

**BY ORDER OF THE
SECRETARY OF THE AIR FORCE**

AIR FORCE INSTRUCTION 91-110

13 JANUARY 2015



Safety

**NUCLEAR SAFETY REVIEW AND LAUNCH
APPROVAL FOR SPACE OR MISSILE USE
OF RADIOACTIVE MATERIAL AND
NUCLEAR SYSTEMS**

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This Air Force Instruction (AFI) implements Presidential Directive/National Security Council Memorandum-25, *Scientific or Technological Experiments with Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems into Space*, dated 14 December 1977 (as modified 8 May 1996), Department of Defense Directive (DoDD) 3100.10, *Space Policy*, 18 October 2012, DoDD 3200.11, *Major Range and Test Facility Base*, 27 December 2007, Department of Defense Instruction (DoDI) 3100.12, *Space Support*, September 14, 2000, AFRPD 91-1, *Nuclear Weapons and Systems Surety*, 13 December 2010 and establishes the nuclear safety review and launch approval procedures for radioactive materials intended for space or missiles use. This instruction applies to all Regular Air Force (RegAF), Air Force Reserve, and Air National Guard units that design, develop, modify, evaluate, test and/or operate existing and future Air Force space systems (operational, test, and experimental), AF space support systems, or use or operate AF launch facilities or ranges. The authorities to waive wing/unit level requirements in this publication are identified with a Tier (“T-0, T-1, T-2, T-3”) number following the compliance statement. See AFI 33-360, *Publications and Forms Management*, Table 1.1 for a description of the authorities associated with the Tier numbers. Submit requests for waivers through the chain of command to the appropriate Tier waiver approval authority, or alternately, to the Publication Office of Primary Responsibility (OPR) for non-tiered compliance items. Ensure all records created as a result of processes prescribed in this publication are maintained IAW Air Force Manual (AFMAN) 33-363, *Management of Records*, and disposed of IAW Air Force Records Information Management System (AFRIMS) Records Disposition Schedule (RDS). This publication may be supplemented at any level, but send any supplements

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SUMMARY OF CHANGES

This document has been substantially revised and must be completely reviewed. The threshold quantities for radioactive materials have been specified to meet higher guidance. Reference the *International Atomic Energy Agency Safety Standards, Regulations for the Safe Transport of Radioactive Material, Specific Safety Requirements No. SSR-6 (IAEA SSR-6) 2012 Edition*, for the threshold values used in determining launch approval and reporting levels.

Section A—General Information

1. Defining Scope and Requirements. This instruction defines the nuclear safety review and launch approval process for the use of radioactive materials aboard a space or missile system. These requirements complement AFI 40-201, *Managing Radioactive Materials in the US Air Force*, which allows Air Force installations to possess radioactive materials. This instruction implements Presidential Directive/National Security Council Memorandum-25, *Scientific or Technological Experiments with Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems into Space*, dated 14 December 1977 (as modified 8 May 1996), Department of Defense Directive (DoDD) 3100.10, *Space Policy*, 18 October 2012, DoDD 3200.11, *Major Range and Test Facility Base*, 27 December 2007, Department of Defense Instruction (DoDI) 3100.12, *Space Support*, September 14, 2000, and AFD 91-1, *Nuclear Weapons and Systems Surety*, 13 December 2010.

1.1. Nuclear safety review and launch approval procedures apply to:

1.1.1. Agencies that use any radioactive materials aboard a space or missile system (atmospheric, ballistic, orbital, or earth escape), including radioactive materials that the US Nuclear Regulatory Commission (NRC), Agreement States, or other Military Services exempt from licensing. (T-0)

1.1.2. Any materials held under Section 91b of the Atomic Energy Act of 1954, as amended (42 U.S.C. 2121). (T-0)

1.1.3. Air Force agencies that develop, test, or have operational responsibility for radioactive materials in space. (T-0)

1.1.4. Other agencies or organizations that plan to use an Air Force facility, range, or other physical asset to launch radioactive materials and have not completed a range-approved equivalent nuclear safety review. (T-0)

1.2. These procedures do not apply to radioactive materials in gravity weapons or manned aircraft where they are used as structural material, instruments, or ballast.

