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NASA Procedural Requirements

NPR 8715.5B

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COMPLIANCE IS MANDATORY FOR NASA EMPLOYEES

Range Flight Safety Program

Responsible Office: Office of Safety and Mission Assurance

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Preface

P.1 Purpose

This NPR documents the NASA roles, responsibilities and procedural requirements related to range flight safety. This NPR provides for implementation of NPD 8700.1 regarding the protection of the public, NASA workforce, and property during range operations associated with flight.

P.2 Applicability

P.2.1 This directive is applicable to:

a. NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers. This directive applies to the Jet Propulsion Laboratory (JPL) (a Federally-Funded Research and Development Center), other contractors, recipients of grants, cooperative agreements, or other agreements only to the extent specified or referenced in the applicable contracts, grants, or agreements.

b. Range Flight Operations using:

(1) Aircraft engaged in test and evaluation operations when those operations require the use of restricted airspace and/or involve activities such as missile firings, drop tests, water ingestion tests, laser operations, or other hazardous instruments or payloads and could pose a risk to the public, NASA workforce, or property.

(2) Other vehicles - e.g., space launch vehicles, entry vehicles (including sample return capsules), Reusable Launch Vehicles (RLVs), fly-back boosters, Expendable Launch Vehicles (ELVs), high-altitude balloons, high-power amateur rockets, sounding rockets, Unmanned Aircraft Systems (UAS).

(a) Operated or controlled by NASA, or

(b) Carrying a NASA payload or crew and the operation is not licensed or regulated by the FAA or conducted by a foreign government entity.

(3) Permanent and temporary ranges, launch sites, or landing sites operated or controlled by NASA.

P.2.2 This NPR provides procedural range safety requirements for flight, which represent only a portion of the requirements applicable to NASA Projects involved in range operations. NASA range flight operations subject to this NPR and the technical requirements contained in NASA-STD-8719.25 may also be subject to local range requirements (e.g., Air Force Space Command Manual (AFSPCMAN) 91-710).

P.2.3 In this document, the term NASA Program Manager refers to program and project managers who have programmatic responsibility for flight activities using vehicles specified in the Applicability section of this NPR. This includes NASA Program/Project Managers developing launch systems, NASA Program/Project Managers who procure or sponsor launch systems (including the NASA Launch Services Program), and any NASA project personnel who manage small flight projects such as small UASs or high-power amateur rockets.

P.2.4 In this directive, all mandatory actions (i.e., requirements) are denoted by statements containing the term “shall.” The terms: “may” or “can” denote discretionary privilege or permission, “should” denotes a good practice and is recommended, but not required, “will” denotes expected outcome, and “are/is” denotes descriptive material.

P.2.5 In this directive, document citations are assumed to be the latest version, unless otherwise noted.

P.2.6 This directive is not applicable to:

- a. Ground safety requirements and the processing of a vehicle or payload at a range, launch site, or landing site. NASA vehicles and payloads are subject to the local ground safety requirements and other specific Agency and Project requirements.
- b. On-orbit operations that take place after orbital insertion and before initiation of reentry operations.
- c. Safety concerns associated with orbital debris.
- d. The safety of crew on board a vehicle during flight.
- e. Transportation or shipping of a vehicle or payload to or from a range, launch site, or landing site when this activity is not part of a range flight operation. Federal, State, and local regulations apply.
- f. Takeoff, landing, or in-flight operations of conventional piloted aircraft unless a specific aspect of an aircraft operation requires range flight safety involvement to protect the public, NASA workforce, and property.

P.3 Authority

- a. National Aeronautics and Space Act, 51 U.S.C. § 20113.

