



Center-wide Procedures and Guidelines (PG)

DIRECTIVE NO. 800-PG-8715.5.1A

EFFECTIVE DATE: April 24, 2019

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APPROVED BY Signature: Original Signed By

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COMPLIANCE IS MANDATORY

Responsible Office: Code 803/WFF Safety Office

Title: Range Safety Process for Programs and Projects

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P.1 PURPOSE

This Goddard Space Flight Center (GSFC) Procedures and Guidelines (PG) defines the range safety process for programs and projects that conduct range operations under the authority of Wallops Flight Facility (WFF). This PG provides for implementation of NPR 8715.5, *Range Flight Safety Program*, NASA-STD-8719.25 *Range Flight Safety Requirements*, and the operational safety requirements outlined in NPR 8715.3, *NASA General Safety Program Requirements*.

The range safety process ensures proper implementation of range safety requirements. In concert with this PG, range operations shall comply with GSFC-STD-8009, *GSFC/WFF Range Safety Manual*, which contains range safety requirements for all range operations under the authority of WFF.

P.2 APPLICABILITY

This PG applies to all organizations, programs, and projects that conduct range operations under the authority and cognizance of the WFF Safety Office. This PG defines roles and responsibilities and contains requirements that specifically apply to members of the WFF Safety Office and key members within the Code 800 Suborbital and Special Orbital Projects Directorate for providing range safety support to programs and projects.

- a. In this document, all citations are the latest version unless otherwise noted.
- b. In this document, 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.3 AUTHORITY

- a. NPR 8715.3, NASA General Safety Program Requirements
- b. NPR 8715.5, Range Flight Safety Program

P.4 APPLICABLE DOCUMENTS AND FORMS

- a. NPD 8700.1, NASA Policy for Safety and Mission Success,
- b. NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Record Keeping
- c. NPR 8715.3, NASA General Safety Program Requirements
- d. NPR 8715.5, Range Flight Safety Program
- e. NASA-STD-8719.25, Range Flight Safety Requirements
- f. GPR 8621.4, GSFC Mishap Preparedness and Contingency Plan
- g. GSFC-STD-8009, GSFC/WFF Range Safety Manual
- h. 800-PG-8715.0.4, Certification Procedures for Operations Safety Supervisors at WFF

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- i. 803-PG-3410.2.2, WFF Safety Office Training and Certification Program
- j. 803-PG-8715.1.16, Autonomous Flight Termination System (AFTS) Certification
- k. RCC 319, FTS Commonality Standards
- l. WFF Safety Office web site (<http://sites.wff.nasa.gov/code803/>)

P.5 CANCELLATION

800-PG-8715.5.1, Range Safety Process for Programs and Projects

P.6 SAFETY

N/A

P.7 TRAINING

Personnel serving in various safety positions defined in this PG require training and certification in accordance with the 803-PG-3410.2.2, WFF Safety Office Training and Certification Program.

P.8 RECORDS

| Record Title | Record Custodian | Retention |
|---|----------------------------------|--|
| Approved Range Safety Waiver/ELS Requests | Program/Project Offices | NRRS 8/103: Temporary. Destroy/delete between 5 and 30 years after program/project termination |
| Project Request Form | Range Safety Process Coordinator | NRRS 8/103 |

* *NRRS 1441.1 – NASA Records Retention Schedule*

P.9 MEASUREMENT/VERIFICATION

Internal/external audits related to the “Range Safety Process” will assess the effectiveness of this PG.

PROCEDURES

Chapter 1.0 RANGE SAFETY PROCESS OVERVIEW

1.1 Introduction

WFF operates facilities and conducts missions that involve launching, flying, landing, and testing space vehicles, aeronautical vehicles, and associated technologies. These activities, referred to in this PG as “range operations,” present hazards, which can pose significant risk to life and property. This PG defines all elements of the process for ensuring that the WFF Safety Office is involved in each program and project and provides the oversight and support needed to ensure proper implementation of range

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safety requirements for protecting the public, the workforce, and property during range operations. GSFC-STD-8009 contains the range safety requirements that each range operation shall satisfy.

Safety is the responsibility of all National Aeronautics and Space Administration (NASA) personnel, contractors, tenants, experimenters, and range users while conducting operations under the authority of WFF. The safe operation of rockets, manned and unmanned aircraft, balloons, and other special range missions and all associated activities requires a concerted effort by all personnel to mitigate and control hazards, to minimize risks, and effectively manage residual risks.

The range safety process includes ground and flight safety involvement in program/project formulation, safety personnel assignments, range operation safety analysis and planning, real-time operational support, and post-operation activities. The assessment of safety risk and the evaluation of non-compliance with safety requirements are critical aspects of the overall range safety process. As such, this PG also provides the Range Safety Risk Assessment Code (RAC) Matrix and associated guidelines and the process for requesting relief from range safety requirements.

Note: The range safety process defined by this PG does not apply to conventional piloted aircraft missions unless a specific aspect of the mission requires range safety involvement to mitigate increased risk to the public, workforce, and/or property.

1.2 Authority, Roles, and Responsibilities

The range safety process is a cooperative effort between the WFF Safety Office, the applicable launch range, and program or range user. This section defines the specific authority, roles, and responsibilities at the management and mission implementation levels.

The GSFC Center Director has final authority and accountability for all aspects of safety at operational locations under the management of WFF. Per GPR 8710.8, *GSFC Safety Program Management*, the Center Director delegates certain authorities to the Director of WFF and additional members of leadership to ensure appropriate attention on range safety.

1.2.1 Safety Management Roles and Responsibilities

1.2.1.1 Director of WFF – responsibilities include:

- a. Designating the WFF Safety Office Chief (see Section 1.2.1.2)
- b. Delegating range safety technical authority to the WFF Range Safety Chief Engineer (RSCE) within the WFF Safety Office.
- c. Approving the WFF range safety processes, policies and requirements.
- d. Serving as the final authority for approving pre-mission and real-time range safety waivers. (See Chapter 3, Relief from Range Safety Requirements).

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1.2.1.2 Chief, WFF Safety Office – oversees the planning, development, and implementation of the WFF’s range safety process. Responsible for hiring and supervising WFF Safety Office personnel. The WFF Safety Office Chief’s responsibilities include:

- a. Concurring on the WFF range safety processes, policies, and requirements.
- b. Developing, coordinating, and updating range safety process documentation, including this PG.
- c. Developing cost estimates for programs and projects.
- d. Periodically monitoring WFF range operations to ensure that the WFF range safety process is effective and to identify any needed process changes and/or improvements.
- e. Assigning WFF Safety Office personnel to satisfy the responsibilities stated in this PG for each program/project.
- f. Assigning a WFF Safety Office point-of-contact (POC) to coordinate with each program/project and facilitate the range safety process defined by this PG.
- g. Signing safety documentation (approval/concurrence) per Appendix C of this PG.
- h. Designating the Lead Range Safety Officer and Range Safety Chief Engineer.
- i. Approving the operational safety personnel assignments for each mission.

Note: Specific assignments of personnel to serve in safety roles for programs, projects, and each mission are accomplished in coordination between the WFF Safety Office leadership and are subject to final approval by the WFF Safety Office Chief. The Safety Office leadership consists of the Safety Office Chief, the Deputy for Ground Safety, the Deputy for Flight Safety, and the Lead Range Safety Officer.

1.2.1.3 WFF Range Safety Chief Engineer (RSCE) – exercises safety technical authority over flight and ground range safety policy and requirements. The WFF RSCE responsibilities include:

- a. Interpreting and monitoring the application of range safety requirements to programs utilizing launch ranges through definition, design, development, and operation.
- b. Ensuring proper implementation of the range safety tailoring and requirements relief process (see Chapter 3, Relief from Range Safety Requirements).
- c. Signing safety documentation (approval/concurrence) per Appendix C of this PG.

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d. Providing WFF Safety Office approval/certification for range systems including all elements of the Flight Safety System (FSS). This includes:

(1) Coordinating input from the WFF Safety Office and other key stakeholders during the design, test, implementation, and maintenance phases of system development and providing safety input to the program/project manager and/or system development lead.

(2) Serving as the safety panel member at system milestone reviews (or assigning a designee).

(3) Concurring on successful completion of system Operational Readiness Reviews (ORRs) (or equivalent) and issuing safety specific approvals/certifications as needed.

Note: Per NASA NPR 8715.5, an FSS is a system (including any flight or ground subsystem) whose performance is factored into the range safety analysis and relied upon during flight to mitigate hazards (e.g., a flight termination system). This PG also considers ground data systems that support the Range Safety Go for Launch decision as part of the FSS as their performance is factored into the range safety analysis.

e. Serving as the Center Range Flight Safety Lead (CRFSL) as defined in NPR 8715.5 and ensuring that the associated responsibilities are satisfied.

f. Serving as the focal point for all matters involving the WFF range safety process, including interpreting the applicability of this PG to each range user, program, or project.

1.2.1.4 Lead Range Safety Officer (RSO) – serves as technical lead for the RSOs within the Safety Office and is responsible for operational implementation of range safety policy, processes, and requirements. Lead RSO responsibilities include:

a. Providing technical guidance and direction to the WFF Safety Office and programs/projects throughout the range safety process and completion of each mission, focusing on operational implementation of range safety requirements.

b. Participating as a key stakeholder and providing expertise in the design, testing, maintenance, and use of all elements of the FSS and recommending operational approval to the RSCE.

c. Coordinating with other WFF Safety Office leadership on operational safety assignments and developing cost estimates with a focus on operational support.

d. Establishing and overseeing the training and certification for all operational range safety personnel that satisfies NASA-STD-8719.25 in addition to any specific training requirements to address unique aspects of WFF range operations.

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Note: With regard to operational wind weighting and operational safety analyst positions, the Lead RSO has responsibility for training and certification focused on the unique aspects of serving in an operational role, including on-console performance and communications protocols. The Deputy for Flight Safety is responsible for training and certifying the technical aspects of the wind weighting and operational safety analyst positions. The Lead RSO and Deputy for Flight Safety coordinate to ensure the overall training and certification for personnel to serve in these positions during range operations.

- e. Serving as technical lead for the RSOs within the WFF Safety Office.
- f. Signing safety documentation (approval/concurrence) per Appendix C of this PG.

Note: The Lead RSO may delegate one or more of these responsibilities for a given range operation or system. See mission specific RSO responsibilities in Section 1.2.2.4.

