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**Committee on the Peaceful Uses  
of Outer Space**  
**Scientific and Technical Subcommittee**  
**Fifty-eighth session**  
Vienna, 1–12 February 2021

**Draft report on the implementation of the Safety  
Framework for Nuclear Power Source Applications in Outer  
Space and recommendations for potential enhancements of  
the technical content and scope of the Principles Relevant to  
the Use of Nuclear Power Sources in Outer Space**

**Prepared by the Working Group on the Use of Nuclear Power  
Sources in Outer Space**

**Current status of the draft report**

The following draft report on the implementation of the Safety Framework for Nuclear Power Source Applications in Outer Space and recommendations for potential enhancements of the technical content and scope of the Principles Relevant to the Use of Nuclear Power Sources in Outer Space was prepared by the Working Group on the Use of Nuclear Power Sources in Outer Space of the Scientific and Technical Subcommittee during the course of its work in 2020, including at the fifty-seventh session of the Subcommittee, in February 2020, and at a number of intersessional online meetings held between June and October 2020. The draft report consists of paragraphs that have been fully agreed by the Working Group, as well as those which require further discussion. Each paragraph of the draft report is provided with a footnote indicating the status of the considerations of the Working Group with regard to the language of the text. In instances where the discussion of a particular paragraph is still pending or ongoing, the options for alternative wording of that paragraph are provided in a footnote. The draft report is expected to be further elaborated and finalized by the Subcommittee at its fifty-eighth session, in 2021.



## Draft report

1. In accordance with paragraph [...] of General Assembly resolution [...], the Scientific and Technical Subcommittee, at its [...] session, on [...] February 2021, reconvened its Working Group on the Use of Nuclear Power Sources in Outer Space, with [...] as Chair.<sup>1</sup>
2. The Working Group recalled the following objectives of its multi-year workplan for the period 2017–2021, adopted by the Subcommittee at its fifty-fourth session, in 2017 (A/AC.105/1138, annex II, paras. 8 and 9):

Objective 1. Promote and facilitate the implementation of the Safety Framework for Nuclear Power Source Applications in Outer Space by:

(a) Providing an opportunity for member States and international intergovernmental organizations considering or initiating involvement in space nuclear power source (NPS) applications to summarize and discuss their plans, progress to date and any challenges faced or foreseen in implementing the Safety Framework;

(b) Providing an opportunity for member States and international intergovernmental organizations with experience in space NPS applications to make presentations on challenges identified under subparagraph (a) above, and on their mission-specific experiences in implementing the guidance contained in the Safety Framework.

Objective 2. 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 through presentations from member States and international intergovernmental organizations based on one or more of the following:

(a) Their practical experience in implementing the Principles;

(b) Their knowledge of advances in science and technology relating to space nuclear power sources;

(c) Their knowledge of internationally accepted norms, standards and practices regarding radiation protection and nuclear safety.<sup>2</sup>

3. In 2017, the Working Group agreed that it would achieve those objectives by considering technical presentations by member States and international intergovernmental organizations during the period 2018–2020 relating to the first and/or second objectives. The presentations would be of three types: (a) presentations by member States and international intergovernmental organizations that are considering or initiating involvement in NPS applications in outer space, summarizing their plans and progress to date, and any specific challenges faced or foreseen in implementing the Safety Framework or specific elements thereof; (b) presentations by member States with experience in space NPS applications, providing information pertinent to addressing the challenges in implementing the Safety Framework; and (c) presentations by member States and international intergovernmental organizations with experience in space nuclear power sources on the application of the Principles, and on advances in knowledge and practices that have the potential for enhancing the technical content and scope of the Principles.<sup>3</sup>

### Background

4. Since the dawn of the space age, NPS applications have played a critical role in the exploration of space, enabling missions of scientific discovery to destinations across the solar system. These amazing voyages have helped to unlock the mysteries

<sup>1</sup> Consensus language.

<sup>2</sup> Consensus language.