P.4 Applicable Documents and Forms

- a. Special Use Airspace, 14 CFR pt. 73.
- b. Federal Aviation Administration, Department of Transportation, 14 CFR pt. 101, Moored Balloons, Kites, Amateur Rockets, Unmanned Free Balloons, and Certain Model Aircraft.
- c. Federal Aviation Administration, Department of Transportation, 14 CFR pt. 107, Small Unmanned Aircraft Systems.
- d. Commercial Space Transportation, Federal Aviation Administration, Department of Transportation, 14 CFR pts. 400-1199.
- e. NPD 1000.0, NASA Governance and Strategic Management Handbook.
- f. NPD 1000.3, The NASA Organization.
- g. NPD 8700.1, NASA Policy for Safety and Mission Success.
- h. NPR 8000.4, Agency Risk Management Procedural Requirements.

i. NASA-STD-8719.25, Range Flight Safety Requirements.

j. NASA/FAA MOU, Memorandum of Understanding between Department of Transportation FAA and NASA Concerning A Partnership to Achieve Goals in Aviation and Space Transportation.

P.5 Measurement/Verification

Compliance with the requirements contained in this directive is continuously monitored by the Centers and by the Safety and Mission Assurance (SMA) Technical Authority. Compliance may also be verified as part of selected life-cycle reviews and by assessments, reviews, and audits of the requirements and processes defined within this directive.

P.6 Cancellation

NPR 8715.5A, Range Flight Safety Program, dated September 17, 2010.

Chapter 1. Program Overview

1.1 Introduction

1.1.1 NASA operates and uses ranges for the purpose of launching, flying, landing, recovering, and testing space and aeronautical vehicles and associated technologies. These activities, referred to in this NPR as range flight operations, often present hazards which can pose significant risk to life and property. This NPR defines the NASA Range Flight Safety Program for protecting the public, NASA workforce, and property during range operations associated with flight.

1.1.2 The key technical objectives for the Range Flight Safety Program are:

- a. Ensure each NASA range operation associated with flight undergoes a range safety risk analysis to establish any design or operational constraints needed to control hazards and risks to life and property.
- b. Contain or mitigate the risk to the public, NASA workforce, and any property requiring protection from debris impact or other hazards associated with vehicle flight.
- c. Ensure proper risk acceptance decisions are made that integrate concerns for all identified hazards for the range flight operation and ensure Agency risk criteria are satisfied.
- d. Ensure launch/flight commit criteria for a range flight operation are identified and dispositioned prior to initiation of flight or phase of flight (to include entry, landing, and recovery operations).
- e. Make real-time operational decisions, when required (e.g., flight termination) to control risk. These occur prior to initiation of flight, prior to each phase of flight, and during flight up to orbital insertion and during recovery.

Chapter 2. Roles and Responsibilities

2.1 Chief, Safety and Mission Assurance (SMA)

2.1.1 The Chief, SMA, as stated in NPD 1000.3, is responsible for advising the Administrator and other senior officials on matters related to risk, safety, and mission success. As part of this responsibility, the Chief, SMA:

- a. Establishes Agency policy, requirements, and guidelines to ensure range flight safety functions consistent with national policy and international guidelines.
- b. Collects, develops, promulgates, and advises on procedures, tools, models, methods, and data, to assess and mitigate the risk associated with range flight operations.
- c. Reviews, monitors, and periodically reports to the Agency on compliance with range flight safety requirements by NASA Centers and Mission Directorates and associated programs and projects.
- d. Initiates, in conjunction with the relevant offices, notifications to, and coordinates with, external Agencies concerning significant events and non-compliances.

2.1.2 The Chief, SMA, establishes the NASA Range Flight Safety Program to support the implementation of these responsibilities and designates the NASA Range Flight Safety Program Manager to oversee and maintain this Program.

2.2 Center Directors

2.2.1 The Center Director is responsible for:

- a. Protecting the public, NASA workforce, and property from potential harm resulting from NASA and non-NASA range flight activities and operations at his/her Center, or from vehicles assigned to his/her Center, and to limit exposure to risk to acceptable levels.
- b. Providing resources (e.g., personnel qualified to perform range flight safety functions appropriate to the types of vehicles and range flight operations).
- c. Overseeing the implementation of requirements in this NPR and applicable standards, including the establishment of Center-specific standards and adjudication of requests for relief.
- d. Informing the Chief, SMA, of non-compliances with Agency range flight safety requirements and of other unsafe activities and practices.
- e. Designating a qualified Center Range Flight Safety Lead (CRFSL).

Note: The person fulfilling this role may also be referred to as the Center Range Safety Representative, the Center Range Safety Manager, the Center Range Safety Chief Engineer, or be part of the Center Range Safety Organization.