1.2.1.5 Deputy Chief, Ground Safety – advises, coordinates, and monitors the implementation of ground safety requirements and supervises WFF Safety Office personnel involved in the ground safety process (Section 1.3.4). The Deputy Chief for Ground Safety responsibilities include:

- a. Developing WFF Safety Office cost estimates for programs and projects with regard to ground safety support.
- b. Assigning the ground safety personnel for each range operation.
- c. Signing safety documentation (approval/concurrence) per Appendix C of this PG.
- d. Researching, developing and maintaining capabilities, methodologies, and tools needed to complete ground safety analyses, safety packages, and plans.
- e. Establishing and overseeing the ground safety personnel training to ensure their preparedness and readiness to perform assigned pre-mission ground safety tasks.
- f. Coordinating as needed with the Lead RSO to ensure mission specific operation training for ground safety personnel.
- g. Establishing and overseeing the training and certification of Operations Safety Specialists (OSS) and Ground Safety Officers (GSO) (see Sections 1.2.2.7 and 1.2.2.8).

Note: 800-PG-8715.0.4 contains procedures for OSS certification.

- h. Directing the implementation of facility system safety, industrial hygiene, and Occupational Safety and Health Administration (OSHA) programs.

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i. Providing technical aerospace engineering advice and guidance during mission planning, integration, and coordination with respect to ground safety.

1.2.1.6 Deputy Chief, Flight Safety - advises, coordinates, and monitors the implementation of flight safety requirements and supervises WFF Safety Office personnel involved in the flight safety process (Section 1.3.5). The Deputy Chief for Flight Safety responsibilities include:

- a. Developing WFF Safety Office cost estimates for programs and projects with regard to flight safety support.
- b. Assigning the flight safety personnel for each range operation.
- c. Signing safety documentation (approval/concurrence) per Appendix C of this PG.
- d. Researching, developing, and maintaining the capabilities, methodologies, and tools needed to perform pre-mission flight safety analyses, to develop flight safety plans and data packages, as applicable and to perform launch-day operational safety risk assessments.
- e. Establishing and overseeing flight safety personnel training to ensure their readiness to perform assigned pre-mission flight safety tasks that satisfies that NASA-STD-8719.25 in addition to any specific training requirements to address unique aspects of WFF range operations.
- f. Establishing and overseeing the technical training and certification of Wind Weighting Analysts and Operations Safety Risk Analysts.
- g. Coordinating as needed with the Lead RSO to ensure overall operational training and certification is accomplished for flight safety personnel.
- h. Providing technical aerospace engineering advice and guidance during mission planning, integration, and coordination with respect to flight safety.
- i. Providing launch availability studies with regard to satisfying safety risk criteria when requested by the program/project.

1.2.2 Mission Specific Safety Roles

The following identifies the key safety roles and responsibilities involved in the range safety process for a typical range operation from WFF (unless otherwise noted). Safety roles and responsibilities are tailored from this baseline depending on the specific operation, e.g., orbital launch vehicles, sounding rockets, scientific balloons, and Unmanned Aircraft Systems (UAS). Individual functions outlined below may be designated to several people under the prime. The number of safety personnel supporting an operation will vary depending on the nature of the operation. The determination of the makeup of the safety support for a particular mission occurs as part of early range safety involvement in project planning (see Section 1.3.3, Range Safety Involvement in Project Planning) and is documented in a

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Range Safety Operations Plan (RSOP) (or equivalent). The Ground and Flight Safety Analysts and the FTS Engineer (Sections 1.2.2.1 – 1.2.2.3) are most active prior to mission execution. The remainder of the safety roles listed below (Sections 1.2.2.4 – 1.2.2.12) are operational as they are directly involved in mission execution and generally have duties involved in preparing for an operation. Appendix C of this PG identifies the responsibilities for signing mission safety documentation (approval/concurrence).

Note: Qualified and certified Safety Office personnel generally perform the safety roles for range operations; however, personnel from other organizations may perform certain safety roles for specific range operations with training and certification from the WFF Safety Office and approval by the Safety Office Chief.

1.2.2.1 Ground Safety Analyst - coordinates with the program/project, assigned Mission Range Safety Officer (MRSO), and other mission personnel to conduct pre-mission analysis, develop mission plans, and implement the overall pre-mission ground safety process defined in Section 1.3.4, Ground Safety Process. The Ground Safety Analyst works with the program/project to facilitate on-time delivery of ground data packages and other range user supplied data.

1.2.2.2 Flight Safety Analyst - coordinates with the program/project, assigned MRSO, and other mission personnel to conduct pre-mission analysis, develop mission plans, and implement the overall pre-mission flight safety process defined in Section 1.3.5, Flight Safety Process. The Flight Safety Analyst works with the program/project to facilitate on-time delivery of flight data packages and other range user supplied data.

1.2.2.3 Flight Termination System (FTS) Engineer - oversees the design, development, testing and implementation of the onboard safety system components for a mission requiring the use of a commanded FTS or Autonomous FTS (AFTS). The FTS Engineer:

- a. Participates in FTS/AFTS requirements tailoring and recommends approval to the RSCE.
- b. Provides WFF Safety Office concurrence on FTS/AFTS component qualification and acceptance related issues and activities as long as the tailored requirements are satisfied.
- c. Evaluates any FTS/AFTS related Equivalent Level of Safety (ELS) and waiver requests, drafts WFF Safety Office dispositions, and recommends approval to the RSCE.
- d. Witnesses FTS/AFTS component and system level testing at the discretion of the RSCE.
- e. Drafts an FTS/AFTS report that documents that the onboard FTS/AFTS components and overall onboard system for the mission complies with the tailored requirements, and recommends approval to the RSCE and the MRSO.

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Note: Implementation of an AFTS is subject to 803-PG-8715.1.16, which requires evaluation by a team of engineers and analysts led by the WFF Safety Office. The FTS Engineer is a member of this team.

1.2.2.4 Mission Range Safety Officer (MRSO) - leads the operational implementation of the range safety process for a specific range operation. The MRSO:

Note: The Safety Office Chief generally assigns MRSOs from the Safety Office's RSO staff; however, other personnel may serve as MRSO for a specific mission with approval by the WFF Safety Office Chief.

- a. Coordinates the WFF Safety Office support for the mission and leads the presentation of flight and ground safety analysis results and related information at pre-mission reviews.
- b. Leads the development of the Range Safety Operations Plan (RSOP) (or equivalent) for each range operation.

Note: The RSOP for a mission is an internal WFF Safety Office document for use by operational safety personnel. It identifies the operational safety functions required for the mission, documents the operational safety personnel and mission specific responsibilities, contains the MRSO checklist, and contains information that pertains to the safety activities and overall support for the operation.

- c. Leads the operational safety personnel during mission specific training, rehearsals, and execution.
- d. Serves as the safety focal point of contact for all checks or questions from the Range or range user during mission execution, including campaign execution as assigned.
- e. Verifies the readiness of all operational safety elements, including but not limited to the FSS.
- f. Executes and authorizes proper safety procedures followed during unplanned launch contingencies.
- g. Approves the categorization of people for risk management purposes (i.e. mission essential personnel, critical operations personnel, or public/visitors) on WFF property or at locations where WFF has range safety responsibility.
- h. Approves real-time operational deviations from ground and flight safety plans as long as the operation satisfies the requirements of GSFC-STD-8009, *GSFC/WFF Range Safety Manual (or tailored version)* and any other applicable safety requirements. Ensures any approved deviation is documented and submitted to the WFF Safety Office leadership for post-mission review and identification of lessons-learned.

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Note: The MRSO's authority to deviate from approved ground and flight safety plans for a specific mission provides necessary flexibility to address unforeseen circumstances that can occur in an operational environment. When exercising this authority, the MRSO will coordinate with the mission analyst(s) and other subject matter experts to the extent possible as a critical part of the process for arriving at a decision. If there is any doubt as to whether or not a proposed deviation satisfies applicable requirements, the MRSO has the authority to "HOLD" per Section 1.2.2.4i.

- i. Ensures launch commit criteria established in safety plans and other applicable requirements are satisfied and exercises "HOLD" authority on operations when necessary, until the operation satisfies all criteria/requirements or relief is granted per the process defined in Chapter 3.

Note: The MRSO does not have authority to grant relief from range safety requirement. The authority to grant relief from range safety requirements (i.e., ELS and waivers) lies with the RSCE, the Chief of WFF Safety, and the Director of WFF per the process defined in Chapter 3.

- j. Provides final Range Safety 'GO' to the NASA Test Director (TD) (or equivalent) for launch.
- k. Monitors and interprets safety displays of vehicle performance and system status, informs the Flight Safety Officer (FSO) of display status, and serves as emergency backup to the FSO for flight termination when applicable.
- l. In the event of a loss of all vehicle position data after liftoff, implements the process for determining when a malfunctioning vehicle could create a hazard to the public and coordinates with the FSO as needed to make a flight termination decision.
- m. Extracts positional data from safety systems on nominal or off nominal impacts and passes to the TD, Recovery Director, and others as necessary to assist in location of recoverable payloads or debris.
- n. For balloon missions, participates in the decision process for nominal mission termination with a focus on ensuring that applicable safety requirements/risk criteria are satisfied.
- o. Participates in post-operation reviews and coordinates safety input to lessons-learned per Section 1.3.9 of this PG.

1.2.2.5 Flight Safety Officer (FSO) - for missions using a commanded FTS verify the readiness of the FTS during the operation and make real-time flight termination decisions based on established criteria outlined in the Flight Safety Plan (FSP). During operations, the FSO:

- a. Coordinates with the Systems Safety Officer (SSO) and other operational personnel to develop specific prelaunch checkout procedures needed to validate the critical elements of the FSS and inform the MRSO of violations or other concerns.

b. Monitors and interprets flight safety displays to detect errant vehicles and, if deemed necessary, initiate flight termination based on safety plan termination criteria (mission rules).

c. Directs range command transmitter support personnel during the pre-launch, flight, and post-flight phases of the operation. Initiates emergency commanding procedures if required.