<sup>3</sup> Consensus language.

of outer space and spark the imaginations of people all over the world.<sup>4</sup> According to current knowledge and capabilities, space nuclear power sources are the only viable energy option to power some space missions and significantly enhance others. Several ongoing and foreseeable missions would not be possible without the use of space nuclear power sources.

5. As noted in the note by the Secretariat entitled “Thematic priority 1. Global partnership in space exploration and innovation” (A/AC.105/C.1/114), cooperation will amplify accomplishments in space while opening new venues of scientific and technological innovation, as well as bringing together States, international intergovernmental organizations, space agencies, the public, the private sector, non-governmental organizations, academia and civil society to explore space for the benefit of humankind.<sup>5</sup>

6. This spirit of cooperation has been productive for the Working Group, which has provided a useful forum for discussing specific aspects of nuclear power sources and learning from presentations and papers. The Working Group has enabled member States and international intergovernmental organizations considering or initiating involvement in space NPS applications to discuss their plans, progress and challenges and enabled member States and international intergovernmental organizations with experience in space NPS applications to share their mission-specific experiences. Furthermore, international cooperation has contributed to achieving the fundamental safety objective of the Safety Framework, which is to protect people and the environment in Earth’s biosphere from potential hazards associated with relevant launch, operation and end-of-service phases of space NPS applications.<sup>6</sup>

#### **Results of the work of the Working Group under its current multi-year workplan**

7. In 2018, the Working Group took note of the technical presentation entitled “Preliminary safety research on space nuclear power sources” that had been delivered during the fifty-fifth session of the Subcommittee by the representative of China.<sup>7</sup>

8. In relation to objective 2 of its multi-year workplan, the Working Group recalled a conference room paper submitted by France at the fifty-third session of the Subcommittee, in 2016, entitled “Proposal to revise the Principles Relevant to the Use of Nuclear Power Sources in Outer Space adopted by the General Assembly in its resolution 47/68 of 14 December 1992” (A/AC.105/C.1/2016/CRP.7).<sup>8</sup>

9. In 2019, the Working Group considered a conference room paper entitled “Implementation of the guidelines provided for in the international safety framework for nuclear power source applications in outer space for European Space Agency (ESA) space missions: the ESA safety policy on the use of nuclear power sources” (A/AC.105/C.1/2019/CRP.10), which had been prepared by ESA under objective 1 of the multi-year workplan of the Working Group.<sup>9</sup>

10. Also in 2019, the delegation of the United States of America presented an informal paper entitled “How the Safety Framework for Nuclear Power Source Applications in Outer Space satisfies the intent of the Principles Relevant to the Use of Nuclear Power Sources in Outer Space through practical application”. The paper concluded that, in the view of the United States, the practical application of the Safety Framework satisfied the safety intent of the Principles, and therefore was sufficient guidance to States and international intergovernmental organizations seeking to ensure the safe development and use of nuclear power in space. The delegation of the United States stated that that conclusion was supported by the experience of the

<sup>4</sup> Consensus language.

<sup>5</sup> Consensus language.

<sup>6</sup> Consensus language.

<sup>7</sup> Consensus language.

<sup>8</sup> Consensus language.

<sup>9</sup> Consensus language.

United States in the practical application of the Safety Framework to a range of space NPS missions.<sup>10</sup>

11. In 2020, the Working Group considered a working paper entitled “Preliminary analysis of how the Principles Relevant to the Use of Nuclear Power Sources in Outer Space contribute to the safety of space nuclear power source applications” (A/AC.105/C.1/L.378), prepared by the Chair of the Working Group in collaboration with the delegations of France and ESA.<sup>11, 12</sup>

12. Also in 2020, the delegation of the United States presented an informal paper entitled “Updated and risk-informed process for launching space nuclear systems in the United States of America” (A/AC.105/C.1/L.389). The paper concluded that the United States policy, set in the Presidential Memorandum on Launch of Spacecraft Containing Space Nuclear Systems, issued on 20 August 2019, was consistent with the spirit of the Principles and the Safety Framework, and provided the United States with an architecture for ensuring compliance with safety policies, establishing processes to satisfy fundamental safety requirements and objectives, and, ultimately, for the fulfilment of safety in the use of nuclear power in space.<sup>13</sup> The paper also concluded that the updated United States policy was an example of the practical application of the Safety Framework, and satisfied the safety intent of the Principles. Therefore, the paper contended, those two documents, when considered together, provided sufficient guidance to States and international intergovernmental organizations seeking to ensure the safe development and use of nuclear power sources in outer space.<sup>14</sup>