2.3 Center Range Flight Safety Lead

2.3.1 The CRFSL is responsible for overseeing, monitoring, and evaluating Center and project implementation of this NPR, NASA-STD-8719.25, and applicable laws and regulations.

2.3.2 The CRFSL is part of the Institutional Mission Support Authority defined in NPD 1000.0.

2.3.3 For NASA controlled range flight operations, the CRFSL is responsible for:

- a. Ensuring risk assessments and analyses are performed on behalf of the Center.
- b. Providing concurrence on waivers and Equivalent Level of Safety (ELS) determinations.
- c. Informing the Center Director and SMA Director of non-compliances with Agency range flight safety requirements and of other unsafe activities and practices.
- d. Determining the need to monitor range flight operations and the need for flight termination capabilities.
- e. Designating Range Safety Officers (RSOs) or Flight Safety Officers (FSOs) to monitor range flight operations and make real-time decisions concerning flight initiation and termination.

2.4 Mission Directorate Associate Administrator (MDAA)

The MDAA sponsoring or operating the mission is responsible for their program and project compliance with Agency and Center range flight safety requirements.

2.5 NASA Program/Project Managers Responsible for Flight Activities

Program Managers are responsible and accountable for the safe conduct of range flight operations (including aircraft and UAS flight operations) under their cognizance, in accordance with applicable requirements.

Chapter 3. NASA Range Flight Operations

3.1 Center Requirements

3.1.1 Center Directors shall maintain and implement documented range flight safety processes and standards to ensure compliance with this NPR, NASA-STD-8719.25, and applicable laws and regulations and to ensure that the risks to the public, NASA workforce, and property are mitigated to an acceptable level.

3.1.2 Center Directors shall annually inform the Chief, SMA, of the state of the Range Flight Safety Program at their Center, including performance indicators and risks to the satisfactory implementation of range flight safety responsibilities defined in this NPR.

Note: This may be achieved via existing annual reporting mechanisms such as the Annual Operating Agreement.

3.2 Range Flight Safety Standards Applicability

3.2.1 NASA Program Managers shall notify the CRFSL of planned range flight operations as soon as possible once the operation is identified.

3.2.2 NASA Program Managers, with concurrence from the CRFSL, shall determine the applicability of NASA-STD-8719.25 to the specific project and operations in accordance with Table 3-1.

3.2.3 NASA Program Managers shall document and implement a Range Safety Risk Management Process plan consistent with this NPR, NASA-STD-8719.25, and requirements imposed by the range.

3.2.4 NASA Program Managers shall obtain concurrences and approval of the Range Safety Risk Management Process plan, and for any future changes, from the authorities defined in Table 3-1.

Table 3 1. Standard Applicability and Approval Designation

Type of Operation		Example	NASA-STD-8719.25 applicable?	Range Safety Risk Management Process Approval (Concurrence)	ELS Determination (Concurrence)	Waiver Approval (Concurrence)
NASA Vehicles* on a NASA Range		SSL @ KSC	Yes	SMA TA (CRFSL)	SMA TA (CRFSL)	Center Director (CRFSL, SMA TA)
Non-NASA Vehicles* on a NASA Range	FAA-licensed	Antares @ WFF	Yes	SMA TA (CRFSL)	SMA TA (CRFSL) FAA	Center Director (CRFSL, SMA TA) FAA

	Other		Yes	SMA TA CRFSL)	SMA TA (CRFSL)	Center Director (CRFSL, SMA TA)
NASA Vehicles* on a non-NASA Gov't Range	Launch Services Program (per NPD 8610.23)	LSP Veh. @ VBG, AFB	No - when subject to AFSPCMAN 91-710	Range Authority	Range Authority	Range Commander
	Other		Yes	Range Authority (SMA TA)	Range Authority (SMA TA)	Range Commander (SMA TA)
NASA Vehicles* on a non-Gov't Range	Sounding Rocket @ Kodiak, AK		Yes	Range Authority (CRFSL, SMA TA)	Range Authority (CRFSL, SMA TA)	Range Authority (CRFSL, SMA TA)
FAA-Licensed Vehicle on non-NASA range	GOES @ Cape Canaveral		No	N/A	Range Authority	Range Authority, FAA
NASA UAS in National Airspace System (NAS)	Global Hawk		Yes	See paragraph 4.3	See paragraph 4.3	See paragraph 4.3

*Vehicles – Launch Vehicles, Unmanned Aerial Vehicle (UAVs), etc. falling under P.2 Applicability (1).