1.2.2.6 Systems Safety Officer (SSO) - supports the FSO and MRSO in verifying FTS readiness during the operation and monitoring of other safety related information available via telemetry. The SSO:

a. Coordinates with the FSO and other personnel to develop specific prelaunch checkout procedures needed to validate elements of the FTS and informs the MRSO of violations or other concerns.

b. Monitors and interprets safety displays and communicates with range personnel to determine the health of on-board and ground-based elements of the FTS.

c. Assists the FSO to direct range command assets to ensure command control over the vehicle as needed throughout flight.

1.2.2.7 Ground Safety Officer (GSO) - implements ground safety requirements in accordance with the ground safety plan and reports ground safety status to the MRSO. During the operation, the GSO:

a. Monitors prelaunch conditions with respect to ground safety launch commit criteria and informs the MRSO of violations or related concerns.

b. Coordinates with the Operations Safety Specialist (OSS), range, and program/project personnel on pre-launch activities and pad operations.

c. Evaluates proposed deviations to approved hazardous procedures or deviations to vehicle system or ground support system mission constraints for compliance with GSFC-STD-8009 (or tailored version) and recommends approval to the MRSO.

Note: The MRSO may delegate authority to the GSO to grant specific ground safety related deviations for specific missions.

d. Coordinates with protective services and/or Launch Pad Managers (LPMs) to secure launch hazard areas.

Note: The MRSO may perform these functions for some missions without designating a specific GSO. For example, sounding rocket, balloon, and UAS missions typically do not require a GSO.

1.2.2.8 Operations Safety Specialist (OSS) - provides on-site safety oversight of hazardous operations. During the operation the OSS:

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- a. Monitors on-site conditions subject to safety plans and operating procedure limits and informs the MRSO or GSO of violations or other related concerns.
- b. Exercises on-site “STOP-WORK” authority if deemed necessary to ensure safety.

1.2.2.9 Surveillance Officer (SO) - coordinates with range surveillance personnel to verify hazard areas are clear and associated launch commit criteria are met. During the operation the SO:

- a. Monitors the range surveillance system, which includes air and surface target displays.
- b. Operates the range surveillance system and coordinates with surveillance personnel with respect to range surveillance assets.
- c. Determines clearance status of debris hazard areas and relays information to the MRSO.
- d. Reports ship and aircraft safety risk related information to the MRSO as needed to implement the safety risk criteria.

NOTE: The MRSO may perform SO functions for some operations without designating a specific SO. For example, balloon launches and UAS operations typically do not require a designated SO.

1.2.2.10 Operations Safety Risk Analyst - is responsible for operating analysis tools to assess safety risks associated with launch debris, toxic, and/or Distant Focus Overpressure (DFO) hazards and providing day-of-launch risk assessment results to the MRSO.

Note: A range operation may require one or more analysts depending on the complexity of the mission. The MRSO responds to any inquiries during a launch countdown regarding safety risk assessments using the proper communications channel.

1.2.2.11 Wind Weighting Analyst - performs analysis for unguided suborbital launch operations using day-of-launch measured wind data and vehicle trajectory models to determine launcher settings needed to achieve mission requirements. The Wind Weighting Analyst:

- a. Configures the wind-weighting system with the proper wind and vehicle models to perform the real-time analysis.

Note: The flight safety process includes pre-mission analysis to develop the wind and vehicle models. The Deputy Chief of Flight Safety assigns this function to the flight safety analyst for the mission, the wind weighting analyst, or another analyst.

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- b. Coordinates with range personnel to meet the safety schedule for release of pre-launch balloons used to measure wind speed and other data.
- c. Creates day-of-launch wind profile from measured data.
- d. Monitors launcher-setting variability.
- e. Uses a certified system to compute wind effects on vehicle trajectories and the required compensation and provides compensated launcher settings to the MRSO.
- f. Monitors specific wind magnitude, wind direction, launcher settings, and launcher variability limits for compliance with mission rules and reports any violation or other related concern to the MRSO.

1.2.2.12 Sky Screen (SS) - observers for a mission using a commanded FTS who provide critical vehicle performance information to the FSO and MRSO immediately following lift-off. A typical mission that uses a commanded FTS at WFF requires the following two SS observers:

- a. The Back-Azimuth observer (call sign “Back-AZ”) is located approximately 180 degrees from the launch azimuth. The Back-Azimuth observer monitors the vehicle flight for a gross left or right turn from the nominal trajectory and any other early visual or audio indication of abnormal vehicle performance.
- b. The Pitch observer (call sign: “Pitch”) is located approximately perpendicular to the launch azimuth. The Pitch observer monitors the vehicle flight for any turn backwards and any other early visual or audio indication of abnormal vehicle performance.

1.2.3 Range and Program/Project Management Roles

1.2.3.1 NASA Program or Project Manager (PM) – The PM coordinates with the range user, program or project, and the WFF Safety Office to provide mission specific data and participates in a cooperative effort to implement the range safety process. The PM is responsible for submission of any requests for relief from range safety requirements per the process defined in Chapter 3 of this PG. The PM may represent the range user during requirements relief discussions and present mission benefits that warrant acceptance of risk by the WFF Director. *NPD 8700.1, NASA Policy for Safety and Mission Success*, outlines additional PM responsibilities.

1.2.3.2 NASA Campaign Manager (CM) and/or Mission Manager (MM) – The CM and MM are mission management positions that are applicable when conducting operations at ranges and launch locations other than WFF. The CM and MM roles and responsibilities are essentially the same as a PM. Mission specific safety plans identify the specific positions with responsibility for implementing WFF safety policy, criteria, requirements, and planning when operating at ranges and launch sites other than WFF.

1.2.3.3 NASA Test Director (TD) – The TD coordinates with operational personnel to verify all range requirements are satisfied during the countdown and provides the WFF range final GO for launch. The TD:

- a. Requests clearances (both air and surface) and coordinates the issuance of Notice to Airmen (NOTAM), Altitude Reservation (ALTREV), and Notice to Mariners (NOTMAR) for hazard areas defined in the flight and ground safety plans.
- b. Requests Collision Avoidance (COLA) assessments and provides results and associated wait times to the MRSO.
- c. Coordinates clearance for hazardous operations (e.g. Radio Frequency (RF) Avoidance and/or RF Silence).
- d. Executes the launch countdown in conjunction with the Range Operations Assistant (ROA).
- e. Provides approval to radiate open loop on Ultra High Frequency (UHF) command frequencies (i.e. 420-425 MHz).

1.2.3.4 Launch Pad Manager (LPM) – The LPM provides oversight and coordination of all operations occurring on a launch pad. The LPM (or equivalent):

- a. Maintains the boundary of the perimeter of any hazard area created by any operation conducted on Wallops Island.
- b. Coordinates with the OSS on hazard and hazard area protection.
- c. Communicates status to and from the launch pad during all operations. Communicates launch pad status to the Range Control Center (RCC).
- d. Ensures the appropriate people and equipment are present at the launch pad.

Note: NASA and tenant organizations operate launch pads at WFF. NASA personnel, tenant personnel, or a combined effort in accordance with the applicable agreements may perform the LPM functions.

1.3 Range Safety Process Elements

1.3.1 Range Safety Process and Support to Programs/Projects

The range safety process and the associated range safety support provided by the WFF Safety Office are essential to the overall success of all programs/projects under the cognizance of WFF. Significant hazards and associated safety risks are often inherent to ground and flight tests and other range operations. The range safety process includes evaluation of the hazards, assessment of the associated

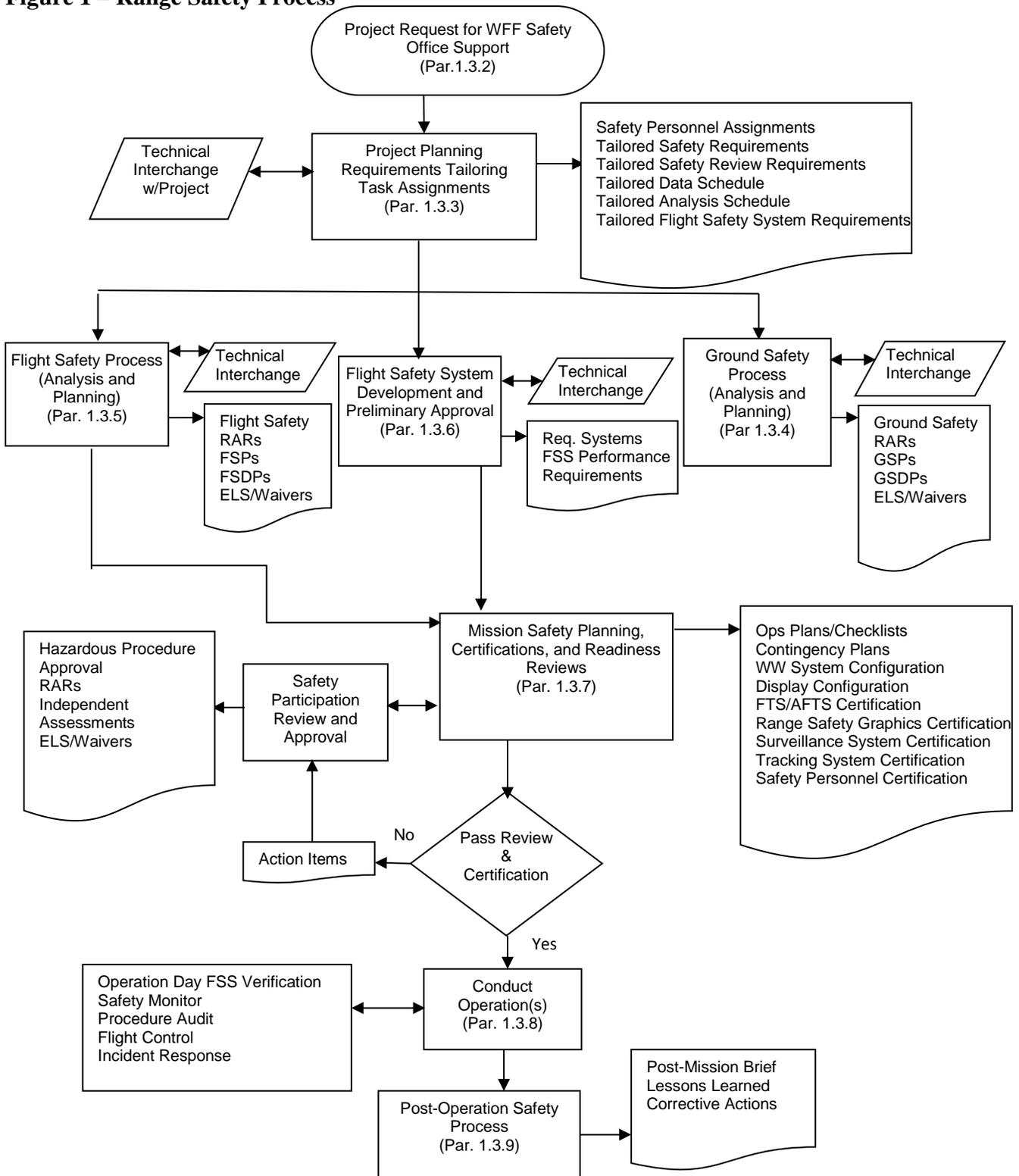
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safety risk, risk mitigation, and implementation of criteria and processes for acceptance of residual risk. The WFF Safety Office provides range safety expertise and oversees implementation of the range safety process for each program/project. The steps outlined in this section are mostly applicable to rocket and large scientific balloon operations. Other range operations (e.g., UAS) may have a more streamlined approach developed in coordination between the program/project and the WFF Safety Office. The WFF Safety Office may adjust the range safety support it provides based on mission needs and works closely with program/project personnel to ensure an effective and efficient range safety process for each mission.