Section B—Roles and Responsibilities**2. Reporting Radiological Mishaps.**

2.1. Follow AFI 91-204, *Safety Investigations and Reports*, to report accidents involving radioactive material. If the radioactive material has a permit from the US Air Force Radioisotope Committee or an NRC license, also follow AFI 40-201 and Title 10, Code of Federal Regulations, *Department of Energy*. (T-0)

3. Obtaining Waivers.

3.1. The Air Force Chief of Safety (AF/SE) may approve MAJCOM/SE-requested waivers to this instruction. For special access programs, the Air Force Vice Chief of Staff or higher-level authority must grant waivers to this instruction in writing. (T-0)

4. HQ Air Force Safety Center. HQ AFSEC/SES will:

4.1. Perform Nuclear Safety Analysis and Review by:

4.1.1. Evaluate safety analysis reports. (T-0)

4.1.2. Provide the DoD coordinator for the Interagency Nuclear Safety Review Panel (INSRP). (T-0)

4.1.3. Assign members to the technical subpanels and/or working groups for INSRP as required. (T-1)

4.1.4. Provide technical assistance to organizations developing systems that incorporate significant amounts of radioactive material. (T-1)

4.2. Grant or obtain nuclear safety launch approval, based on Section IV “Activity Limits and Classifications” of the *IAEA SSR-6*. When the radioactive material exceeds the threshold quantity, HQ AFSEC/SES requests nuclear safety launch approval from the Assistant Secretary of Defense for Nuclear, Chemical and Biological Defense Programs (ASD (NCB)). (T-0)

4.3. Provide a quarterly forecast to the ASD (NCB) of projected Air Force space or missile launches using radioactive quantities greater than 0.1 percent of the A2 value listed in Section IV “Activity Limits and Classifications”, Table 2 “Basic Radionuclide Values” of the *IAEA SSR-6*. (T-0)

5. Major Commands (MAJCOMs) will:

5.1. Perform Range Nuclear Safety Inspections. (T-0) These inspections may be performed in conjunction with other MAJCOM inspections. These inspections must evaluate:

5.1.1. Safety procedures for launching radioactive material and contingency plans for responding to a radiological mishap. (T-0)

5.1.2. Safety measures to prevent radiological mishaps. (T-0)

5.2. Report the results of these inspections to HQ AFSEC/SES. (T-0)

6. Space Wing Commanders will:

6.1. Ensure all parties utilizing launch ranges comply with **Table 1**, Nuclear Safety Review, Approval, and Reporting Procedures. (T-1)

6.2. Develop and exercise radiological safety and contingency plans for launch-related radiological mishaps. (T-1)

6.3. Review radiological issues at launch readiness reviews for launches containing radioactive material which will include:

6.3.1. Types and quantities of radiological materials on board the missile or launch vehicle and payload. (T-1)

6.3.2. Review of radiological safety plans and procedures in place. (T-1)

6.3.3. Review of plans and operations in place, to include coordination with external agencies (Department of Energy, National Aeronautics and Space Administration (NASA), US Navy, etc.), regarding contingency, clean up, or recovery plans. (T-1)

7. Program Managers.

7.1. Program Managers that launch, develop, test, or operate any programs or systems that use radioactive material in space or missile systems will:

7.2. Comply with **Table 1**, Nuclear Safety Review, Approval, and Reporting Procedures. (T-1)

7.3. Notify HQ AFSEC/SES of the potential use of radioactive material as early as possible in the development or acquisition phase of the program. (T-1)

7.4. Prepare a Safety Analysis Summary (SAS) for any planned launch of radioactive material when the total quantity of radioactive material exceeds the A2 value listed in Section IV "Activity Limits and Classifications", Table 2 "Basic Radionuclide Values" of the *IAEA SSR-6* or as specified by HQ AFSEC/SES. Prepare the SAS according to Attachment 2 and send to HQ AFSEC/SES. (T-0)

7.4.1. For mixed isotopes, follow SAS requirement calculation in Attachment 2, para A2.5. (T-0)

7.4.2. For special form radioactive material as defined in *IAEA SSR-6* Para 415, utilize the A1 value listed in Section IV "Activity Limits and Classifications", Table 2 "Basic Radionuclide Values" of the *IAEA SSR-6*. (T-0)

7.4.3. If the INSRP creates a Safety Evaluation Report (SER), this report, along with the reference Final Safety Analysis Report (FSAR), will be sufficient to meet this requirement.

7.5. Forecast and report all launches using radioactive quantities greater than 0.1 percent of the A2 value listed in Section IV "Activity Limits and Classifications" of the *IAEA SSR-6* quarterly to HQ AFSEC/SES. (T-0) See Attachment 3 for a report format.