13. Also in 2020, the delegation of the United Kingdom presented an informal paper on its plans for research and development in space nuclear power technologies.<sup>15</sup>

14. Also in 2020, the delegation of the Russian Federation presented an informal paper entitled “Experience in the practical application of the Principles Relevant to the Use of Nuclear Power Sources in Outer Space and the Safety Framework for Nuclear Power Source Applications in Outer Space”. The paper concluded that the approach taken by the Russian Federation took into account the recommendations of the Safety Framework and corresponded with the principles and criteria for the safe use of nuclear power sources set forth in the Principles.<sup>16, 17</sup>

15. With respect to objective 1 of its workplan, the Working Group concluded that its work had promoted and facilitated the implementation of the Safety Framework for Nuclear Power Source Applications in Outer Space. Member States and international intergovernmental organizations considering or initiating involvement in space NPS applications had shared and discussed their plans, progress and challenges in implementing the Safety Framework and member States and international intergovernmental organizations with experience in space NPS applications were using the meetings of the Working Group to share their mission-

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<sup>10</sup> Consensus language.

<sup>11</sup> Consensus language.

<sup>12</sup> A revised version of the paper, entitled “Updated preliminary analysis of how the Principles Relevant to the Use of Nuclear Power Sources in Outer Space contribute to the safety of space nuclear power source applications”, prepared by France, Italy, the United Kingdom of Great Britain and Northern Ireland and the European Space Agency, is available as document A/AC.105/C.1/L.390.

<sup>13</sup> This part of paragraph 12 is regarded as consensus language.

<sup>14</sup> This part of paragraph 12 is regarded as being under discussion.

<sup>15</sup> This paragraph is regarded as being under discussion.

<sup>16</sup> This paragraph is regarded as being under discussion.

<sup>17</sup> The paper was further elaborated and submitted to the Secretariat in September 2020, which made it available as a working paper prepared by the Russian Federation, entitled “Experience in the practical application of the Principles Relevant to the Use of Nuclear Power Sources in Outer Space and the Safety Framework for Nuclear Power Source Applications in Outer Space” (A/AC.105/C.1/L.388).

specific experiences in implementing the guidance contained in the Safety framework.<sup>18</sup>

16. The information provided to the Working Group supports the conclusion that the Safety Framework is widely accepted and has proved valuable to member States when developing and/or applying their national systems for ensuring the safe use of nuclear power sources in outer space. Its usefulness has also been acknowledged and accepted by other member States and international intergovernmental organizations that are not currently involved in utilizing nuclear power sources in space, as they consider the safe use of such applications. No significant implementation challenges have been identified, although several Working Group members were of the view that, as a decade had passed since its adoption, the Framework could usefully be revisited to ensure that it is still up to date, in the light of modern technical standards and other developments. These developments include the potential involvement of non-governmental and commercial entities in a variety of space NPS missions, and the need to take account of the guidance being developed on the long-term sustainability of space.<sup>19</sup>

17. With respect to objective 2 of its workplan, the Working Group discussed 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 through presentations from member States and international intergovernmental organizations.<sup>20</sup>

18. With respect to objective 2 of its workplan, the Working Group:

(a) Discussed whether and how the preamble and the 11 principles of the Principles Relevant to the Use of Nuclear Power Sources in Outer Space contributed to safety during the design and development, implementation and operation, and post-end-of-service phases of space NPS applications;

(b) Noted that some of the Principles had a practical impact on the safety aspects of space NPS applications;

(c) Also noted that, since the adoption of the Principles in 1992, substantial advances had taken place in knowledge and practices, as well as in internationally accepted norms and standards, relevant to the safety of NPS applications.<sup>21</sup>

