8 February 2019

English only

Committee on the Peaceful Uses of Outer Space
Scientific and Technical Subcommittee
Fifty-sixth session
Vienna, 11–22 February 2019

Implementation of the guidelines provided for in the international safety framework for nuclear power source applications in outer space for ESA space missions — The ESA safety policy on the use of nuclear power sources

Paper submitted by the European Space Agency

I. Introduction

1. Safety considerations are an inherent part of the design and operation of space missions of the European Space Agency (ESA) making use of Nuclear Power Sources (NPS) due to the presence of radioactive materials in NPS used for space applications and their potential harm to humans and the environment in Earth's biosphere due to an accident.

2. ESA Member States and ESA have been actively participating in the drafting of the international safety framework for space NPS applications and continue to fully support the guidelines, which represent an international consensus and which are based on the best practices reflected in the national safety frameworks of states with experience in using space NPS.

3. Since the latest use of nuclear power sources by ESA in joint missions with NASA in the 1980's and 1990's, the nuclear safety standards, the best practices, the public awareness, perception and required level of transparency and scrutiny involving nuclear activities have substantially evolved.

4. The new "ESA Safety Policy on the Use of Nuclear Power Sources" implements the guidelines established by the Scientific and Technical Subcommittee (STSC) of UN COPUOS and the IAEA and aims to mitigate risks arising from the use of NPS. Its application is mandatory for ESA missions and provides assurance that ESA's use of space NPS applications is done in a safe manner, while it also intends to facilitate bilateral and multilateral cooperation on space missions using NPS.

5. ESA recognizes the value of the guidelines and appreciates the flexibility to apply these guidelines to best fit the specific implementation situation. While following closely the structure, definitions and terms of the international safety framework, ESA adapted them in some minor aspects to the requirements of an international intergovernmental organization.

6. The ESA safety policy has been issued by the ESA Director General (DG) on 19 June 2018 in the form of an Administrative Instruction (ADMIN) with the reference number ESA/ADMIN/IPOL-INSR(2018)1, following the appropriate internal approval process. ADMINs are the primary regulatory mean through which DG establishes the Agency's organization, structure, management, operations and administration. As internal legal documents, they are addressed to, and legally binding for, ESA staff.

II. ESA Policy on the use of nuclear power sources

7. The ESA safety policy on the use of nuclear power sources implements all three levels of guidance contained in the international safety framework: guidance for governments (chapter 3), guidance for management (chapter 4) and technical guidance (chapter 5).

8. The policy, binding for ESA staff, applies to all space missions with ESA involvement, including bilateral and multilateral cooperation space missions. It applies to nuclear safety aspects of all launch, operations and end-of-service phases of space NPS applications. In the case of space missions undertaken in cooperation with other organizations, a clear definition of responsibilities for nuclear safety aspects, requirements and processes shall be agreed upon.

9. It is ESA's policy that space missions using NPS shall:

   a. be appropriately justified, considering alternatives;

   b. comply with the guidelines laid out in the "Safety Framework for Nuclear Power Sources Applications in Outer Space (Ref. A/AC.105/934, 19 May 2009)", jointly published by the International Atomic Energy Agency and the United Nations Committee on the Peaceful Uses of Outer Space Scientific and Technical Subcommittee; and

   c. be managed by developing, implementing and maintaining a safety culture that ensures nuclear safety as well as:

      i. clear lines of authority, responsibility and communication;

      ii. active feedback and continuous improvement;

      iii. individual and collective commitment to safety at all organizational levels;

      iv. safety accountability of the space mission organization at all levels; and

      v. questioning and learning attitude to discourage complacency with regard to safety.

10. ESA's nuclear safety policy contains safety principles which cover:

   a. **The Protection of people and the environment:** The fundamental safety objective of ESA space missions using nuclear power source applications shall be to protect people and the environment in Earth's biosphere from potential hazards associated with relevant launch, operation and end-of-service phases of these applications. The benefits of the mission results shall be weighed against risks to people and the environment for launch, operation and end-of-service phases of the space NPS application.

   b. **ESA nuclear safety launch approval:** The launch of ESA missions with NPS shall be subject to a nuclear safety approval process.

   c. **Reduction of radiation risk to as low as reasonably achievable:** The design, development and conduct of ESA space missions with NPS shall ensure that the radiation risks to people and the environment arising from

normal operations and potential accidents is acceptable and as low as reasonably achievable.

d. **Integration of nuclear safety throughout all mission phases:** ESA space missions with NPS shall integrate safety considerations in the context of the entire space NPS application (i.e. space NPS, spacecraft, launch system, mission design and flight rules) and consider nuclear safety from the earliest stages of design and development and throughout all mission phases.

e. **Accident consequence mitigation:** As part of the safety process for ESA space NPS applications, measures shall be evaluated and implemented as required to mitigate the consequences of accidents with the potential to release radioactive material into Earth's environment.

f. **Compliance with national and international regulations:** ESA missions with NPS shall comply with relevant national and international regulations for the Terrestrial and Launch Phases. All activities occurring during the Terrestrial Phase of space NPS applications, such as development, testing, manufacturing, handling and transportation shall comply with the applicable national and international standards and regulations relating to terrestrial nuclear installations and activities.

g. **Collaboration with other organizations:** In the case of space missions in cooperation with other organizations, a clear definition of responsibilities for nuclear safety aspects, requirements and processes shall be agreed to ensure that all nuclear safety aspects are adequately covered while avoiding conflicting or duplicative requirements and unnecessary burden.

h. **Provision of Nuclear Safety Files:** At the time of seeking ESA authorization for implementation and for launches the respective Nuclear Safety Files shall be provided.

i. **Endorsement of ESA Member States:** Where required, endorsement of ESA Member States shall be sought.