3.2.5 Requirements for the implementation of a Range Safety Risk Management Process are contained in paragraph 3.3. 3.2.6 NASA Program Managers shall notify the CRFSL of potential requests for ELS determinations or waivers as soon as the potential need for one is identified. 3.2.7 NASA Program Managers shall obtain ELS determinations and waiver approvals from the authority defined in Table 3-1. 3.2.8 When a waiver is approved in real-time during a range flight operation, NASA Program Managers shall generate and maintain a written waiver request as part of the official operation records. This may be accomplished in real-time through the use of a recorded voice network and then documented, in writing, after the operation is complete.

3.3 Range Safety Risk Management Process

3.3.1 NASA Program Managers shall ensure that each NASA range flight operation undergoes a range safety risk analysis to establish any design or operational constraints needed to control risk to the public, NASA workforce, and property, in accordance with NASA-STD-8719.25.

3.3.2 NASA Program Managers shall ensure that the range safety risk analysis incorporates the applicable requirements of any range, launch site, or landing site that supports the range flight operation.

3.3.3 NASA Program Managers shall obtain concurrence on the range safety risk analysis from the CRFSL.

3.3.4 Using the results of the range safety risk analysis, the NASA Program Managers responsible for range flight operations, in coordination with cognizant range flight safety personnel, the authority responsible for the range, launch site, or landing site, and any other range users/tenants and public or private entities in the flight vicinity, shall:

- a. Identify any NASA or non-NASA property in the vicinity of the flight that requires protection from potential debris impact or other accepted hazards.

Note: Local authorities and Programs are responsible for determining what property requires protection. Local authorities may have risk management requirements that apply to certain high-value equipment, assets, or other property. There may be specific property for which the Program requires risk management due to its proximity to the flight and the consequences associated with potential hazards.

b. Ensure decisions to accept risks associated with range flight operations consider risk to the public, NASA workforce, any property identified in paragraph 3.3.4 a., and the mission, including the safety of any flight crew and mission constraints.

Note: NPD 8700.1 authorizes Center Directors to consent to risk on behalf of the public in the vicinity of their Centers. NASA's requirements for risk management and acceptance of risk to safety and mission success are documented in NPR 8000.4.

c. Make operational decisions needed to control risk to an acceptable level prior to initiation of flight or each phase of flight.

3.3.5 NASA Program Managers shall develop and maintain formal documentation that provides the details of the Range Safety Risk Management Process.

Note: This documentation may take the form of a standalone plan or consist of a compilation of Center or Project documents, such as tailored range flight safety requirements, ELS determinations, Range Flight Safety Waivers, risk mitigation procedures, launch/flight commit criteria, or review presentations. This documentation includes the risk management requirements and processes of any other organization that supports the Center or Project, such as the range, launch site, or landing site.

3.4 Flight Safety Systems

3.4.1 NASA Program Managers, subject to NASA-STD-8719.25, shall obtain a determination from the CRFSL, early in the planning stages, as to whether flight safety systems, such as a Flight Termination System (FTS) or a Contingency Management System (CMS), are required. In other cases, range authorities may separately require the implementation of such systems.

3.4.2 If the use of a FTS or CMS is required based on a determination by the CRFSL, the NASA Program Manager responsible for range flight operations shall request the designation of a qualified civil service personnel RSO/FSO from the CRFSL to operate those systems in accordance with NASA-STD-8719.25.

Note: The RSO/FSO functions are inherently governmental.

Note: For operations with small UAS with CMS capabilities, the risk assessment required per NASA-STD-8719.25 will determine whether an RSO/FSO is required during the operation.

3.4.3 If the use of a FTS or CMS is required, the NASA Program Manager responsible for range flight operations shall obtain activation criteria from the RSO/FSO.