19. Some delegations expressed the view that the Principles contained a number of deficiencies in technical content, especially with regard to safety, and that its limitations in scope were unhelpful in a number of respects.<sup>22</sup> The safety provisions of the Principles were covered in the Safety Framework in a better and more comprehensive way.<sup>23</sup> The working paper referred to in paragraph 11 contended that some of the Principles, if applied rigorously, could be counterproductive from the point of view of safety. Some provisions of the Principles, however, gave more specific guidance than the Safety Framework (e.g., on prior notification of use) and could usefully be incorporated into the Safety Framework.<sup>24</sup> The following specific issues were identified:

<sup>18</sup> Consensus language.

<sup>19</sup> Consensus language.

<sup>20</sup> Consensus language.

<sup>21</sup> Consensus language.

<sup>22</sup> This part of paragraph 19 is regarded as being under discussion. One suggested variation reads as follows: "Some Member States and an international intergovernmental organization of the Working Group provided an analysis of the Principles document that showed it could be clarified or enhanced in its technical content, especially with regard to safety".

<sup>23</sup> This part of paragraph 19 is regarded as consensus language.

<sup>24</sup> This part of paragraph 19 is regarded as being under discussion. One suggested variation reads as follows: "The view was expressed by some Member States and an international intergovernmental organization in the Working Group that the Principles, if applied rigorously, could be confusing from a safety point of view. The view was also expressed by some Member States and an international intergovernmental organization in the Working Group that there were, however, some

(a) The Principles contain a number of outdated provisions and quantitative requirements that do not reflect current knowledge and technology, thus posing the potential risk of negatively impacting safety during the design and development of NPS applications;

(b) The wider scope of the Principles resulted in the inclusion of certain specific provisions and requirements related to the safety of space NPS applications with regard to the safety of humans beyond Earth's biosphere and the potential contamination of outer space, which were not included in the Safety Framework. However, those outdated provisions and requirements could negatively impact safety during the design and development of space NPS applications;

(c) The requirement contained in the Principles to make a safety assessment publicly available prior to the launch of an NPS application, and the associated additional scrutiny implied thereby, can be considered as an added contribution to the safety of NPS applications; by comparison, the Safety Framework contains no such requirement;

(d) The Principles contain outdated requirements regarding the operation and end of life of NPS applications in space that do not reflect modern knowledge and technology. The generic approach adopted in the Safety Framework is more up to date and more helpful to space NPS practitioners.<sup>25, 26</sup>

20. The two member States with the greatest experience in developing and using space nuclear power sources expressed the view that the information and guidance provided by the Principles and the Safety Framework, when taken together, were sufficient for developing their national control and authorization systems. The Working Group recognized that other member States and international intergovernmental organizations, without the long experience of the two member States with the greatest experience in developing and using space nuclear power sources, were likely to find the disparate guidance and requirements contained in the two documents confusing.<sup>27</sup>

21. The Working Group discussed various technical approaches that may be considered in order to clarify the guidance in the Principles and in the Safety Framework, with the aim of enhancing safety in the development and use of space NPS applications.<sup>28</sup>

22. The Working Group identified the following six options for potential activities to further enhance safety in the development and use of space NPS applications:<sup>29, 30</sup>

(a) The Subcommittee could confirm that the application of the Principles, in conjunction with the practical recommendations contained in the Safety Framework, provides a sufficient tool for member States and international intergovernmental organizations wishing to ensure the safe development and use of nuclear power

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provisions of the Principles that gave more specific guidance than the Safety Framework (e.g., prior notification of use) and could be incorporated into the Safety Framework in a useful way".

<sup>25</sup> Subparagraphs (a) to (d) of paragraph 19 are regarded as being under discussion.

<sup>26</sup> There is a proposal to move paragraph 19, once its language is fully agreed, to the end of paragraph 11.

