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Standard for Meeting NASA Nuclear Flight Safety Requirements

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FOREWORD

This standard establishes a means by which NASA programs and projects can meet requirements and leverage codified best practices associated with NASA's nuclear flight safety activities falling within NASA's domain (as opposed to that of other Federal authorities). The scope of this standard is identical to that of NPR 8715.26 and is intended to be a companion document for implementation of the NPR's requirements. It specifically does not cover routine ground processing activities that NASA personnel perform under the auspices of the Office of the Chief Health and Medical Officer's (OCHMO's) Ionizing Radiation Protection Program.

This standard was developed by the NASA Office of Safety and Mission Assurance (OSMA). Requests for information, corrections, or additions to this standard should be submitted to OSMA by email to Agency-SMA-Policy-Feedback@mail.nasa.gov or via the "Email Feedback" link at https://standards.nasa.gov.

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STANDARD FOR MEETING NASA NUCLEAR FLIGHT SAFETY REQUIREMENTS

1. SCOPE

1.1 Purpose

The purpose of this standard is to create a means of complying with requirements in NPR 8715.26, Nuclear Flight Safety, in the interest of promoting repeatable and robust processes that benefit from accrued knowledge through experience and lessons learned. It also promotes clear and effective interfaces between activities and stakeholders focused on meeting nuclear flight safety requirements under OSMA's Technical Authority for missions utilizing radioactive material, within the context of NASA's broader nuclear-related activities and interfaces.

1.2 Applicability

1.2.1 This standard is applicable to NASA programs and projects subject to NPR 8715.26.

1.2.2 This standard is approved for use by NASA Headquarters and NASA Centers, including Component Facilities and Technical and Service Support Centers, and may be cited in contract, program, and other Agency documents as a technical requirement. This standard applies to the Jet Propulsion Laboratory, a Federally Funded Research and Development Center, or to other contractors, grant recipients, or parties to agreements to the extent specified or referenced in their contracts, grants, or agreements.

1.2.3 This standard is applicable to Mission Directorates, in consultation with OSMA, to coordinate tailoring considerations for the Nuclear Launch Authorization Plan (NLAP) based on new knowledge or unique mission configuration (see NPR 8715.26).

1.2.4 Based on the system-specific and mission-specific documentation, other means of compliance with NPR 8715.26 may be considered by the responsible Mission Directorate and OSMA.

1.2.5 Alternate or novel methods and approaches for nuclear flight safety implementation not included in this standard may be proposed recognizing the need for adequate resources and schedule for review. OSMA verifies the acceptability of all alternative methods prior to adoption by the project based on project-supplied data. Considering evolving technical consensus, project-supplied data is examined rigorously by relevant subject matter experts and evaluated for the effectiveness of the alternate method for the specific application under consideration.

1.2.6 In this standard, all mandatory actions (i.e., requirements) are denoted by statements containing the term "shall." The term "may" denotes a discretionary privilege or permission, "can" denotes statements of possibility or capability, "should" denotes a good practice and is recommended, but not required, "will" denotes expected outcome, and "are/is" denotes descriptive material.

1.2.7 In this standard, all document citations are assumed to be the latest version unless otherwise noted.

2. APPLICABLE AND REFERENCE DOCUMENTS

NSPM-20	National Security Presidential Memorandum-20 of August 20, 2019 (Launch of Spacecraft Containing Space Nuclear Systems)
NPD 8700.1	NASA Policy for Safety and Mission Success
NPR 1800.1	NASA Occupational Health Program Procedures
NPR 7120.5	NASA Space Flight Program and Project Management Requirements
NPR 7120.8	NASA Research and Technology Program and Project Management Requirements
NPR 8580.1	Implementing the National Environmental Policy Act and Executive Order 12114
NPR 8621.1	NASA Procedural Requirements for Mishap and Close Call Reporting, Investigating, and Recordkeeping.
NPR 8705.2	Human-Rating Requirements for Space Systems
NPR 8705.4	Risk Classification for NASA Payloads
NPR 8705.6	Safety and Mission Assurance (SMA) Audits, Reviews, and Assessments
NPR 8715.6	Orbital Debris Mitigation
NPR 8715.7	NASA Payload Safety Program
NPR 8715.24	Planetary Protection Provisions for Robotic Extraterrestrial Missions
NPR 8715.26	Nuclear Flight Safety
NASA-STD-3001	NASA Spaceflight Human-System Standard.
NASA-HDBK-8715.26	Information and Best Practices Related to NASA Nuclear Flight Safety for Space Flights Involving Space Nuclear Systems
DAFMAN 91-110	Nuclear Safety Review and Launch Approval for Space or Missile Use of Radioactive Material
IAEA SSR-6	Specific Safety Requirements No. 6 (SSR-6), Regulations for the Safe Transport of Radioactive Material