3.4.4 NASA Program Managers shall develop and obtain concurrence from the CRFSL or designated RSO/FSO on launch and flight commit criteria to be used during range flight operations.

3.5 RSO/FSO-Monitored NASA Range Flight Operations

3.5.1 During range flight operations, RSO/FSOs assigned to monitor those operations shall perform the following real-time functions:

- a. Verify that all range flight safety commit criteria are satisfied prior to initiation of flight or each phase of flight.
- b. Monitor the vehicle flight trajectory, vehicle systems, flight safety systems, and the performance of the FTS and CMS, if applicable, to determine if there are any deviations which would require action by the RSO/FSO.
- c. Terminate/ensure a flight is terminated when any aspect of the flight (including, but not limited to, vehicle or support system performance) violates preplanned termination criteria.

Chapter 4. National Airspace System (NAS) and Federal Aviation Administration (FAA) Licenses and Certificates of Authorization

4.1 Introduction

Unique range flight safety requirements may apply to range flight operations depending on the location of the operation or the participation of other entities. This chapter identifies unique range flight safety requirements for range operations that involve commercial launch and entry service providers and the NAS.

4.2 FAA-Licensed Launch and Entry

4.2.1 The FAA has the authority to authorize and supervise commercial space transportation activities conducted in the United States. The FAA licenses commercial launch and entry operations and the operation of commercial launch sites. The FAA licensing regulations are contained in 14 CFR pts. 400-1199.

4.2.2 NASA Program Managers shall obtain FAA licensing for any launch or entry where there is no Government organization directly overseeing and performing the range flight safety function during the activity.

Note: A FAA-licensed launch or entry, carrying a NASA payload or otherwise supporting a NASA mission, does not constitute a NASA range flight operation and is not subject to the requirements contained in this NPR, unless the activity takes place at a NASA facility where the cognizant/local NASA CRSFL is required to implement aspects of this NPR that apply to the activity. In such cases, NASA will coordinate with the FAA to ensure all applicable range flight safety requirements are satisfied.

4.3 Operations in the National Airspace System

4.3.1 This paragraph applies to each NASA Project that uses the NAS during conduct of a range flight operation.

4.3.2 NASA Program Managers that use the NAS shall coordinate with the FAA for those operations in accordance with the FAA procedures and policies.

4.3.3 For operation in the NAS outside of authorized special use airspace (as defined in 14 CFR pt. 73), NASA Program Manager shall obtain a Certificate of Authorization (COA) or Waiver from the FAA, submit a COA via Notification under the NASA/FAA MOU, or follow 14 CFR pt. 107 for each such UAS operation or 14 CFR pt. 101 for each scientific balloon operation. If an operation is to be performed in accordance with 14 CFR pt. 107, or 14 CFR pt. 101, the NASA Program Manager for UAS operations within the NAS shall ensure that all requirements to operate are met.

4.3.4 NASA Program Managers required by this NPR to submit requests to the FAA shall coordinate with the CRFSL prior to submitting those requests to the FAA Center(s) with authority over the planned areas of operation.

Appendix A. Definitions

Certificate of Authorization (COA) or Waiver: A Certificate of Authorization (COA) or Waiver is a document issued by the FAA's Air Traffic Organization to a public operator (e.g., Government organizations, public universities, and law enforcement entities) for a specific activity for a specified period of time (i.e., temporary). The COA or Waiver will specify the operations that are permitted, define the area where the operations may be conducted, the period of time (i.e., temporary), and specify altitudes at which they may be conducted.

Commercial Launch: A service supplied by the private sector that provides the capability of placing a vehicle and any payload into a suborbital trajectory, Earth orbit, or into outer space.

Contingency Management System (CMS): A system designed to manage the vehicle that provides a controlled response under the full set of circumstances defined by the mission's risk assessment. The system may be comprised of a set of elements within the vehicle, including but not limited to, manual control, autonomous control, and recovery capability.

Entry / Entry Operation: The sequence of controlled thrust maneuvers or other events that brings a space vehicle or spacecraft from Earth orbit or outer space to Earth. Entry operations do not include suborbital flights.