<sup>27</sup> The text of paragraph 20 is regarded as being under discussion. The following variation of the wording of this paragraph has been proposed: "Some member States with experience in developing and using space nuclear power sources noted that the information and guidance provided by the Principles and the Safety Framework, when taken together, were sufficient for developing their national control and authorization systems. Some member States and an international intergovernmental organization noted that the disparate guidance and requirements in the two documents were confusing".

<sup>28</sup> Consensus language.

<sup>29</sup> This part of paragraph 22 is regarded as being under discussion. One suggested variation reads as follows: "Some member States identified the following five options that were discussed by the Working Group as potential future activities to further enhance safety in the development and use of space NPS applications. However, the Working Group was unable to reach consensus on these options".

<sup>30</sup> Subparagraphs (a) to (f) of paragraph 22 are regarded as being under discussion and their wording requires further refinement and development.

sources in outer space. Once the work of the Working Group completed, those member States and international intergovernmental organizations with experience in the design, development and use of space nuclear power sources, as well as those considering or initiating involvement in space nuclear power sources, could continue to exchange information under the appropriate Subcommittee agenda item;

(b) The Subcommittee could confirm that the application of the Principles, in conjunction with the practical recommendations contained in the Safety Framework, provides a sufficient tool for member States and international intergovernmental organizations wishing to ensure the safe development and use of nuclear power sources in outer space. In addition, the Subcommittee could create a new, multi-year workplan for the Working Group<sup>31</sup> in order to enable it to develop an additional document to explain how the Principles and the Safety Framework complement each other to provide a comprehensive set of guidance documents for the safe use of nuclear power sources in outer space;<sup>32</sup>

(c) The Subcommittee could confirm that it does not intend to undertake the task of revising and updating the Principles but, instead, proposes that the Working Group should carry out, together with the International Atomic Energy Agency (IAEA), a review and revision of the Safety Framework. The intention of such a review would be to incorporate relevant parts of the Principles into the Safety Framework, ensure that it is properly aligned with the guidance on the long-term sustainability of space and take account of the needs of potential future non-governmental and commercial users of space nuclear power sources;

(i) The Working Group concluded that the option presented in paragraph 22 (c) above could be accomplished by extending the efforts of the Working Group, or by establishing a new expert group or action team;<sup>33</sup>

(ii) With respect to the option identified in paragraph 22 (c) above, the Working Group identified a requirement to consult with IAEA to ensure that joint working arrangements, similar to those employed during the drafting of the Safety Framework, could be agreed upon;

(d) The Subcommittee could confirm that it does not intend to undertake the task of revising and updating the Principles but, instead, proposes that the Working Group should carry out, together with IAEA, a review and revision of the Safety Framework. The intention of such a review would be to incorporate relevant parts of the Principles into the Safety Framework, ensure that it is properly aligned with the guidance on the long-term sustainability of space and take account of the needs of potential future non-governmental and commercial users of space nuclear power sources. The Subcommittee could also consult with the Legal Subcommittee of the Committee on the Peaceful Uses of Outer Space to determine whether it would be appropriate for the Committee to recommend to the General Assembly that the Principles be withdrawn;

(i) The Working Group concluded that the option presented in paragraph 22 (d) above could be accomplished by extending the efforts of the Working Group or by establishing a new expert group or action team;<sup>34</sup>

(ii) With respect to the option identified in paragraph 22 (d) above, the Working Group identified a requirement to consult with IAEA to ensure that joint working arrangements, similar to those employed during the drafting of the Safety Framework, could be agreed;

<sup>31</sup> Proposed addition: "... or establish a new expert group or action team".

<sup>32</sup> Proposed addition: "The new group could also be set up outside the auspices of the United Nations, but with secretariat support from the Office for Outer Space Affairs, similar to the Space Mission Planning Advisory Group".

<sup>33</sup> Proposed addition: "... or setting up a group outside the auspices of the United Nations".

<sup>34</sup> Proposed addition: "... or setting up a group outside the auspices of the United Nations".