3. ACRONYMS AND DEFINITIONS

3.1 Acronyms and Abbreviations

CFR	Code of Federal Regulations
DAFMAN	Department of the Air Force Manual
DOE	Department of Energy (used in Figure 4-1)
DOT	Department of Transportation (used in Figure 4-1)
DoW	Department of War (used in Figure 4-1)
FEMA	Federal Emergency Management Agency
FMECA	Failure Modes, Effects, and Criticality Analysis
FTD	Final Tier Determination
HQ	Headquarters
IAEA	International Atomic Energy Agency
INSRB	Interagency Nuclear Safety Review Board
KDP	Key Decision Point
MDAA	Mission Directorate Associate Administrator
MPCP	Mishap Preparedness and Contingency Planning
NFSO	Nuclear Flight Safety Officer
NLAM	Nuclear Launch Authorization Manager
NLAP	Nuclear Launch Authorization Plan
NRC	Nuclear Regulatory Commission (used in Figure 4-1)
NSPM-20	National Security Presidential Memorandum No. 20
OCHMO	Office of the Chief Health and Medical Officer
OGC	Office of General Counsel
ORSAs	Organizational Risk Safety Assessments
OSMA	Office of Safety and Mission Assurance

PDR	Preliminary Design Review
PFTD	Provisional Final Tier Determination
PTD	Preliminary Tier Determination
SAR	Safety Analysis Report
SBIR	Small Business Innovation Research
SMA	Safety and Mission Assurance
SPD	Space Policy Directive (used in Figure 4-1)
SSR	Specific Safety Requirements

3.2 Definitions

Note: The terms used in this document are consistent with the terms defined in NPR 8715.26. Additional terms are defined below.

Launch activities. The launch phase generally begins when the spacecraft transfers to internal power and generally ends when the spacecraft achieves an operational configuration after separation from the launch vehicle.

Member of the public. This term is defined on an analysis-specific basis by starting with the definition of "public" in 14 *Code of Federal Regulations* CFR 401.7 and addressing any additional considerations relative to the codified policies of the applicable range authority and any applicable terrestrial nuclear safety authority.

Pre-launch activities. Defined to start at the earliest stage of launch vehicle integration operations where a hazard (e.g., crane failure, fire) will exist for credible accidents to cause the uncontrolled release of radioactivity.

4. TECHNICAL REQUIREMENTS OR GUIDANCE

4.1 Clarify Authorization Pathways

4.1.1 The Mission Directorate Associate Administrator's (MDAA) designee can use the template shown in Figure 4-1 as a starting point for determining which segments of the system and mission life cycle may benefit from clarification, who the potential authorities may be, and what nuclear-specific regulations may be relevant. For a given mission, each sub-phase in Figure 4-1 will have one or more associated authorities (i.e., the entities in the "Auspice" row).