Equivalent Level of Safety (ELS) (determination): The approval of an alternative approach to satisfying a range flight safety requirement where the alternative provides an approximately equal level of safety as determined by qualitative or quantitative means.

Expendable Launch Vehicle (ELV): A vehicle that, once launched, is not reused and typically is not retrieved.

Flight: Launch or entry of an orbital or suborbital space vehicle/spacecraft or operation of an aeronautical vehicle (to include aircraft, UAS, and balloons). For the purposes of this NPR, "flight" does not include on-orbit or interplanetary operations.

Flight Safety Officer (FSO): A person responsible for safety during a range flight operation. An FSO has the authority to hold or abort the operation, or take a risk mitigation action, which includes terminating the flight. FSO is synonymous with the term Mission Flight Control Officer (MFCO) used at some DoD ranges.

Flight Safety System(s) (FSS): A system (including any subsystem) whose performance is factored into the Range Safety Analysis and relied upon during flight to mitigate hazards. These systems include range safety displays, range clearance capability, radar, optic tracking systems, telemetry, tracking display systems (including instantaneous impact predictors), contingency management systems, flight termination systems, and command and control capability for flight termination systems.

Flight Termination System (FTS): A type of Flight Safety System designed, tested, and incorporated into vehicles that provides for the independent and deliberate termination of an errant/erratic vehicle's flight.

Landing Site: The earth location on which a vehicle impacts, lands, or is recovered.

Launch: To place a vehicle, payload, or astronauts from Earth in a suborbital trajectory, in Earth orbit or in outer space. For an orbital mission, launch begins with lift-off and ends with orbital insertion. For a suborbital mission, launch begins with lift-off and ends with landing/final impact of all vehicle components.

Launch Site: The location from which a launch takes place. This includes land, air, or a sea-based position.

Mission Essential Personnel: Government or contractor personnel who are directly involved in ensuring the safety and success of a mission. For the purposes of range flight safety, mission essential personnel do not include any people on board the vehicle.

NASA Controlled Range Flight Operations: These are operations from: 1) a NASA range, or an offsite range where NASA is the range authority for the operation; (e.g., KSC; WFF; Kodiak, Alaska) 2) operations by a NASA-operated or controlled vehicle; or 3) operations involving a NASA crew or payload which are not FAA-licensed.

NASA Workforce: Government and contractor personnel who are directly involved in a range flight operation or who work at a range, launch site, or landing site where a NASA range flight operation takes place. For the purposes of this NPR, “workforce” does not include any crew on board a vehicle during flight.

National Airspace System (NAS): The common network of U.S. airspace controlled by the FAA including air navigation facilities, equipment and services, airports or landing areas, aeronautical charts, information and services, rules, regulations, and procedures, technical information, and manpower and material. Also included are system components shared jointly with the military.

Orbital Insertion: With regard to the application of requirements and criteria in this NPR to a space launch, orbital insertion occurs when the vehicle or component achieves a minimum 70 nm perigee based on a computation that accounts for drag.

Payload: The object(s) within a payload fairing carried or delivered by a vehicle to a desired location or orbit.

Property: In the context of this NPR, the term “property” is intended in the broadest sense. Property includes, but is not limited to, public or privately owned land/real estate, homes, factories, livestock, natural resources, facilities, equipment, and other assets (including those on or off a range or launch or landing site). Local authorities and Projects are responsible for identifying property that requires protection. In general, the range flight safety function to protect property does not include protection of the vehicle or payload being flown in a range flight operation.

Public: For the purposes of range safety risk management, public refers to visitors and personnel (excluding NASA workforce) inside and outside NASA-controlled locations who may be on land, on waterborne vessels, or in aircraft.

Range: A permanent or temporary area or volume of land, sea, or airspace within or over which orbital, suborbital, or atmospheric vehicles are tested or flown. This includes the operation of launch vehicles from a launch site to orbital insertion or final landing or impact of suborbital vehicle components. This also includes the entry of space vehicles from the point that the commit to deorbit is initiated to the point of intact vehicle impact or landing or the impact of all associated debris. This includes range operations with aeronautical vehicles from takeoff to landing.