A program or project has the option to perform some elements of the range safety process internally versus having them performed by the WFF Safety Office. For example, a program/project may perform safety analyses and develop the associated mitigations. In this case, the WFF Safety Office will assign appropriate personnel to provide oversight and act as the review/approval authority to ensure safety independence. A program/project must present alternative approaches to accomplishing any element of the range safety process early in mission planning, and must obtain approval from the WFF Safety Office Chief. The same technical and documentation standards followed by WFF apply to an alternative approach.

Figure 1 identifies the major elements of the range safety process and the key WFF Safety Office activities performed in support of programs/projects.

Figure 1 – Range Safety Process



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1.3.2 Project Requests for Safety Office Support

a. The project (Program/Project Manager or designee) requesting safety support shall coordinate with the WFF Safety Office Business Manager to request services and provide the following as a minimum:

- (1) Description of services required
- (2) Designated point of contact
- (3) Time frame
- (4) Source of funding for the project

Note: Initial informal discussions with the WFF Safety Office regarding a proposed program/project may take place in a number of different forums with various members of WFF Safety Office Management. The program/project will work with the WFF Safety Office Business Manager when ready to begin formal work on the range safety process. The WFF Safety Office maintains a project request form (available upon request) that identifies the complete set of information needed to develop safety support cost estimates and assure appropriate assignment of safety personnel for each project.

b. The WFF Safety Office Chief will assign a WFF Safety Office POC who has overall responsibility for coordinating with the program/project and facilitating the range safety process. The WFF Safety Office POC shall assist WFF Safety Office Management in development of cost estimates and establishment of the safety support for the project (as needed).

c. The WFF Safety Office POC shall provide the customer with the name(s) of the WFF Safety Office personnel who will be supplying the services required.

d. WFF Safety Office personnel assigned to a project shall contact the customer's designated POC to begin their participation in the project and implementation of other aspects of the range safety process.

1.3.3 Range Safety Involvement in Project Planning

Early planning and regular coordination between all participants in a range program/project helps to ensure against late system and process changes and the associated cost and schedule impacts. The focus of following process requirements is on establishing the necessary working relationship between the WFF Safety Office and the program/project, identifying key mutual requirements, and early tailoring of the range safety support specifically needed for each project.

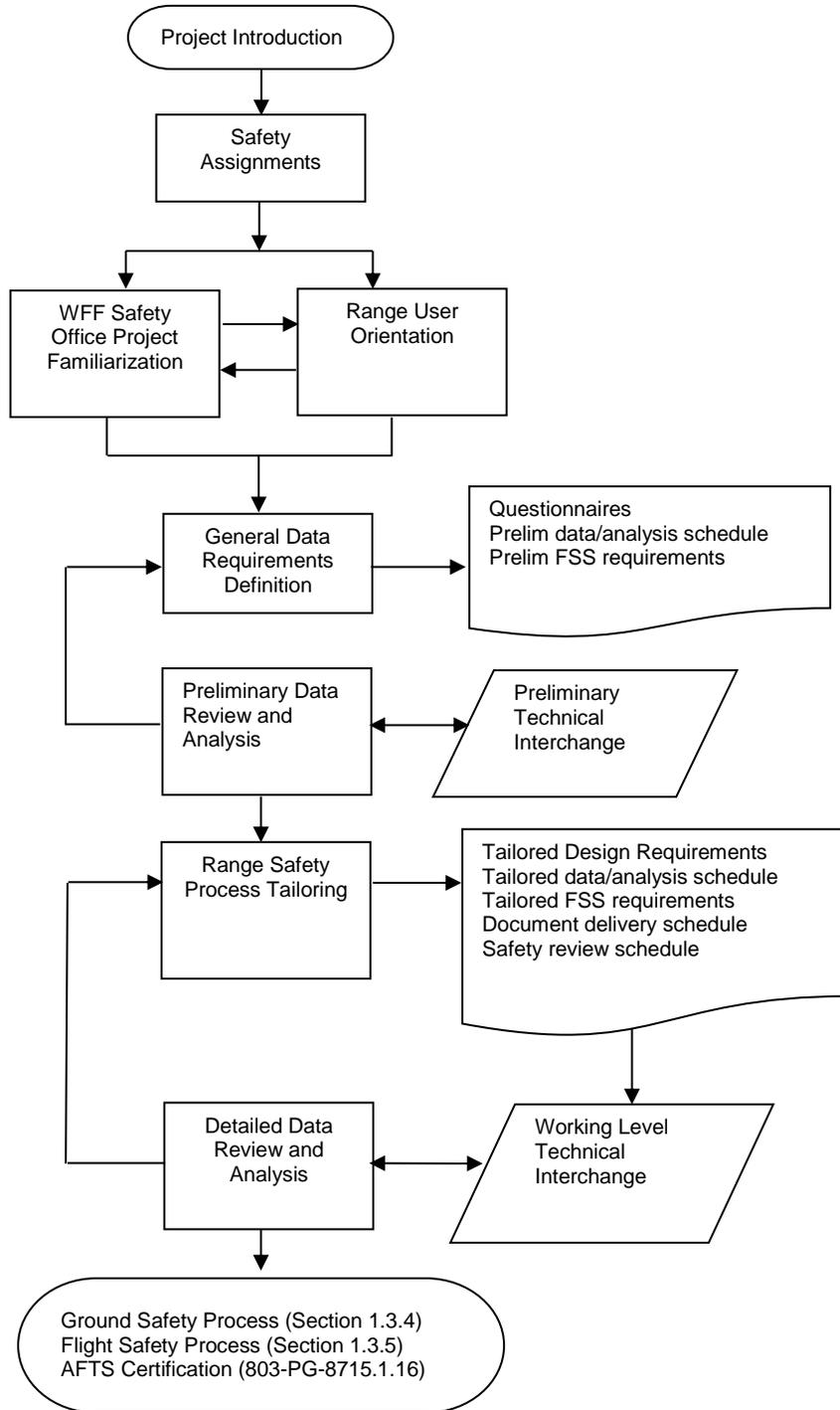
a. Program/project managers shall supply initiating program/project data to the WFF Safety Office. GSFC-STD-8009 contains standard data requirements, which the Safety Office may tailor based on program/project applicability.

b. The WFF Safety Office shall estimate data requirements, analysis level of effort, operation requirements, and documentation requirements within each safety discipline needed and provide this to the program/project manager.

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- c. The WFF Safety Office Chief, Deputy for Flight Safety, and Deputy for Ground Safety shall coordinate to assign safety personnel appropriate to each program/project. In addition to the POC assigned per Section 1.3.2.b, this typically involves the assignment of a Ground Safety Analyst, Flight Safety Analysts, and a MRSO as a minimum. Depending on the mission, operational safety roles such as defined in Sections 1.2.2.4 – 1.2.2.12 may be determined closer to the execution phase of the range operation.
- d. The assigned safety personnel shall work with the program/project team as needed to identify the applicable range safety processes and requirements of this document and GSFC-STD-8009 and consider any unique requirements and/or alternative safety approaches. This process is also known as tailoring.
- e. The PM (or equivalent) shall ensure the overall schedule of activities for each program/project incorporates all safety related steps and products shown in the flow diagram in Figure 2.

Figure 2 Range Safety Project Planning Activities



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1.3.4 Ground Safety (GS) Process (Analysis and Planning)

The GS safety process involves the assessment of hazards and safety risks from ground processing activities. This includes processing of flight vehicles and payloads, mission preparation procedures leading up to flight, and any post-flight or recovery activities conducted under the authority of WFF. The process covers both analysis and planning to mitigate and control hazards to minimize risk to personnel and property.

a. The GS safety analysis is based on data provided by the program/project in accordance with the timeline specified in GSFC-STD-8009. The analysis shall:

- (1) Identify all known hazards associated with the range operation.
- (2) Ensure proper implementation of safety design criteria and hazardous systems are compliant with the technical requirements of GSFC-STD-8009 (or tailored version).
- (3) Provide the basis for establishing safe operating procedures and operational requirements to minimize hazard exposure to the public, personnel, and property.
- (4) Identify and qualify residual risks using the Risk Assessment Code (RAC) matrix and the guidelines identified in Chapter 2.

b. The Deputy Chief of Ground Safety (or designee) shall assign a GS Analyst as part of the program/project planning process described in Section 1.3.3, Range Safety Involvement in Project Planning.

c. The GS Analyst and program/project representative shall coordinate in technical interchange activities where the program/project supplies vehicle/ground support equipment configuration data, hazardous systems data, hazardous procedures, etc. as defined in GSFC-STD-8009.

Note: The WFF Safety Office maintains and provides programs/projects with data sheet templates that identify the needed ground safety related information.

d. The GS Analyst shall document the analysis approach and results in the form of a GS Risk Analysis Report (RAR), and GSP or Ground Safety Data Package (GSDP) where applicable that demonstrates compliance with the requirements of this document and GSFC-STD-8009 or tailored version. The GS RAR provides the results of the analysis and includes engineering calculations for respective danger areas. The GSP identifies the controls and mitigations required to ensure the risks identified in the GS RAR remain at acceptable levels. For operations conducted at other launch locations where WFF is not the range safety authority, the GS Analyst shall develop a GSDP in lieu of a plan. The GSDP provides necessary information to the local range safety authority for use in developing their GSP (or equivalent) for the operation. The ground safety documentation shall include at a minimum:

(1) Hazardous system categorization and the mitigating methods or devices to adequately contain and/or control the hazard and protect non-participating personnel should an inadvertent actuation or other hazard event.