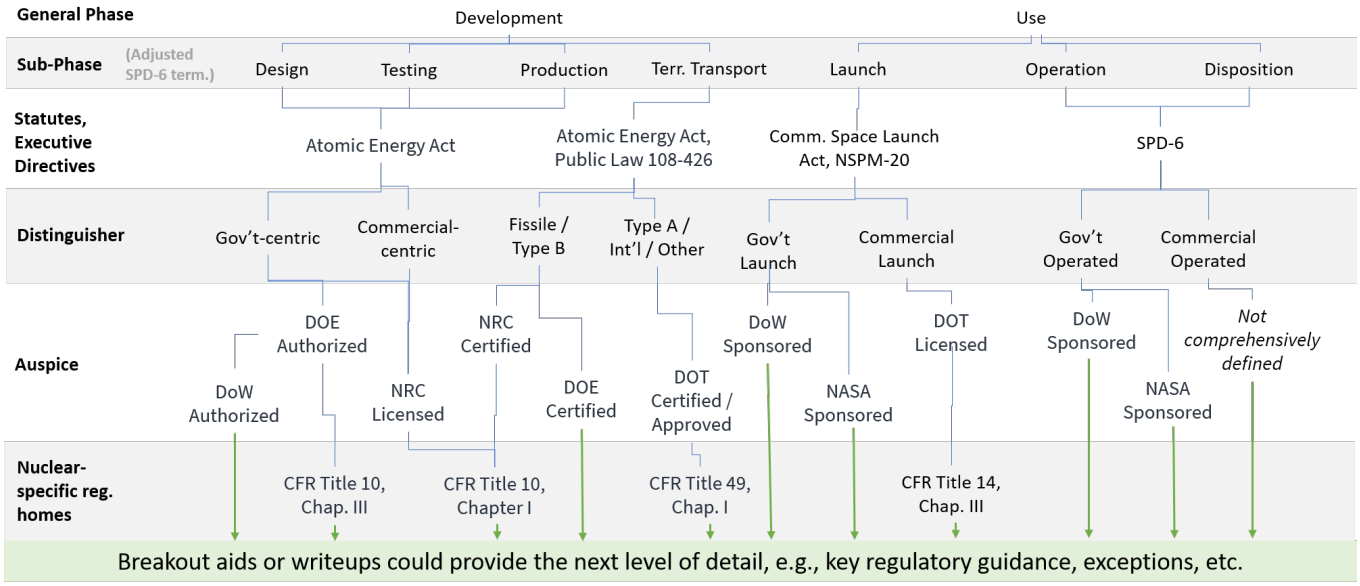

Figure 4-1. Initial Identification of Authorization Pathway Options

4.2 Determine NPR Applicability

4.2.1 In documenting the framework in which nuclear flight safety versus nuclear flight safety-adjacent activities will be managed, the MDAA's designee can use the template in Table 4-1 as a starting point.

Table 4-1. Template for Clarifying Nuclear Flight Safety-Adjacent Activities

<table>
<tr><th colspan="2"></th><th>Prior to pre-launch activities</th><th>Pre-launch activities (e.g. range ground safety)</th><th>Launch and ascent</th><th>Earth-orbiting flight (incl. Earth return)</th><th>Flight outside of Earth's gravity well</th><th>Other celestial bodies</th></tr>
<tr><td rowspan="10">Elements listed in NPD 8700.1F Section 1, here related only to Ionizing radiation</td><td>Spaceflight crew safety</td><td colspan="6">Addressed through the Human Rating Process (NPR 8705.2) and supporting standards (most notably the Permissible Exposure Levels in NASA-STD-3001, Vol. 1)</td></tr>
<tr><td>Mission success risk</td><td colspan="6">Addressed through other NASA health and medical, engineering, and SMA processes, driven by management of project categorization (NPR 7120.5, 7120.8) and payload risk classification (NPR 8705.4)</td></tr>
<tr><td rowspan="2">Public</td><td colspan="3">Addressed via NPR 8580.1</td><td rowspan="4" colspan="2">The focus of NPR 8715.26, with 3 broad stages (early life cycle, NLAP formulation and approval, NLAP implementation)</td><td></td></tr>
<tr><td rowspan="3">Addressed by NPR 1800.1 (which also addresses post-return activities when applicable)</td><td rowspan="3">In partnership with payload safety (NPR 8715.7) and the terrestrial nuclear authority</td><td rowspan="2" colspan="2">Through the human-rating process, where applicable</td></tr>
<tr><td>NASA workforce</td></tr>
<tr><td>High-value property</td><td>Through agency, interagency, and international coordination</td><td>In concert with NPR 8715.24 and Planetary Protection</td></tr>
<tr><td>Terrestrial environment</td><td colspan="3">Addressed via NPR 8580.1</td><td colspan="2"></td></tr>
<tr><td>Orbital environments</td><td>N/A</td><td>N/A</td><td colspan="3">In partnership with NPR 8715.6</td><td>N/A</td></tr>
<tr><td>Planetary environments</td><td rowspan="2">N/A</td><td colspan="4" rowspan="2"></td><td>In concert with NPR 8715.24 and Planetary Protection</td></tr>
<tr><td>Safety culture</td><td colspan="6">Via NPD 8700.1 and NPR 8705.6, and through any relevant OSMA-led Organizational Risk Safety Assessments (ORSAs)</td></tr>
</table>

4.3 Safety-in-Design

Note: Requirements in this area are not applicable to all programs and projects that will use radioactive material. See NPR 8715.26, Section 3.3 for specific applicability.

