocket Program
IT	Information Technology	SRPP	Suborbital Research Program Plan
LCC	Life Cycle Cost	SSOPD	Suborbital and Special Orbital Projects Directorate
LDA	Launch Decision Authority	STP	Space Technology Program
LPM	Launch Pad Manager	SRPO	Sounding Rocket Program Office
MANIACS	Magnetically Assisted NSROC Inertial Control System	TD	Test Director
MOD	Mission Operations Directive	TIM	Technical Interchange Meeting
MSR	Monthly Status Review	UCB	University of Colorado at Boulder
NASA	National Aeronautics and Space Administration	UN	University of Nebraska
NNU	Northwest Nazarene University	UPR	University of Puerto Rico
NSROC	NASA Sounding Rocket Operations Contract	VT	Virginia Tech
NPD	NASA Procedural Directive	VRE	Virtual reality simulation
NPR	NASA Procedural Requirement	WBS	Work Breakdown Structure
ONS	Optical Nitric Oxide	WFF	Wallops Flight Facility
OSS	Operations Safety Specialist	WRIS	Wallops Range Instrumentation Systems
PG	Procedural Guidance	WRMPPIT	Wallops Range Multi-Program Project IT
PI	Principal Investigator		
PM	Project Manager		
PMC	Project Management Council		
PST	Project Support Team		
RAR	Risk Analysis Report		

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