7.6. Ensure coordination with higher authorities, per DoDD 3200.11, *Major Range and Test Facility Base* and DoDI 3100.12, *Space Support*, is accomplished. (T-0)

7.7. Provide technical support to Air Force or INSRP reviews as required. (T-2)

Table 7.1. Nuclear Safety Review, Approval, and Reporting Procedures.

S T E P	A	B	C	D
	Who	What	To	When
1	Program Manager	Initially notifies (T-1)	HQ AFSEC/SES	As early as possible in the acquisition process.
2		Prepares and sends a safety analysis (if required) (T-0)		At least 180 calendar days before launch for HQ AFSEC/SES approval; as directed by HQ AFSEC/SES for higher approval.
3	HQ AFSEC/SES	Evaluates safety analysis. If program needs higher approval establishes Air Force safety position and sends nuclear safety launch approval request (T-1)	ASD (NCB)	At least 150 calendar days before launch
4	Space Wing commander	Ensures the launch of radioactive materials or nuclear systems has required approvals. Provides type and quantity of radioactive material in prelaunch message (T-1)	HQ AFSEC/SES	At least 5 calendar days before launch.
5		Notifies of successful launch (T-3)		Within 5 calendar days after launch.

KURT F. NEUBAUER
Maj Gen, USAF
Chief of Safety

Attachment 1

GLOSSARY OF REFERENCES AND SUPPORTING INFORMATION

References

Presidential Directive/National Security Council Memorandum-25, *Scientific or Technological Experiments with Possible Large-Scale Adverse Environmental Effects and Launch of Nuclear Systems into Space*, dated 14 December 1977 (as modified 8 May 1996)

DoDD 3100.10, *Space Policy*, 18 October 2012

DoDD 3200.11, *Major Range and Test Facility Base (MRTFB)*, 27 December 2007

DoDI 3100.12, *Space Support*, 14 September 2000

AFPD 91-1, *Nuclear Weapons and Systems Surety*, 13 December 2010

AFI 33-360, *Publications and Forms Management*, 25 September 2013

AFI 40-201, *Managing Radioactive Materials in the US Air Force*, 16 March 2011

AFI 91-204, *Safety Investigations and Reports*, 12 February 2014

AFMAN 33-363, *Management of Records*, 1 March 2008, incorporating changes through AFGM 2014-1, 28 Mar 2014

Title 10, Code of Federal Regulations (10 CFR), Chapter 2, *Department of Energy*

Title 42, United States Code (42 U.S.C.), Chapter 23, *DEVELOPMENT AND CONTROL OF ATOMIC ENERGY*

International Atomic Energy Agency (IAEA) Safety Standards, Regulations for the Safe Transport of Radioactive Material, Specific Safety Requirements No. SSR-6, 2012 Edition

Adopted Forms

Air Force Form 847, Recommendation for Change of Publication

Abbreviations and Acronyms

AF—Air Force

AFI—Air Force Instruction

AFPD—Air Force Policy Directive

AFPEO—Air Force Program Executive Office

AF/SE—Air Force Chief of Safety

AFSEC—Air Force Safety Center

AFSEC/SES—Air Force Safety Center, Space Safety Division

ASD (NCB)—Assistant to the Secretary of Defense (Nuclear, Chemical and Biological Defense Programs)

CFR—Code of Federal Regulations

DoD—Department of Defense

DoDD—Department of Defense Directive
DoDI—Department of Defense Instruction
DRU—Direct Reporting Unit
FOA—Field Operating Agencies
FSAR—Final Safety Analysis Report
HQ AFSEC—Headquarters, Air Force Safety Center
IAW—in accordance with
INSRP—Interagency Nuclear Safety Review Panel
MAJCOM—Major Command
NASA—National Aeronautics and Space Administration
NRC—Nuclear Regulatory Commission
OPR—Office of Primary Responsibility
RDS—records disposition schedule
SAS—Safety Analysis Summary
SER—Safety Evaluation Report
SSR—Specific Safety Requirements
U.S.C.—United States Code

Attachment 2

GUIDE FOR SAFETY ANALYSIS SUMMARY

A2.1. Safety Analysis Summary (SAS). Prepare a SAS for any planned launch of radioactive material when the total quantity of radioactive material either exceeds the A2 value listed in Section IV “Activity Limits and Classifications” of *IAEA SSR-6* or (in the case of mixed isotopes), the normalized sum calculated via Figure A2.1 exceeds 1.00. Prepare the SAS according to this attachment and send to HQ AFSEC/SES.