4.3.1 In addressing nuclear flight safety prior to approval of the NLAP, the NASA Program or Project Manager shall:

4.3.1.1 Identify issues that have been important in past development and deployment efforts. Relevant information is provided in NASA-HDBK-8715.26, Information and Best Practices Related to NASA Nuclear Flight Safety for Space Flights Involving Space Nuclear Systems.

4.3.1.2 For systems with heritage, assess the continued relevance of existing safety-in-design features and constraints of the system for the spaceflight(s) of interest.

4.3.1.3 Explicitly include nuclear flight safety in the reliability and maintainability studies, system safety, and risk management activities using standard tools (e.g., inclusion of all nuclear hardware within failure mode, effects, and criticality analyses (FMECAs), inclusion of all nuclear hardware in hazard analysis).

Table 4-2 provides an example of how these activities may fit into differing project types.

Table 4-2. Illustration of Nuclear Flight Safety Activities in the System/Mission Life Cycle

Technology Maturation	Technology Demonstration	System Development Project Pre-Formulation	System Development Project Formulation	Flight (Launching) Project Pre-Formulation	Flight (Launching) Project Formulation
E.g., SBIRs, etc.	E.g., NPR 7120.8 Projects	E.g., NPR 7120.5 pre-KDP-A	E.g., NPR 7120.5 pre-KDP-C	E.g., NPR 7120.5 pre-KDP-A	E.g., NPR 7120.5 pre-KDP-C
S1	S1, S2	S1, S2, S3		S2, S3	
O1, O4	O3, O4	O1, O3, O4	O3, O4	O2, O3, O4	O3, O4
	T1, T2		T1, T2, T3, T4		T4, T5, T6

Table legend:

Safety-in-design (i.e., managing hazards and risk via inherent features of a system's design or operation):

- S1: Document an expectation that personnel will use safety-in-design to design and develop the system, or consider it in acquisition of the system
- S2: Identify the functional areas in which safety-in-design is relevant to the system or mission
- S3: Identify measures (e.g., principal nuclear safety criteria) to be used to track safety-in-design

Other analysis activities:

- O1: Familiarization and nuclear design discussions for novel[1] systems
- O2: Familiarization and nuclear design discussions for novel[1] mission uses
- O3: Inclusion of nuclear in design trades
- O4: Inclusion of nuclear in system safety activities (e.g., FMECAs, hazard analysis)

Testing:

- T1: Overview of system testing plans
- T2: Nuclear system development testing
- T3: Nuclear system qualification testing
- T4: Nuclear system acceptance testing
- T5: Overview of mission testing plans
- T6: Flight vehicle testing relative to carrying a nuclear payload

[1] Here, novel refers to a situation where the system or mission in question has not been developed to the point of having system testing or flight history

4.3.1.4 Collect input from relevant NASA stakeholders (e.g., the Nuclear Flight Safety Officer (NFSO), the Radiation Safety Officer for affected NASA Centers, NASA projects that have flown similar systems), as well as other relevant stakeholders (e.g., other government agencies) to help ensure the system is designed to the appropriate standards.

4.3.1.5 Specify a set of principal safety objectives (i.e., nuclear principal safety criteria) that will be used during early development decision-making or already-developed system acquisition to inform decisions prior to a mature radiological risk assessment being available (e.g., the space nuclear reactor system will be designed to include two independent features to preclude criticality during the launch phase). NASA-HDBK-8715.26, Appendix E, provides some additional information.

4.3.2 The Nuclear Launch Authorization Manager (NLAM), a role established via implementation of NPR 8715.26, shall describe the activities related to nuclear safety-in-design for nuclear flight safety, as well as any safety features that will be controlled and monitored during the portions of mission implementation relevant to nuclear flight safety, in suitable program or project documentation (e.g., as an appendix to the NLAP).

4.4 Categorization and Nuclear Launch Authorization Planning

4.4.1 For tiered missions, the NLAM shall determine the NSPM-20 (National Security Presidential Memorandum on the Launch of Spacecraft Containing Space Nuclear Systems) tier (with an associated technical basis) and obtain Chief, SMA concurrence to inform the graded approach outlined in NPR 8715.26 and this Standard. NASA-HDBK-8715.26 Appendix H provides information on NSPM-20 tiers. The NFSO will evaluate each tier determination to inform the Chief, SMA's concurrence.