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Note: This applies to all hazardous systems including but not limited to explosives, chemical systems, pressure systems, cryogenic systems, battery systems, and RF transmitters.

(2) Hazardous system danger areas and their implementation, restrictions, and list of responsible personnel. Common danger areas for a typical range operation include:

- (a) Pre-Launch Danger Area (PLDA), which applies during vehicle staging and hazardous operations on the launch pad such as preliminary arming.
- (b) Launch Danger Area (LDA), which applies when there are less than two inhibits for the vehicle initiating circuit, which typically occurs after final arming.
- (c) Launch Hazard Area (LHA) applies for some launches to define where specific people (generally observers) may be located at the time of launch.

Note: For rocket vehicles, final arming occurs within a few minutes of launch. The range, project, or program may choose to enforce the LDA in advance of final arming to further ensure a clear range at lift off.

- (3) Hazard analyses and calculations used to define danger/hazard areas.
- (4) RF avoidance times for non-ionizing controls.
- (5) RF transmitter related analyses and resulting standoff distances, such as Hazards of Electromagnetic Radiation to Ordnance (HERO), Hazards of Electromagnetic Radiation to Fuel (HERF), and Hazards of Electromagnetic Radiation to Personnel (HERP).
- (6) Hazard areas associated with the potential for a chemical spill (if applicable to the operation).
- (7) Range-user, program, or project supplied Hazard Analysis Reports (HAR).

Note: The WFF Safety Office maintains templates for developing GS RARs, GSPs, and GSDPs. The templates contain guidance for preparing each document and identify the data that are required in each section. The templates help to ensure a consistent approach to developing ground safety documentation. The templates are available to any program or project that elects to prepare ground safety documents for review and approval by the WFF Safety Office.

- e. The GS Analyst shall review hazardous procedures and systems for compliance with GSFC-STD-8009 requirements (or tailored version) and work with the programs/projects to resolve related concerns.
- f. The Deputy for Ground Safety shall assign a technical peer review as part of the development and approval of each ground safety analysis and plan.
- g. The GS Analyst and MRSO shall coordinate to ensure the procedures and requirements identified in the GSP are operationally feasible.

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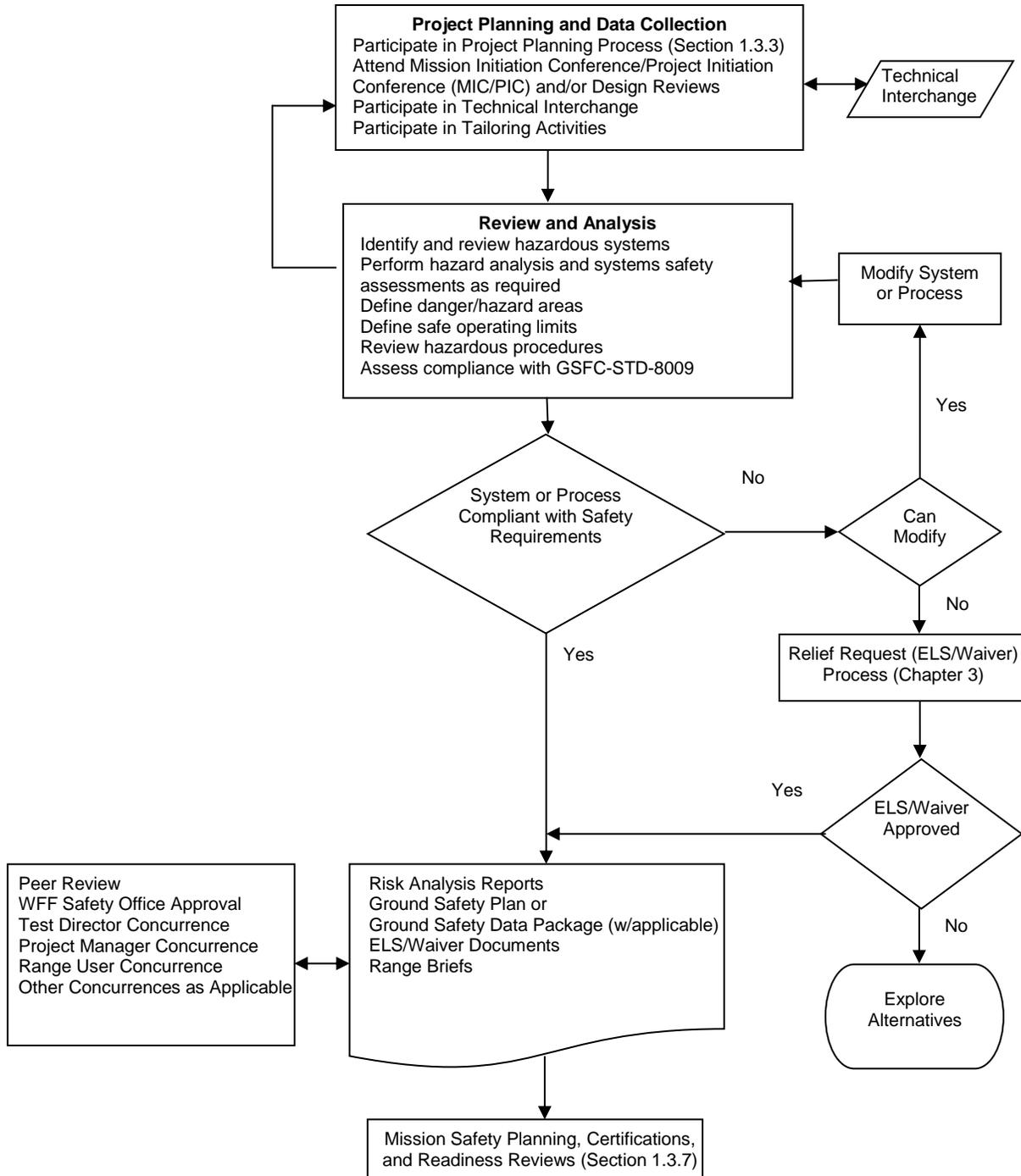
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- h. The Deputy for Ground Safety shall ensure successful completion of the ground safety process for each mission and approve all ground safety analyses and plans.
- i. The GS Analyst shall coordinate with the range and the program/project to ensure that the ground safety process incorporates the elements shown in Figure 3 and to obtain TD, program/project, and range user concurrences on ground safety documentation.
- j. The MRSO shall brief the results of the ground safety analysis at program/project reviews (e.g., at Mission Readiness Reviews, Range Readiness Reviews, and Launch Readiness Reviews) with support from the GS Analyst.

Note: For some projects (e.g. small UAS) and range operations with limited hazards that can be fully contained (e.g., dropping a test article from an aircraft to a cleared target area), the WFF Safety Office may elect to prepare a Range Safety Plan (RSP) that combines the elements of ground safety and flight safety documents into one analysis/plan document. In such cases, the assigned lead engineer/analyst works with other ground and/or flight safety personnel as needed to address the hazards associated with the range operation.

Figure 3 Ground Safety Process (Analysis and Planning)



1.3.5 Flight Safety (FS) Process (Analysis and Planning)

The FS process involves the assessment of hazards and safety risks associated with the flight of aerospace vehicles and payloads to protect the public, workforce, and property. The FS process reduces the risk to an acceptable level as defined by safety risk criteria. The process addresses both analysis and planning to mitigate and control hazards and manage risk to personnel and property.

a. The program/project shall provide FS data in accordance with the requirements and timeline specified in GSFC-STD-8009 or tailored version of the document. The FS analysis is based on the program/project provided data and shall:

- (1) Identify flight related hazards and characterize the associated safety risks. The risk characterization shall employ quantitative means unless the WFF Safety Office agrees to a qualitative approach.
- (2) Identify the safety risk mitigations and/or controls needed to ensure the acceptable risk criteria are satisfied as specified in GSFC-STD-8009 or a tailored version of the document.
- (3) Provide the basis for determining the need for an on-board vehicle FSS such as an FTS.
- (4) Provide the basis for establishing the mission specific flight safety operational requirements/restrictions documented in the FSP.

b. The Deputy for Flight Safety shall assign a FS Analyst as part of the program/project planning process described in Section 1.3.3, Range Safety Involvement in Project Planning. For unguided rockets, the FS Analyst could also perform as the Wind Weighting Analyst.

c. The FS Analyst and program/project representatives shall coordinate in technical interchange activities and the program/project shall provide specific vehicle/payload configuration, hazardous systems, trajectory, and other data pertinent to the flight safety analysis in accordance with the data submittal requirements of GSFC-STD-8009 or tailored version of the document.

Note: The WFF Safety Office maintains and provides programs/projects with data sheet templates that identify the needed flight safety related information.

d. The FS Analyst, MRSO, and RSCE shall coordinate with the program/project to determine the need for an on-board vehicle FSS and/or the extent of such a system (e.g., on various stages) to ensure safety.