Range Flight Operation: The flight of a launch or entry vehicle or experimental aeronautical vehicle including any payload, at, to, or from a range, launch site, or landing site. Range flight operations utilize specific infrastructure as well as trained and certified personnel to monitor, command, and control the range flight safety elements associated with Projects. Range flight operations do not include the flight of conventional piloted aircraft unless specific aspects of the operation require range flight safety involvement to protect the public, NASA workforce, and property. Range flight operations do not include on-orbit operations of vehicles after orbital insertion or prior to initiation of entry.

Range Safety: Application of safety policies, principles, and techniques to protect the public, NASA workforce, and/or property from hazards associated with range flight operations. Additionally, the term “Range Safety” is informally used to refer to the organization responsible for implementing/enforcing range safety requirements.

Range Safety Officer (RSO): A person responsible for safety during a range flight operation. An RSO has the authority to hold or abort the operation, or take a risk mitigation action, which includes terminating the flight. RSO is synonymous with the term Mission Flight Control Officer used at some DoD ranges.

Range Flight Safety Program: A Program implemented to ensure that the risk to the public, NASA workforce, and property during range flight operations is effectively managed.

Reusable Launch Vehicle: Experimental or operational space launch vehicle that is intended to be reused (at least in part).

Risk: A measure that takes into account both the probability of occurrence and the consequence of a hazard or combination of hazards to a population or installation. Unless otherwise noted, risk to people is measured in casualties and expressed as individual risk or collective risk.

Unmanned Aerial Vehicle (UAV): A vehicle without a pilot on board that is controlled autonomously by an onboard control and guidance system or is controlled from a monitoring station outside of or remote from the UAV vehicle. A UAV is defined as an aircraft by the FAA.

Unmanned Aircraft Systems (UAS): A UAS includes an Unmanned Aerial Vehicle (UAV) or similar vehicle and all the associated support equipment, control station, data links, telemetry, and communications and navigation equipment necessary to operate the vehicle. UAS can be operated via a remotely located, manually operated flight control system or ground control system.

Appendix B. Acronyms

AFSPCMAN	Air Force Space Command Manual
CMS	Contingency Management System
COA	Certificate of Authorization or Waiver
CRFSL	Center Range Flight Safety Lead
ELS	Equivalent Level of Safety
ELV	Expendable Launch Vehicle
FSO	Flight Safety Officer
FTS	Flight Termination System
NAS	National Airspace System
RSO	Range Safety Officer
SMA	Safety and Mission Assurance
UAS	Unmanned Aircraft Systems
UAV	Unmanned Aerial Vehicle

Appendix C. References

- C.1 NPD 8610.23, Launch Vehicle Technical Oversight Policy.
- C.2 NPR 7120.5, NASA Space Flight Program and Project Management Requirements.
- C.3 NPR 7900.3, Aircraft Operations Management.
- C.4 NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping.
- C.5 NPR 8705.2, Human-Rating Requirements for Space Systems.
- C.6 NPR 8715.2, NASA Emergency Preparedness Plan Procedural Requirements.
- C.7 NPR 8715.3, NASA General Safety Program Requirements.
- C.8 NPR 8715.6, NASA Procedural Requirements for Limiting Orbital Debris and Evaluating the Meteoroid and Orbital Debris Environments.
- C.9 NPR 8715.7, Expendable Launch Vehicle Payload Safety Program.
- C.10 NASA STD 8719.12, Safety Standard for Explosives, Propellants, and Pyrotechnics.
- C.11 Air Force Instruction (AFI) 91-217, Space Safety and Mishap Prevention Program.
- C.12 Air Force Space Command Manual (AFSPCMAN) 91-710, Range Safety User Requirements Manual.
- C.13 Eastern and Western Range (EWR) 127-1, Range Safety Requirements.
- C.14 RCC 319, Range Commanders Council Flight Termination Systems Commonality Standard.
- C.15 RCC 321, Range Commanders Council Common Risk Criteria for National Test Ranges.
- C.16 RCC 323, Range Commanders Council Range Safety Criteria for Unmanned Air Vehicles.
- C.17 RCC 555, User Guide for Unmanned Aerial Systems Operations on National Ranges.