> *Note: NSPM-20 does not provide an A_2 mission multiple "floor" below which a mission will be precluded from consideration of NSPM-20. For the purposes of this STD, the NSPM-20 "floor" is assumed to be 1 (i.e., a mission with an A_2 mission multiple less than 1 is not subject to NSPM-20 for the purposes of this STD (unless it meets other tiering criteria)).*

4.4.2 For the aspects of mission tiering based on the quantity of material-at-risk, the NLAM (to be the individual that was delegated overall nuclear flight safety responsibilities if multiple projects are contributing radioactive material to the same flight) shall use the highest A_2 mission multiple based on the quantity of radioactive materials expected:

a. During pre-launch activities at the launch complex.

b. At launch.

c. Anytime the spacecraft will be in the Earth-Moon system with the potential for an inadvertent reentry.

d. During any planned return to the Earth-Moon system (including reentry or fly-by).

4.4.3 The NLAM shall make a tier determination at up to 3 stages, as follows (the reasoning for multiple tiering determinations is discussed in NASA-HDBK-8715.26 Appendix H):

a. Preliminary Tier Determination (PTD) – This determination is made at Preliminary Design Review (PDR) (or equivalent), as part of baselining the NLAP. This tiering determination will be made predominantly on the material-at-risk (A_2 mission multiple) and nuclear fuel-type provisions (for fission reactor systems). Information related to the potential radiation exposure levels and associated likelihoods from the safety analyses of relevant past missions will also be considered. This determination serves to provide initial alignment and clarity on whether a mission Safety Analysis Report (SAR) is required, whether the Interagency Nuclear Safety Review Board (INSRB) needs to be engaged, and who the likely authorizing official will be. The International Atomic Energy Agency (IAEA)-issued A_2 values used at the time of the PTD will remain valid for the Provisional Final Tier Determination (PFTD) and the Final Tier Determination (FTD), regardless of any updates to the IAEA A_2 values after the PTD is completed.

b. Provisional Final Tier Determination – This determination is made at the approximate mid-point between initial mission SAR release and final mission SAR delivery, using the postulated accident exposure levels and associated likelihoods available at that time. The PFTD serves to ensure earlier recognition of situations where the authorizing official may change with the final mission SAR (either a higher or lower level of authorization required), or where the degree of INSRB involvement (or lack thereof) requires adjustment (i.e., Tier I vs. Tier II).

c. Final Tier Determination – This determination is made upon issuance of the mission SAR (Tier I), or the Safety Evaluation Report (Tier II or III). The FTD will codify the level of authorization required for the mission and provide mission planners with the requirements that are necessary for seeking that authorization. The FTD also serves to establish a final and transparent basis for establishment of the authorizing official.

4.4.4 For all un-tiered missions, the NASA Program or Project Manager, in consultation with the cognizant Center Radiation Safety Officer(s), shall use total mission radioactive material inventory to calculate the A_2 mission multiple value per the instructions below.

Note: The instructions below relate to the use of IAEA guidance as it pertains to nuclear flight safety, consistent with the use of this same guidance in NSPM-20 and preceding Presidential direction. This guidance is used as a matter of convenience, understanding that the guidance was not developed specifically for use in launch or reentry. Its invocation here may differ from other NASA uses of this guidance, as they pertain to transportation of radioactive material by land, sea, or air under the authorization or licensing by other Federal agencies.

4.4.4.1 The latest available version of IAEA SSR-6 shall be used.

Note: IAEA SSR-6 provides values in terabecquerels (TBq), while NASA sources are often catalogued in curies (Ci), so care should be taken when calculating the mission multiple; one curie = $3.7x10^{10}$ disintegrations per second = $3.7x10^{10}$ becquerels [10 Code of Federal Regulations 20.1005].

4.4.4.2 While the Appendix provided in IAEA SSR-6 is typically sufficient for obtaining the necessary A_2 multiples, the user should be aware of the caveats and explanations that appear in Section IV of that document (e.g., Sections 402-407 in the case of the 2025 Update), which are applicable to special circumstances.