Note: GSFC-STD-8009 contains the requirements and criteria for determining when vehicles require an FSS.

e. The FS Analyst shall perform specific engineering analyses and document the analysis approach and results in the form of FS RAR, and FSP or Flight Safety Data Package (FSDP) (where applicable) that demonstrate compliance with the requirements of this document, GSFC-STD-8009 or tailored version, and NASA-STD-8715.25. The FS RAR provides the results of the analysis and includes engineering and safety risk calculations that demonstrate compliance with the applicable criteria and define respective flight hazard areas. The FSP identifies the controls and mitigations required to ensure the risks identified in the FS RAR remain at acceptable levels. For operations conducted at other launch

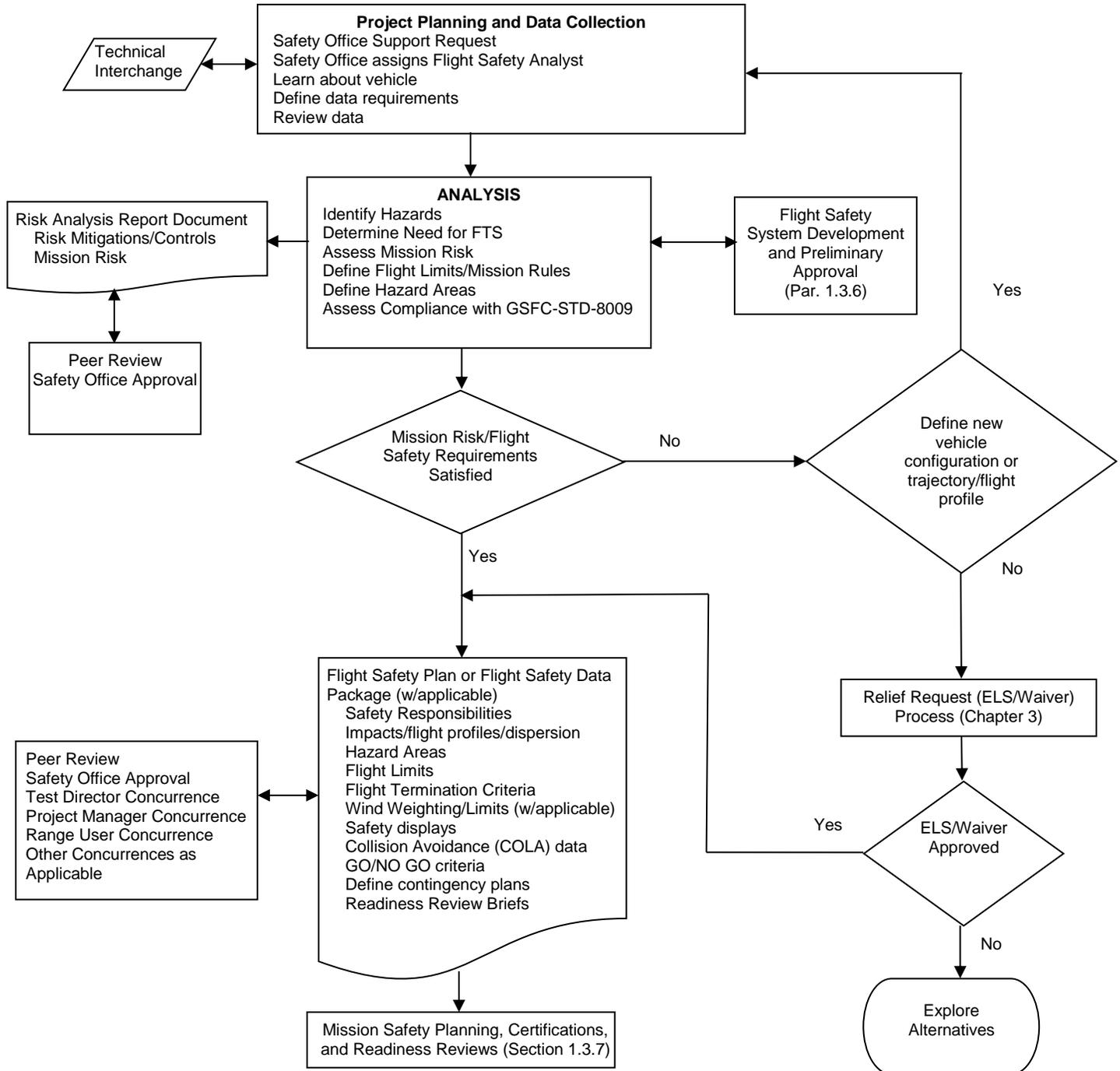
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locations where WFF is not the range safety authority, the FS Analyst shall develop an FSDP in lieu of a plan. The FSDP provides necessary information to the local range safety authority for use in developing their FSP (or equivalent) for the operation.

- f. The Deputy for Flight Safety shall assign a technical peer review as part of the development and approval of each flight safety analysis and plan.
- g. The FS Analyst and MRSO shall coordinate to ensure the procedures and requirements identified in the FSP or FSDP are operationally feasible.
- h. The Deputy for Flight Safety shall ensure successful completion of the FS process and approve all flight safety analyses and plans.
- i. The FS Analyst shall coordinate with the range and the program/project to ensure that the FS process incorporates the elements shown in Figure 4 and to obtain the Test Director, program/project, and the range user concurrences on flight safety documents.
- j. The MRSO shall brief the FSP at program/project reviews (e.g., at Mission Readiness Reviews, Range Readiness Reviews, and Launch Readiness Reviews) with support from the FS Analyst.

Note: For some projects (e.g. UAS) and range operations with limited hazards that can be fully contained (e.g., dropping a test article from an aircraft to a cleared target area), the WFF Safety Office may elect to prepare a RSP that combines the elements of ground safety and flight safety documents into one analysis/plan document. In such cases, the assigned lead engineer/analyst works with other ground and/or flight safety personnel as needed to address the hazards associated with the range operation.

Figure 4 Flight Safety Process (Analysis and Planning)



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1.3.6 Flight Safety System (FSS) Development and Preliminary Approval

The process for approving elements of the FSS applies to FTS, AFTS, Contingency Management Systems (CMS), and all safety-critical range or range-user provided systems.

a. WFF Safety Office Management will assign an engineer or appropriate personnel to participate directly in the system requirements definition, system development, and system implementation activities.

(1) For FTS and AFTS, the Deputy for Flight Safety will assign a FTS engineer to work with the range user on requirements tailoring and to provide oversight of the component qualification and acceptance testing, system implementation, and system-level testing in accordance with GSFC-STD-8009.

(2) For an AFTS, in addition to the FTS engineer, the WFF Safety Office leads a team of WFF personnel with the technical expertise to evaluate and approve an AFTS in accordance with GSFC-STD 8009. 803-PG-8715.1.16, *AFTS Certification*, specifies the certification process and associated requirements for AFTS.

(3) For other range or range-user provided safety-critical systems (e.g., CMS, tracking, surveillance systems, safety displays, etc.) the WFF Safety Office Chief will assign an RSO or other appropriate personnel as the WFF Safety Office's primary participant in the development process.

b. The process will include identifying the system verification activities required for each specific mission to include pre-mission testing and countdown checklists/steps.

c. The RSCE provides WFF Safety Office approval for all elements of an FSS. This includes overseeing and participating in the approval of any relief from applicable requirements (ELS or range safety waiver) per Section 1.2.1.3 and Chapter 3 of this PG.

1.3.7 Mission Safety Planning, Certifications, and Readiness Reviews

The process for ensuring readiness of the program/project, the range, and the operational safety personnel to conduct a launch or other range operation shall include verification of the following:

a. Requirements Flow-Down – Safety requirements found in GSPs and FSPs flow into mission operations plans, updates to contingency plans, FSS functional test checklists, and GO/NO-GO checklists.

b. FSS Configuration – Range safety computer displays, video consoles, surveillance displays, wind weighting computer, flight termination consoles, and other equipment configured to enable safety personnel to monitor conditions subject to constraints documented in safety plans and act in accordance to the requirements given in the plans.

c. FSS Verification, Validation, Certification:

(1) For an FTS or AFTS, successful completion of component acceptance tests, bench tests, installation, and system-level tests in accordance with the requirements of GSFC-STD-8009 and program/project

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specific requirements (e.g., tailored RCC 319). The assigned WFF Safety Office FTS Engineer is responsible for tracking all related activities and generating an FTS/AFTS report that documents the system's readiness/certification.

- (2) In addition for an AFTS, successful development and testing of the mission data load and other unique aspects per 803-PG-8715.1.16.
 - (3) For other range or range-user provided safety-critical systems (e.g., CMS, tracking, surveillance systems, safety displays, etc.), WFF Safety Office participation and concurrence in the verification/certification efforts for the system in general and for each range operation as applicable.
- d. Failure Modes Training – Personnel performing safety roles during mission execution shall successfully complete mission-specific training as part of their certification that includes simulated failure mode scenarios as appropriate in order to practice the implementation of mission rules and contingency plans.
- e. Pre-Mission Briefings and Reviews – The WFF Safety Office personnel shall participate in range readiness reviews, flight readiness reviews, and pre-mission briefs as appropriate.
- f. Range Entry Safety Briefings – Safety personnel shall give range entry briefs to range users and visiting personnel to acquaint them with site hazards and response procedures.
- g. Special Safety Briefings – The WFF Safety Office shall give special briefings to project personnel as needed to address peculiar hazards to an operation.

1.3.8 Safety Process During Range Operations

- a. The MRSO leads all safety activities during a range operation. Personnel serving in safety roles shall perform in accordance with the applicable procedures, work instructions, operations directives, safety plans, operations plans, and associated checklists.
- b. The operational safety personnel shall participate in day-of-launch verification of the FSS. The FSS approval and certification processes discussed in Section 1.3.6 and 1.3.7 of this PG include the identification of verification activities/steps for each element of the FSS.
- c. The MRSO shall exercise safety authority over the operation in accordance with Section 1.2.2.3 including providing a GO/NO-GO for launch, calling HOLD/ABORT if required and participating in the on-console waiver process defined in Section 3.5 if needed.

1.3.9 Post-Operation Safety Process

The MRSO and other mission safety personnel conducts or participates in post-operation activities to ensure that safety related lessons-learned during an operation are captured, acted upon, and relayed to personnel supporting future operations.

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Note: Generally, the program/project conducts post-operation reviews and documentation of lessons-learned with participation by safety personnel. In the event of a mishap or close call, NPR 8621.1, NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping, and related GSFC policy and requirements in GPR 8621.4, GSFC Mishap Preparedness and Contingency Plan, will apply.

- a. Operation safety personnel shall record unplanned hazards, anomalies, and safety variances that occur during each operation.
- b. Operation safety personnel shall participate in post-mission briefs and other post-mission meetings held by the program/project and participate in discussions on non-conformances, unplanned hazards, anomalies, and any procedures that need improvement.
- c. Safety personnel responsible for analysis and planning shall review post-operation ground and flight data as needed to determine the effectiveness of pre-mission analysis and mission rules.
- d. The MRSO shall coordinate with operation safety personnel, other mission personnel, and program/project managers to:
 - (1) Identify and document conditions leading to any unplanned hazards, anomalies, variances, and/or procedural concerns.
 - (2) Document lessons-learned and establish corrective actions.