(iii) With respect to the options identified in paragraph 22 (d) above, the Working Group identified a requirement for the Scientific and Technical Subcommittee to consult with the Legal Subcommittee in order to reach an agreement on a recommendation on the Principles to be taken to the General Assembly;

(e) The Scientific and Technical Subcommittee could carry out a consultation with the Legal Subcommittee with a view to bringing forward a proposal to the Committee to review whether the Principles should be revised and updated;

(i) The Working Group concluded that the option presented in paragraph 22 (e) above could be accomplished by extending the efforts of the Working Group, or by establishing a new expert group or action team;<sup>35</sup>

(ii) With respect to the option identified in paragraph 22 (e) above, the Working Group identified a requirement for the Scientific and Technical Subcommittee to consult with the Legal Subcommittee in order to reach an agreement on a recommendation on the Principles to be taken to the General Assembly;

(f) The Scientific and Technical Subcommittee could carry out a consultation with the Legal Subcommittee with a view to bringing forward a proposal to the Committee to revise and update the Principles;

(i) The Working Group concluded that the option presented in paragraph 22 (f) above could be accomplished by extending the efforts of the Working Group, or by establishing a new expert group or action team;<sup>36</sup>

(ii) With respect to the option identified in paragraph 22 (f) above, the Working Group identified a requirement for the Scientific and Technical Subcommittee to consult with the Legal Subcommittee in order to reach an agreement on a recommendation on the Principles to be taken to the General Assembly.

23. In 2020, the Working Group agreed that, in order to carry out the tasks for the year 2020 under its multi-year workplan, it would be necessary to convene an intersessional meeting. In that connection, the Working Group agreed to meet from 17 to 19 June 2020, on the margins of the sixty-third session of the Committee, and requested that the Secretariat facilitate that meeting. Owing to the restrictions related to the global health crisis, the Working Group could not hold the planned meeting. It therefore could not reach a consensus.<sup>37</sup>

24. On the basis of the above conclusions and taking into consideration the preliminary results of the current workplan, the Working Group reached consensus on the following recommendation:<sup>38</sup>

25. The multi-year workplan for the period 2017–2021, adopted by the Scientific and Technical Subcommittee at its fifty-fourth session, in 2017 (A/AC.105/1138, annex II, paras. 8 and 9), should be extended by one year under the same objectives to enable the Working Group to hold meetings and reach a consensus.

<sup>35</sup> Proposed addition: "... or setting up a group outside the auspices of the United Nations".

<sup>36</sup> Proposed addition: "... or setting up a group outside the auspices of the United Nations".

<sup>37</sup> Consensus language.

<sup>38</sup> The text of paragraph 25 is regarded as being under discussion. The list of recommendations is expected to be further expanded on the basis of future deliberations in the Working Group.

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## Annex

### **Documents that have been considered by the Working Group on the Use of Nuclear Power Sources in Outer Space under its multi-year workplan for the period 2017–2021**

#### **2018**

- Technical presentation by the delegation of China, entitled “Preliminary safety research on space nuclear power sources”

#### **2019**

- Conference room paper prepared by the European Space Agency (ESA), entitled “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” (A/AC.105/C.1/2019/CRP.10)

#### **2020**

- Working paper entitled “Preliminary analysis of how the Principles Relevant to the Use of Nuclear Power Sources in Outer Space contribute to the safety of space nuclear power source applications” (A/AC.105/C.1/L.378), prepared by the Chair of the Working Group in collaboration with the delegations of France and ESA
  - Working paper prepared by the Russian Federation, entitled “Experience in the practical application of the Principles Relevant to the Use of Nuclear Power Sources in Outer Space and the Safety Framework for Nuclear Power Source Applications in Outer Space” (A/AC.105/C.1/L.388)
  - Working paper prepared by the United States of America, entitled “Updated and risk-informed process for launching space nuclear systems in the United States of America” (A/AC.105/C.1/L.389)
  - Working paper prepared by France, Italy, the United Kingdom of Great Britain and Northern Ireland and ESA, entitled “Updated preliminary analysis of how the Principles Relevant to the Use of Nuclear Power Sources in Outer Space contribute to the safety of space nuclear power source applications” (A/AC.105/C.1/L.390).
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