4.4.4.3 The A_2 mission multiple will be determined using the equation below, where *n* represents each radioisotope present on the launch vehicle and spacecraft. A simple example is provided in Table 4-3.

$$A_2\ Mission\ Multiple = \sum_n \frac{Radioisotope_n\ Activity}{Radioisotope_n\ Isotopic\ A2\ Value}$$

Table 4-3. Sample Multi-source A2 Mission Multiple Illustration

Radioisotope	Activity (Ci)	A_2 value[1] (Ci)	A_2 mission multiple
Ni-63	0.005	810	6.2×10^{-6}
Co-60	0.005	11	4.6×10^{-4}
Cm-244	0.0005	0.054	9.3×10^{-3}
		Total A_2 mission multiple =	9.8×10^{-3}

[1] From the appendix of IAEA SSR-6, Regulations for the Safe Transport of Radioactive Material 2025 Edition, converted to Curies

4.5 Nuclear Flight Safety Analysis

Note: Requirements in this area are not applicable to all programs and projects that will use radioactive material. See NPR 8715.26, Section 3.5 for specific applicability.

4.5.1 In documenting a clarification-of-roles matrix of the owner, contributors, reviewer, and approver roles (or equivalent) for all portions of the nuclear launch authorization safety process, the NLAM should include within that matrix the following attributes:

4.5.1.1 Phases of activity should start with the final activity performed completely under terrestrial nuclear authorities (typically being payload processing or transport of the radioactive material to the launch complex) and end with the last activity where the radioactive material has the potential to affect Earth's biosphere (i.e., the last chronological activity within the scope of activities described in Section 4.4.2);

4.5.1.2 The matrix should delineate any cases where one authority addresses the protection of some entities (e.g., NASA's responsibility under NSPM-20 for public dose for a NASA-sponsored launch) versus another authority addressing the protection of other entities during the same operation (e.g., assessment of risk for critical assets);

4.5.1.3 The matrix should specify which safety analysis product will contain the necessary information to fulfill relevant obligations (e.g., the mission safety analysis for INSRB review may contain the comparison to the NSPM-20 Safety Guidelines while a

submittal to the Space Launch Delta may contain the calculation of the $P_{CancerC}$ metric in DAFMAN-91-110).

4.5.2 In negotiating and implementing a process in which NASA acquires, develops, and supplies (as applicable) all relevant nuclear safety analysis data for the aspects under NASA's purview, the NLAM should address the following attributes:

4.5.2.1 The entity requesting authorization should provide the safety analysis and safety evaluation associated with terrestrial nuclear licensing, certification, or authorization for the radioactive material's terrestrial possession, use, and transport. (In the case of Federal Aviation Administration launch licensing, providing a description of the pre-flight ground operation approval(s) is compulsory, per 14 CFR 450.45(e)(6)(iii).)

4.5.2.2 The nuclear system development effort may be documented in a system-specific SAR (as that term is used in Section 5(b) of NSPM-20) to facilitate the phased review of the mission safety analysis.

4.5.2.3 When NASA is not the sponsoring agency for launch but is responsible for the payload development, NASA may need to provide a system-specific SAR and other inputs to the launch operator (i.e., to the entity that is directly interfacing with the launch authority).

4.5.2.4 When NASA is the sponsoring agency for launch but is not responsible for the payload development, NASA may need to acquire data related to the basis for safety (e.g., characterization of the material and its response during accident scenarios, radiological risks) of radioactive material from the payload operator.

4.5.2.5 In all cases in which a comparative analysis is being utilized (e.g., a system-specific SAR developed for a prior mission), NASA will need to:

4.5.2.5.1 Demonstrate that the mission is within the safety basis envelope established in the comparative analysis or include supplemental safety analysis for any deviations that are outside of the established safety basis envelope, and

4.5.2.5.2 Address any significant changes in nuclear safety state-of-knowledge practices between the prior and current missions.

4.5.2.6 The mission safety analysis will need to address:

4.5.2.6.1 The Safety Guidelines described in NSPM-20 Section 3,

4.5.2.6.2 The other measures described in NSPM-20 Section 5, including that the mission SAR incorporates technical peer review,

4.5.2.6.3 Whether the probability of exceeding 25 rem total effective dose (as that term is defined in section 835.2 of title 10, Code of Federal Regulations), or a differing surrogate for a prompt casualty risk with accompanying justification, is greater than or less than 1×10^{-6}, and an accompanying waiver (where applicable) to the range authority in the case that it exceeds this threshold, and

4.5.2.6.4 The calculation of the $P_{CancerC}$ (latent casualty) metric in DAFMAN 91-110 (or the provision of the information needed for the calculation to be performed by a third party) along with a justification in the case that it exceeds 1×10^{-6}.