Chapter 2.0 RANGE SAFETY RISK ASSESSMENT CODE (RAC) MATRIX AND GUIDELINES

2.1 Introduction

The Range Safety RAC matrix and associated guidelines for its proper use provide a unified basis for the conduct of qualitative and quantitative safety risk assessments for missions and projects conducted under the authority of the WFF.

2.2 Risk Assessment Process

2.2.1 Range Safety RAC Matrix

The Range Safety RAC Matrix is in Table A. The Matrix categorizes risk as a function of both probability and severity of mishap.

Note: The RAC Matrix provided in Table A and the associated guidelines in Table B apply specifically to the assessment and management of range safety risk and have distinct differences when compared to other RAC matrixes used by NASA. Tables A and B apply specifically with regard to range safety requirements and criteria and provide for risk management decision-

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making that is consistent with the overall goals of the range safety process defined by this PG. The WFF Range Safety RAC matrix is consistent with the RAC matrix used by other members of the national range community responsible for managing range safety risk.

2.2.2 Range Safety RAC Guidelines

Table B provides the guidelines for use of the RAC matrix in Table A. The guidelines provide qualitative and quantitative interpretations of probability and severity intervals.

NOTE: These guidelines do not give quantitative credence to a qualitative analysis. When conducting a qualitative risk assessment, use the numerical guidelines to aid in combinatorial and sensitivity analysis, but always convert the results back to a qualitative form.

Table A: WFF RAC Matrix

| Severity Category | Probability of Mishap | | | | |
|-------------------|-----------------------|------------------|---------------------|----------------------|--|
| | A High .3 | B Fair .03 | C Slight .003 | D Remote .0003 | E Extremely Improbable .00003 |
| I Catastrophic | 1 | 1 | 1 | 2 | 3 |
| II Critical | 1 | 1 | 2 | 3 | 3 |
| III Marginal | 2 | 2 | 3 | 3 | 3 |
| IV Negligible | 2 | 3 | 3 | 3 | 3 |

Key to Table A

- 1 Operation prohibited. Requires risk mitigation.
- 2 Waiver required for operation
- 3 Operation permissible

Table B: Guidelines for Use of the WFF Range Safety RAC Matrix

| Adjective | Descriptions of Probability | | |
|----------------------|--|------------------------------------|-----------------------|
| High | Should be used when the analyst is confident that the event is almost certain to occur at least once in 100 trials or that the average number of trials per occurrence is between 1 and 30. | | |
| Fair | Should be used when the analyst is confident that the event is almost certain to occur at least once in 3000 trials or that the average number of trials per occurrence is between 30 and 1000. | | |
| Slight | Should be used when the analyst is confident that the event is almost certain to occur at least once in 100,000 trials or that the average number of trials per occurrence is between 1000 and 30,000. | | |
| Remote | Should be used when the analyst is confident that the event is almost certain to occur at least once in 3,000,000 trials or that the average number of trials per occurrence is between 30,000 and 10 ⁶ . | | |
| Extremely Improbable | Should be used when the analyst is confident that the event will not occur for at least 50,000 trials or that the average number of trials per occurrence is greater than 10 ⁶ . | | |
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| Adjective | Descriptions of Severity | | |
| | Personal Injury | Third Party Property Damage | Equipment Loss |
| Catastrophic | May cause death or permanent injury | > \$500K | > \$1M |
| Critical | May cause severe injury or occupational illness | \$25K - \$500K | \$250K - \$1M |
| Marginal | May cause minor injury or occupational illness | \$1K - \$25K | \$10K - \$250K |
| Negligible | Will not result in injury or occupational illness | < \$1K | < \$10K |

Chapter 3.0 RELIEF FROM RANGE SAFETY REQUIREMENTS

3.1 Introduction

A range user may obtain relief from range safety requirements through the tailoring process defined in GSFC-STD-8009 or by obtaining an ELS determination or range safety waiver as described in this chapter. The requirements relief processes defined in the GSFC-STD-8009 and this chapter defines the WFF implementation of associated NASA agency requirements in NPR 8715.5 and NPR 8715.3. The range user or vehicle program is strongly encouraged to take advantage of the range safety tailoring process to avoid last minute requests for relief that have the potential to impact cost and schedule.

3.2 Range/Launch Safety Requirements Relief Request Format

The WFF Safety Office maintains a Range/Launch Safety Requirements Relief Request format and associated instructions and provides the electronic version to range users. This format applies to ELS and waivers. The WFF Safety Office developed this format in coordination with NASA HQ Office of Safety and Mission Assurance, the Federal Aviation Administration (FAA) Office of Commercial Space Transportation, and Air Force Range Safety representatives. The intent is to help streamline relief request documentation by using this format when programs/projects fall under the safety authority of one or more federal agencies in addition to the WFF. The WFF will participate with other cognizant safety authorities in a cooperative effort to disposition relief requests. (See Section 3.5 for on-console waiver requests during a range operation.)

Note: The WFF Range/Launch Safety Requirements Relief format and instructions are available on the WFF Safety Office Web Site (<http://sites.wff.nasa.gov/code803/>) and upon request.

3.3 Relief Request Development Process

3.3.1 The range user shall first consult with the cognizant WFF program office's PM (or equivalent) regarding the feasibility of obtaining relief from a safety requirement.

Note: For most missions that fly at the WFF range, the cognizant WFF program office is the Range and Mission Management Office (RMMO). The RMMO assigns the responsible PM. The Sounding Rocket and Balloon Programs assign PMs (or equivalent) for campaign missions flown at other locations.

3.3.2 The PM shall coordinate with the cognizant WFF program office's management and the WFF Safety Office to determine the potential for developing a successful relief request.

3.3.3 The range user shall draft each relief request using the format discussed in Section 3.2, Range/Launch Safety Requirements Relief Request Format, or equivalent.

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3.3.4 The range user shall coordinate with the cognizant WFF program office and WFF Safety Office together with any other cognizant safety authority (e.g., the FAA for a public safety related request for a licensed commercial launch) in developing each relief request and the associated rationale.

3.3.5 The range user shall allow sufficient time for the safety authorities to review and comment on preliminary drafts.

3.4 Relief Request Approval Process

3.4.1 The range user shall submit the final draft relief request to the PM and any other cognizant safety authority outside the WFF (e.g., FAA).

3.4.2 The PM shall:

- a. Coordinate with the cognizant WFF program/project office management and ensure that the relief request addresses any range and/or mission management concerns,
- b. Coordinate with the WFF approval/concurrence authorities,
- c. Obtain the final WFF disposition,
- d. Provide a copy to the range user,
- e. Maintain a copy of all approved relief request as part of the program/project records.

3.4.3 An ELS requires approval by the WFF Safety Office Chief and concurrence by the WFF Range Safety Technical Authority and the WFF Project Manager. A range safety waiver requires approval by the WFF Director and concurrence by the WFF Safety Office Chief, the WFF Range Safety Technical Authority, and the WFF Project Manager.

Note: The WFF Director delegates WFF Range Safety Technical Authority to the RSCE.

3.4.4 Final disposition of a range safety waiver typically takes place during a meeting with the WFF Director and the other WFF signatories. The PM shall schedule this meeting and may request range user participation depending on the complexity of the associated issues and other specific circumstances dictating the need for direct range user participation.

3.4.5 Approval by other safety authorities (e.g., the FAA) is per their applicable policies. The range user shall obtain the final disposition of any other cognizant safety authority directly from that authority. The range users shall communicate such approvals and any related constraints to the WFF Safety Office as needed to ensure/coordinate implementation.

3.5 On-Console Range Safety Waiver Approval Process

In some operational situations, the need for range safety requirements relief may arise during an operational countdown. In these instances, the range user or the PM may request an on-console waiver of a known range safety requirement. The on-console discussion of range safety requirements relief shall follow a similar process to that defined above for a pre-mission range safety waiver.

Note: All on-console requests for relief from range safety requirements are range safety waivers and as such represent some associated increase in safety risk. In general, there is insufficient time available on-console to assess an equivalent level of safety.

3.5.1 The range shall establish a “Waiver Net” channel on the WFF Mission Operations Voice Enhancement (MOVE) system that assures controlled communication and recording of any discussion on the relief of a safety requirement that may or may not result in formal approval of a range safety waiver by the WFF Director on console.

- a. The MOVE channel access shall be restricted to the console positions of the TD, WFF Management, PM, and WFF Safety Office representatives.
- b. The participants tied in at these console stations shall include those required by the PM, WFF Safety Office, and WFF Director to:
 - 1) Communicate the relief request effectively.
 - 2) Ensure risk assessment, mitigation, and safety approval are effectively communicated
 - 3) Ensure authoritative comment and disposition are comprehensive based on the nature of the relief request.

3.5.2 The topics communicated during an on-console safety waiver discussion shall include:

- a. Program name and associated range user by the PM
- b. Subject of the safety requirement relief request by the PM
- c. Formal source of the safety requirement under discussion by the PM or the WFF Safety Office
- d. Need and rationale for the relief request by the PM or the WFF Safety Office
- e. Any known alternative approaches
- f. Any hazard or risk mitigations
- g. Risk assessment information brought forth by the PM on behalf of the Range user

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- h. WFF Safety Office comments and disposition
- i. Other comments from individuals on the “Waiver Net”

3.5.3 At the conclusion of the discussion, concurrences from the PM and the Range Safety Technical Authority, approval/concurrence from the WFF Safety Office Chief, and approval from the WFF Director are required.

Note: The RSCE is the WFF Range Safety Technical Authority. The WFF Safety Office Chief may fill this role for the on-console process if the RSCE is unavailable.

3.5.4 The PM will convey the results of the safety waiver discussion to the range user using the normal communications channel between the PM and the range user.

3.5.5 The PM shall generate a record of each on-console safety waiver request, rationale, and approval and maintain it as part of the official mission operations records.

