

PRPPWG: Proliferation Resistance and Physical Protection assessment methodology Working Group

The Generation IV Roadmap defined the following Proliferation Resistance and Physical Protection (PR&PP) goal for future nuclear energy systems:

Generation IV nuclear energy systems will increase the assurance that they are a very unattractive and the least desirable route for diversion or theft of weapons-usable materials, and provide increased physical protection against acts of terrorism.

The Proliferation Resistance and Physical Protection Working Group (PRPP WG) was created to develop, implement and foster use of an evaluation methodology to assess Generation IV nuclear energy systems with respect to the GIF PR&PP goals. The current version of the methodology is presented in a document entitled Evaluation Methodology for Proliferation Resistance and Physical Protection of Generation IV Nuclear Energy Systems, Rev. 6, which was released for general distribution in 2011.

The methodology provides designers and policy makers a generic and formal comprehensive approach to evaluate, through measures and metrics, the Proliferation Resistance (PR) and Physical Protection (PP) characteristics of advanced nuclear systems. As such, the application of the evaluation methodology offers opportunities to improve the PR and PP robustness of system concepts throughout their development cycle. Other major outcomes from the group are available to the GIF community and more broadly through the GIF public website, including the Example Sodium Fast Reactor (ESFR) Case Study Report. The compendium report with white papers on the PR&PP characteristics of each of the six GIF nuclear energy systems prepared with the SSCs, and a set of Frequently Asked Questions and materials from workshops. In 2016 PRPPWG launched a questionnaire for the SSCs to assess the need to update the white papers. A joint SSCs-PRPPWG workshop was then held at the OECD NEA in Paris, April 2017. The PR&PP WG and the six SSCs/pSSCs are currently in the process of updating the six white papers to reflect changing and updated designs and new work on several of these systems.

As a first task the template for the white papers was updated. The SSCs updated first the description of the systems, considering both changes occurred in designs and new designs not considered in the 2011 white papers. After having updated the systems description, the PRPPWG, in collaboration with the SSCs, started updating the parts related to the PR and PP features of the considered designs. For each design option, the PRPP evaluation begins by identifying the relevant system elements with respect to potential adversary targets and applicable safeguards and physical protection approaches. The evaluation then proceeds to assess the design against potential threats using the technical design information to gauge the response of the system. A first draft, providing an overview of technology characteristics and status of design development for each of the six GIF systems was completed by the SSCs/pSSCs in the fall of 2018. A special session with the SSCs/pSSCs was held during the 29th meeting of the PRPPWG, in Oc. 2018. Members of the collaborative team provided status updates on the PR&PP white papers. A roundtable discussion identified information gaps in the white papers and the team developed a work plan to address all parts of the white papers in 2019. In 2019, the PRPPWG focused its activities on:

- continuing collaborative work with SSCs/pSSCs in the updating the white papers on PR&PP aspects of the six GIF systems;
- publicising the methodology and its applications within and outside GIF; and
- monitoring related activities in the areas of proliferation resistance and physical security for their relevance to the GIF programme.

An updated draft of the white papers was completed in November 2019 and an in-depth review of each white paper was planned for the 30th meeting. **Table PRPP 1** presents the high-level structure of the white papers.

During this meeting an extended working session of one and a half days was dedicated to the revision and discussion of the PR&PP white paper updates. Each PRPPWG Point of Contact for the six GIF systems had to:

- introduce the paper, and the reason for the update with regard to the 2011 version; to point out the main differences with regard to the 2011 version;
- illustrate the paper structure and content; drive the discussion on the paper, in general and section by section; execute a deep dive in the papers and get feedback; illustrate missing parts and propose a way forward and timeline;
- propose topics for cross-cutting considerations and availability to lead their investigation.

An observer from the IAEA and a representative from the RSWG also attended the meeting.

Table PRPP 1. **High-level structure of the updated SSCs/pSSCs PR&PP white papers**

Section	Type of Information
Overview of Technology	<i>Description of the various design options in terms of their major reactor parameters, such as: core configuration, fuel form and composition, operating scheme and refueling mode, fresh/spent fuel storage and shipment, safety approach and vital equipment, physical layout and segregation of components, etc.</i>
Overview of Fuel Cycle(s)	<i>High-level description of the type, or types, of fuel cycles that are unique to this Gen-IV system and its major design options. Information such as recycle approach, recycle technology, recycle efficiency, waste form(s)</i>
PR&PP Relevant System Elements and Potential Adversary Targets	<i>For each design option, identification and description of the relevant system elements and their potential adversary targets, safeguards and physical security approaches</i>
Proliferation Resistance Features	<i>High-level, qualitative overview developed jointly by the SSC and the PR&PP working group, to identify and discuss the features of the system reference designs that create potential benefits or issues for each of the representative proliferation threats. Ideally the section should highlight the response of the system to a) the concealed diversion or production of material, b) the use of the system in a breakout strategy, and c) the replication of the technology in clandestine facilities</i>
Physical Protection Features	<i>High-level, qualitative overview developed jointly by the SSC and the PR&PP working group, to discuss those elements of the system design that create potential benefits or issues for potential subnational threats, with specific discussion on the general categories of PP threats (a) theft of material for nuclear explosives or dispersal device and b) radiological sabotage)</i>
PR&PP Issues, Concerns and Benefits	<i>Review of the outstanding issues related to PR&PP for the concepts and their fuel cycles, the areas of known strength in the concept, and plans for integration and assessment of PR&PP for the concept. This section would ideally terminate with a bullet list of identified PR&PP R&D needs for the system concept</i>

The white paper team is preparing a new draft of the white papers incorporating review comments that arose during the review sessions. The team expects to release a final draft for approval by the SSC/pSSC by spring 2020. In addition to the peculiarities of each of the six GIF reactor technologies, addressed by the corresponding White Papers, there are topics that are common to all the six families. The 2011 white papers identified some of the cross-cutting areas, but others are being identified in the course of the update. Cross-cutting topics will be dealt with in the course of 2020.

In 2019, new members were nominated to the PRPPWG, two representatives from the United Kingdom, one additional representative from Canada and two substitute observers from Korea.

The working group continues to publicise its methodology within and outside the GIF through presentations in national and international fora and publications in scientific journals. The group contributed papers on PR&PP to the 4th GIF Symposium 2018, the IAEA Symposium on International Safeguards 2018, the 41st ESARDA Annual Meeting Symposium on Safeguards and Nuclear Material Management 2019. Presentation of the work of PRPPWG, its methodology and its results at these international fora provided opportunities to discuss with other experts and get feedback on its perceived benefits and drawbacks and potentials for its improvement and collaboration.

In support of knowledge management, the group maintains a bibliography providing a comprehensive list of publications in scientific journals and papers presented at major international conferences, covering all aspects of the PR&PP methodology and its applications within and outside GIF). The 2019 revision of the bibliography is near completion.

Within GIF, collaboration with the Risk and Safety Working Group (RSWG) was strengthened by personal exchanges at each group's meeting. Topics for further discussion between the two groups were identified including: establishment of an integrated framework encompassing the RSWG and PRPPWG methodologies, and identification of synergies and complementarities in the two approaches and evaluations, such as the interface between safety and security.

In its engagement with the IAEA, the PRPPWG maintains regular exchanges with the IAEA INPRO Project and the agency's Department of Safeguards. An observer in the working group from the IAEA, made several presentations for the special session with the SSC at the 29th PRPPWG Meeting covering safeguards needs for Gen-IV reactors, GIF-IAEA interactions and IAEA INPRO update.



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