4.5.2.7 The range may require data (e.g., the range contamination impact statement in DAFMAN 91-110) that is additional to what the NASA nuclear launch authorization process requires.

4.5.3 The NLAM should facilitate an annual assessment (e.g., a discussion with associated documentation) of the nuclear safety analysis team that focuses on how the team's integrated safety culture comprises the characteristics described in NPD 8700.1, Section 1.c.

4.6 Nuclear Flight Safety Review

4.6.1 The NFSO should seek out the safety evaluation associated with terrestrial nuclear licensing, certification, or authorization for the radioactive material's terrestrial possession, use, and transport, if not provided by the entity requesting launch authorization.

4.6.2 In the case of tiered missions, the NFSO should engage with other approval authorities through the INSRB, or through direct bilateral discussions, to leverage information that will make the review more effective.

4.6.3 In developing the Radiological Safety Review, where applicable, the NFSO should describe the specific isotopes, their form, and their quantity, describe the relevant mission profile, provide an analysis of the probabilities of launch and in-flight accidents which could result in the terrestrial release of radioactive materials (surface and air), provide a realistic and a pessimistically-biased estimate of the health and other effects due to a radioactive material release in the considered accident scenarios, and provide mission-specific information that will be relevant for contingency planning and material recovery.

4.6.4 The NASA INSRB Review Group Chair (NASA-sponsored Tier II and Tier III missions) or the NASA INSRB representative (other mission involving INSRB evaluation) should follow the non-binding INSRB guidance documents (e.g., the INSRB Playbook), tailored to the nature of the review.

Note: The NFSO can also consider the non-binding INSRB guidance documents in performing evaluation of Tier I missions in a scaled and tailored manner.

4.7 Launch and Reentry Authorization

(Reserved)

4.8 Radiological Contingency Planning

Note: NASA-HDBK-8715.26 Appendix M provides extensive information on past practices.

4.8.1 In developing the process to address safety in the event of a mishap that may result in the release of ionizing radiation, the MDAA's designee (typically the NLAM) and the Center Director's designee (typically referred to as the Center Radiological Contingency Planning Lead) shall address:

4.8.1.1 Definition of an appropriate radiological contingency planning risk posture, comparative or otherwise, to inform decisions regarding radiological safety.

4.8.1.2 Development, reporting, independent review, and acceptance by relevant authorities of an assurance case tailored to the defined radiological contingency planning risk posture substantiating sufficient radiological material control and mishap preparedness, including the information necessary to make informed and reliable decisions regarding:

4.8.1.2.1 Invoking contingency plans (with mission-specific plans being developed) to control where the radiological material will impact when vehicle or spacecraft control is possible.

4.8.1.2.2 Monitoring, assessment, analysis, and communication capabilities sufficient to determine whether a release of ionizing radiation has occurred, characterize the location and nature of the release, and develop protective action recommendations for the safety of personnel and the public.

4.8.1.2.3 Invoking material recovery plans (with mission-specific plans being developed).

4.8.1.2.4 Disseminating information about the mishap and any recommended protective actions at the local and State levels.

4.8.1.2.5 Coordinating with the Department of Homeland Security's Federal Emergency Management Agency (FEMA) to support Federal-level coordination, and meeting the expectations of the National Response Framework and the Nuclear/Radiological Incident Annex to the Response and Recovery Federal Interagency Operational Plans (including NASA's role as Primary Authority, when applicable).

4.8.1.2.6 Working in concert with nuclear and other flight safety authorities or licensing entities to ensure additional relevant requirements therein are being met.

4.8.1.2.7 Preparing, obtaining approval of, and issuing communications to the general public and to international partners, via the appropriate communications channels.

4.8.1.3 Implementation and exercising of the above process, plans, and capabilities, and integration of the above process within the mission-wide mishap preparedness and contingency planning (MPCP) process, which is developed in accordance with NPR 8621.1.

4.9 Nuclear Flight Safety in System and Mission Operations

(Reserved)

4.10 Nuclear Flight Safety in End-of-Mission Planning

(Reserved)

4.11 Internal and External Reporting

(Reserved)