Appendix A – Definitions

- A.1 Autonomous Flight Termination System (AFTS):** An onboard system that includes all hardware and software needed to make a flight termination decision and initiate actions that end a vehicle flight to ensure public safety without ground-based intervention.
- A.2 Equivalent Level of Safety (ELS) (determination):** The approval of an alternative approach to satisfying a range safety requirement where the alternative provides an approximately equal level of safety as determined by qualitative or quantitative means.
- A.3 Flight Safety Data Package (FSDP):** Flight Safety documentation that establishes the minimum NASA flight safety mission requirements and criteria necessary to uphold GSFC-STD-8009. WFF creates an FSDP when WFF does not have local range safety authority for the operation; however, NASA Range Safety requirements still apply.
- A.4 Flight Safety Plan (FSP):** Flight Safety documentation that establishes the flight safety mission requirements and criteria necessary to ensure flight related hazards are mitigated to acceptable levels per GSFC-STD-8009. WFF generates an FSP when WFF holds local range safety authority for the operation.
- A.5 Flight Safety System:** All vehicle and range elements used to mitigate risk to the public, workforce, and property during a range flight operation. This includes the ground-based instrumentation required to track, calculate/display safety critical data parameters, and initiate the proper command signals as well as the vehicle's FTS.
- A.7 Ground Safety Data Package (GSDP):** Ground Safety documentation that establishes the minimum NASA ground safety mission requirements and criteria necessary to uphold GSFC-STD-8009. WFF generates a GSDP when WFF does not hold local range safety authority for the operation; however, NASA Range Safety requirements still apply and are applicable to NASA personnel and contractors.
- A.8 Ground Safety Plan (GSP):** Ground Safety documentation that establishes the ground safety mission requirements and criteria necessary to ensure ground related hazards are mitigated to acceptable levels. WFF generates a GSP when WFF holds local range safety authority for the operation.
- A.9 Risk Analysis Report (RAR):** Documentation that provides the results of safety analysis for a range operation. This includes engineering calculations for respective hazard areas and other mission safety rules and demonstration of how safety risk criteria are satisfied for the operation. Most range operations involve the development of a Ground Safety RAR and a Flight Safety RAR.
- A.10 Risk Assessment Code (RAC):** Identifies the position on a RAC matrix used to characterize safety risk as a function of both probability and severity of mishap.

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A.11 Range Safety Operations Plan (RSOP): Operational range safety documentation identifies the necessary steps to ensure an operation meets all requirements established in the FSP, GSP, and/or RSP. An RSOP is a document that is internal to the WFF Safety Office and is generated by the MRSO when WFF holds range safety operational authority for the operation.

A.12 Range Safety Plan (RSP): Range Safety documentation that establishes both ground and flight safety mission requirements and criteria necessary to ensure all related hazards are mitigated to acceptable levels. WFF creates an RSP when WFF holds local range safety authority for the operation and the WFF Safety Office has determined the complexity of the mission does not require separate plans for ground and flight.

A.13 Range Safety Waiver: A written authorization allowing a range operation to continue even though a specific range safety requirement is not satisfied and the program/project is not able to demonstrate an equivalent level of safety. A Range Safety Waiver involves the formal acceptance of increased safety risk by appropriate authorities.

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Appendix B – Acronyms

| | |
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| AFTS | Autonomous Flight Termination System |
| ALTREV | Altitude Reservation |
| CM | Campaign Manager |
| CMS | Contingency Management System |
| COLA | Collision Avoidance |
| DFO | Distant Focusing Overpressure |
| ELS | Equivalent Level of Safety |
| ELV | Expendable Launch Vehicles |
| FAA | Federal Aviation Administration |
| FS | Flight Safety |
| FSDP | Flight Safety Data Package |
| FSO | Flight Safety Officer |
| FSP | Flight Safety Plan |
| FSS | Flight Safety System |
| FTS | Flight Termination System |
| GS | Ground Safety |
| GSFC | Goddard Space Flight Center |
| GSO | Ground Safety Officer |
| GSDP | Ground Safety Data Package |
| GSP | Ground Safety Plan |
| HAR | Hazard Analysis Reports |
| HERF | Hazards of Electromagnetic Radiation to Fuel |
| HERO | Hazards of Electromagnetic Radiation to Ordnance |
| HERP | Hazards of Electromagnetic Radiation to Personnel |
| LDA | Launch Danger Area |
| LHA | Launch Hazard Area |
| LPM | Launch Pad Manager |
| MIC | Mission Initiation Conference |
| MM | Mission Manager |
| MOVE | Mission Operations Voice Enhancement |
| MRSO | Mission Range Safety Officer |
| NASA | National Aeronautics and Space Administration |
| NOTAM | Notice to Airmen |
| NOTMAR | Notice to Mariners |
| ORR | Operational Readiness Review |
| OSHA | Occupational Safety and Health Administration |
| OSS | Operations Safety Specialist |
| PG | Procedures and Guidelines |
| PIC | Project Initiation Conference |
| PLDA | Pre-Launch Danger Area |
| PM | Program Manager |
| POC | Point of Contact |

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RAC Risk Assessment Code
RAR Risk Analysis Report
RCC Range Control Center
RF Radio Frequency
RMMO Range and Mission Management Office
ROA Range Operations Assistant
RSCE Range Safety Chief Engineer
RSO Range Safety Officer
RSOP Range Safety Operational Plan
SAR Safety Analysis Report
SO Surveillance Officer
SS Sky Screen
SSO System Safety Officer
TD Test Director
TO Telemetry Officer
UAS Unmanned Aircraft Systems
UHF Ultra High Frequency
WBS Work Breakdown Schedule
WE Work Year Equivalent
WFF Wallops Flight Facility

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Appendix C – WFF Safety Office Document Signature Process

| Document | 803 Initiator (GS or FS Analyst, Engineer, MRSO) | Peer Reviewer | Deputy for Flight Safety or Ground Safety | Lead RSO or Designated MRSO or Project POC | WFF Safety Chief | Test Director Office | 840 PM (WFF Range Missions Only) | NASA Program Office (SRPO, BPO) | Aviation Safety Officer | Facility Director | Commercial/FAA | Commercial/MID | External Program/Project | External Range RSO/POC (Andoya, WSMR, PFRR) | External Federal Agency | Range Safety Chief Engineer | SME (Laser, Pressure, FTS, Explosives, Software, other) |
|---|--|---------------|---|--|------------------|----------------------|----------------------------------|---------------------------------|-------------------------|-------------------|----------------|----------------|--------------------------|---|-------------------------|-----------------------------|---|
| Ground Safety Risk Analysis Report | GSA | TR | PC AA | OE | | | | | | | | | | | | | TR |
| Ground Safety Plan (GSP) | GSA | TR | PC AA | OE | | OE | PA | PA | | | PA | PA | | | PA | | TR |
| Ground Safety Data Package (GSDP) - WSMR | GSA | TR | PC AA | | | | | PA | | | | | | OE | | | TR |
| Ground Safety Data Package (GSDP) – NOR, KWAJ, PMRF | GSA | TR | PC AA | | | | | | | | | | | | | | TR |
| Flight Safety Risk Analysis Report | FSA | TR | PC AA | OE | | | | | | | | | | | | | |
| Flight Safety Plan (FSP) | FSA | TR | PC AA | OE | | OE | PA | PA | | | PA | PA | | | PA | | |
| Flight Safety Data Package (FSDP) | FSA | TR | PC AA | | | | | PA | | | | | | OE | | | |
| Range Safety Plan (RSP) | FSA GSA MRSO | TR | PC | OE | | OE | PA | | OE | | PA | | | | | AA | |
| Aircraft Instrument Safety Plan (Appendix to A/C Test Plan) | GSA | TR | AA PC | | | | | | | | | | | | | | TR |
| Requirements Tailoring | | | | | | | | I | | | | | I | | | AA | TR |

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|--|---------------------|--|----|----------|----------|--|----|--|----|--|--|--|---|--|--|----------|----|
| Flight Termination System/Autonomous FTS Report (FTSR/AFTSR) | FTSE FSA MRSO | | PC | AA TR | | | | | | | | | | | | TR | |
| Equivalent Level of Safety (ELS) | | | | | AA | | I | | | | | | I | | | TR PC | TR |
| Range Safety Waiver | | | | | TR PC | | I | | AA | | | | I | | | TR PC | TR |
| Range Safety Operations Plan (RSOP) | MRSO | | | TR AA | | | | | | | | | | | | | |
| Classification of a safety-critical software system | | | | TR | | | I | | | | | | | | | AA | TR |
| Change request or problem disposition for an operational safety-critical software system | | | | TR | | | I | | | | | | | | | AA | TR |
| Products delivered by a safety-critical software system project for a milestone review (requirements, test plan, test summary report, retirement/replacement plan) | | | | TR | | | I | | | | | | | | | AA | TR |
| Safety plan for a safety-critical software project external to WFF (acquisition) | | | | TR | | | | | | | | | I | | | AA | TR |
| Test procedure or test report referenced by a test plan or test summary report for a safety-critical software system | | | | AA | | | I | | | | | | | | | | TR |
| Software system hazard analysis (including trace to safety-critical requirements and test procedures) | | | | TR | | | TR | | | | | | | | | AA | I |
| Certification memorandum for safety-critical systems | | | | TR | | | I | | | | | | | | | AA | TR |

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Document Signature Approval Process - Acronyms

| | | |
|------|------------------------------------|--|
| AA | Approval Authority | Responsible for ensuring a technical and administrative review process |
| FSA | Flight Safety Analyst | Responsible for developing or contributing to FS documents as assigned |
| FTSE | Flight Termination System Engineer | Responsible for developing flight termination system related documents as assigned |
| GSA | Ground Safety Analyst | Responsible for developing or contributing to GS documents as assigned |
| I | Initiator | Primary responsibility for generating a safety related document |
| MRSO | Mission Range Safety Officer | Responsible for developing or approving mission safety documents as assigned |
| OE | Operational Execution | Responsible for ensuring the document and mission can be operationally executed per safety requirements |
| PA | Program Assessment | Responsible for ensuring the program assets are available to perform the operation |
| PC | Process Control | Responsible for ensuring the process properly followed and staffed with the correct technical representatives |
| POC | Point of Contact | Responsible for communication between Code 803 and project, providing input to and in some cases providing safety approval of project documentation (e.g., software system and/or flight safety system projects) |
| SME | Subject Matter Expert | Person recognized by Code 803 as having the expertise to technically review or, in some cases initiate/generate safety documents |
| TR | Technical Review | Responsible for performing and verifying the document is technically correct |
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CHANGE HISTORY LOG

| Revision | Effective Date | Description of Changes |
|----------|----------------|---|
| Baseline | 9/12/2014 | Initial Release |
| A | 4/24/2019 | Incorporates updated roles and responsibilities and other material that was originally contained in the WFF Range Safety Manual, RSM 2002C. This revised PG was developed in concert with a complete revision and update of the RSM, now GSFC-STD-8009. |
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