A2.2. Mission Description. This description should include system, radioactive material, and mission profile descriptions.

A2.2.1. System Description:

A2.2.1.1. Program name.

A2.2.1.2. Launch vehicle description.

A2.2.1.3. Spacecraft or missile, and payload description.

A2.2.2. Radioactive Material: Describe each radionuclide separately, if applicable. Each radioactive material description consists of:

A2.2.2.1. Radionuclides.

A2.2.2.2. Modes of decay and associated energy intensities.

A2.2.2.3. Activity (in Terabecquerels).

A2.2.2.4. Radiation exposure levels, with particular emphasis on areas accessible to personnel.

A2.2.2.5. Proposed use.

A2.2.2.6. Location on launch vehicle and payload.

A2.2.2.7. Manufacturer and source identification number.

A2.2.2.8. Nuclear Regulatory Commission or Agreement State sealed source and device registry number and the license or permit authorizing possession, if applicable.

A2.2.2.9. Source construction, including the chemical and physical form.

A2.2.2.10. Construction materials.

A2.2.2.11. Dimensions.

A2.2.2.12. Design criteria.

A2.2.2.13. Other information pertinent to assessing source integrity in normal and extreme operating conditions and potential accident environments.

A2.2.3. Mission Profile:

A2.2.3.1. Launch facility identification.

A2.2.3.2. Proposed launch date.

A2.2.3.3. Launch azimuth.

A2.2.3.4. Mission profile description, including orbital or flight parameters.

A2.2.3.5. Mission duration.

A2.2.3.6. Impact predictions, if applicable.

A2.3. Normal Mission Analysis. This analysis should address:

A2.3.1. Nuclear and radiation safety considerations throughout the mission, including handling from installation through flight and post-flight.

A2.3.2. Disposing of radioactive material. Identify the license or permit under which you will receive recovered materials, if applicable.

A2.4. Accident Evaluation. This evaluation should address:

A2.4.1. All mission phases, including prelaunch, launch, ascent, orbital, reentry, impact, and post impact.

A2.4.2. Potential accident scenarios, environments, and contingency options.

A2.4.3. Mission failure evaluation, including launch vehicle, payload, and source failure mode analyses and associated probabilities.

A2.4.4. Source response to accidents and potential consequences to the public and the environment.

A2.4.5. Any additional information pertinent to the SAS.

A2.5. Mixed Isotopes.

A2.5.1. When using several isotopes or a mixture of isotopes, base the required nuclear safety review on the normalized total quantity of radioactive material present. The normalized total is the sum of the ratios of the individual isotopes to their respective threshold quantities as shown in Figure A2.1. If the normalized totals exceed 1.00, a safety analysis summary is required. AFSEC/SES must complete a nuclear safety review and obtain launch approval from ASD (NCB).

Figure A2.1. Mixed Isotopes.

$$\frac{\text{Isotope A (TBq)}}{\text{Threshold A (TBq)}} + \frac{\text{Isotope B (TBq)}}{\text{Threshold B (TBq)}} + \frac{\text{Isotope C (TBq)}}{\text{Threshold C (TBq)}} + \dots < 1.00$$

Example:

1.2 x 10⁻⁴ TBq of Pu-238 is 1.2 x 10⁻⁴ TBq / 1.0 x 10⁻³ or 12 percent of the analysis threshold limit for Pu-238.

0.5 TBq of Nb-95 is 0.5 TBq / 1.0 TBq, or 50 percent of the analysis threshold limit for Nb-95.

7.0 TBq of Be-7 is $7.0\text{TBq}/20\text{ TBq}$, or 35 percent of the analysis threshold limit of BE-7. Therefore, the normalized total is 97 percent and an SAS would not be required.

Attachment 3**LAUNCH FORECAST REPORT FORMAT**

A3.1. Launch Forecast Report: Forecast of all scheduled launches meeting radioactive materials reporting criteria during the next quarter. The report must be received by AFSEC/SES at least 15 calendar days before the start of each calendar-year quarter. The forecast should include:

A3.1.1. Program name.

A3.1.2. Launch vehicle, site, and date.

A3.1.3. Impact area or orbital parameters.

A3.1.4. Specific radioisotopes and associated activities (in Terabecquerels).

A3.1.5. Type of nuclear system or device, if applicable.