11. The ESA safety policy clearly specifies the respective roles and responsibilities of ESA staff. It specifically details the role and responsibilities of:

a. The ESA Director General

b. The Programme Directors and the Director in charge of Technology, Engineering and Quality

c. Study Managers

d. Project Managers

e. Mission Managers

f. The ESA Safety Office

g. The ESA Inspector General.

12. The ESA nuclear safety policy details specific implementation requirements, contained in the annex 1 of the policy. These specify the ESA nuclear safety launch approval process, the approach to reducing the radiation risks to as low as reasonably achievable levels, the integration of nuclear safety throughout all mission phases, the approach to accident consequence mitigation, the compliance with national and international regulations, and the content and timing of the different nuclear safety files.

III. Specifics of the ESA Policy on the use of nuclear power sources

13. Definitions.

a. The ESA safety policy includes some ESA specific terms and definitions such as the one of a ‘Study Manager’, which refers to managers of early mission phase studies of space missions (typically pre-phase A, phases A and phase B1). In addition to a reference to the IAEA Glossary, 2007 Edition, and the Safety Framework for NPS Applications in Outer Space A/AC.105/934, the safety policy adds an explicit reference to the terms and definitions of the European Cooperation for Space Standardization (ECSS) developing and maintaining a coherent, single set of user-friendly standards for use in all European space activities (ECSS-S-ST-00-01).

14. Scope.

a. The ESA safety policy on the use of nuclear power sources is issued in the form of an internal Administrative Instruction by the ESA Director General. It is addressed to, and binding for, ESA staff and its scope is limited to the programmes and activities of ESA, carried out under the responsibility of the ESA Director General and under the applicable legal and regulatory framework.

b. ESA is an international intergovernmental organization with legal personality, established by the “Convention for the Establishment of a European Space Agency”. Although it therefore fundamentally differs from a national government, the provisions contained in the international safety framework with regards to the guidance for governments (chapter 3) are applied, as appropriate, to relevant processes within the Agency’s activities and programmes. These are related to the recommendations that: “Governments that authorize or approve space nuclear power source missions should establish safety policies, requirements and processes”; “The government’s mission approval process should verify that the rationale for using the space nuclear power source application has been appropriately justified.”; “A mission launch authorization process for space nuclear power source applications should be established and sustained.”; and that “Preparations should be made to respond to potential emergencies involving a space nuclear power source”.

c. Specifically, the guidance provided by the international safety framework for the mission launch authorization addresses specifically ‘governments’ and not, as most other provisions, ‘governments and relevant international intergovernmental organizations’ by stating that “the government that oversees and authorizes the launch operations for space NPS missions should establish a mission launch authorization process focused on nuclear safety aspects.” The ESA safety policy for nuclear power sources therefore defines responsibilities of the ESA Director General to:

i. seek endorsement of the ESA Member States as appropriate;

ii. give authorization to proceed with the implementation for the space mission; and

iii. give the ESA authorization to proceed to launch and operate the space mission.

The “ESA authorization” is to be considered as the latest authorization step within the ESA launch approval process. In contrast, the authorization by the government that oversees and authorizes the launch operations for

space NPS missions is not covered by the ESA safety policy for nuclear power sources.

15. Since the policy's entry into force on 19 June 2018, ESA has not launched a space mission involving nuclear power sources. Following the first application cases and the lessons to be learned in applying the policy, the ESA DG might further adapt its content as appropriate.

16. ESA is currently investigating together with relevant authorities and stakeholders' different specific processes related to this policy, including those related to the safety process, procedures and requirements for the use of radioisotope heat and power source on space applications to be launched from the European launch site at the Centre Spatial Guyanais. ESA is planning to share any challenges that might emerge during these activities according to the work plan of the Working Group on the Use of Nuclear Power Sources in Outer Space.

17. The drafting of the ESA safety policy on the use of nuclear power sources has benefitted from the fruitful exchanges within the Working Group on the Use of Nuclear Power Sources in Outer Space of the Scientific and Technical Subcommittee of the Committee on the Peaceful Uses of Outer Space. In view of continuously improving the safety of space nuclear power source applications worldwide, ESA therefore welcomes the opportunity provided by this working group to space NPS applications to summarize and discuss plans, progress to date and any challenges faced or foreseen in implementing the Safety Framework and on and on mission-specific experiences in implementing its guidance. ESA welcomes equally the opportunity to discuss within the Working Group advances in knowledge and practices and their potential for enhancing the technical content and scope of the Principles Relevant to the Use of Nuclear Power Sources in Outer Space.