

## Proliferation Resistance and Physical Protection Methodology Working Group

The Proliferation Resistance and Physical Protection Working Group (PRPPWG) was established to develop, implement and foster the use of an evaluation methodology so as to assess Gen-IV nuclear energy systems with respect to the GIF PR&PP goal, whereby:

“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 methodology provides designers and policymakers with a technology-neutral framework and a 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&PP robustness of system concepts throughout their development cycle. The working group released the current version (revision 6) of the methodology for general distribution in 2011,<sup>1</sup> and Japanese and Korean translations of the methodology report have been produced for national use.

Since 2018, the main focus of the PRPPWG has been on updating the white papers on proliferation resistance and physical protection robustness of the six GIF design concepts. This is a joint effort with the System Steering Committees (SSCs) and provisional System Steering Committees (pSSCs) of the six Gen-IV technologies. The first versions of these white papers were produced in the period

Table PRPP-1. System designs considered in the white paper updates

GIF System	System options considered in the update	Design tracks considered in the update	Comments
GFR	Reference concept	2400MWt GFR ALLEGRO as a GFR demonstrator (EU)	Other Gen-IV designs include: EM2 (GA) ALLEGRO (V4G4)  High-energy neutron modular helium reactor (HEN MHR) (CEA-ANL and GA-AREVA)
LFR	Large system	ELFR, (EU))	These are the three reference design configurations discussed in the GIF-LFR System Research Plan
	Intermediate system	BREST-OD-300, (RF)	
	Small transportable	SSTAR, (US)	
MSR	Liquid-fuelled with integrated salt processing	MSFR (EU), MOSART (RF)	There is a wide variety of MSR technologies, encompassing thermal/fast spectrum reactors, solid/fluid fuel, burner/breeder modes, Th/Pu fuel cycles, and on-site/ off-site fissile separation.
	Solid-fuelled with salt coolant	Mk1 PB-FHR (US)	
	Liquid-fuelled without integrated salt processing	IMSR (Canada)	
SCWR	Pressure vessel	HPLWR (EU) (thermal)	Most concepts are based on “familiar” technology, such as light water coolant, solid fuel assemblies, and batch refuelling. Implementation of Th and Pu fuel cycles creates additional, special nuclear materials of concern.
		Super FR (Japan)	
		Super LWR (Japan) (thermal)	
		CSR 1000 (China) (thermal)	
		Mixed spectrum (China)	
	Fast core (RF)		
Pressure tube	Canadian SCWR (Canada) (thermal)		
SFR	Loop configuration	JSFR (Japan)	Expect key PR&PP issues to be tied to fuel handling, TRU inventory and fuel cycle options.
	Pool configuration	ESFR (EU), BN-1200 (Russia), KALIMER-600 (Korea)	
	Small modular	AFR-100 (US)	
VHTR	Prismatic fuel block	Modular HTR, Framatome (ANTARES)	SC-HTGR is a follow on of the ANTARES and the GA GT-MHR development.
		SC-HTGR, Framatome (US)	
		GT-MHR General Atomics (US)	
		GT-MHR OKBM (Russia)	
		GTHTR300C, JAEA (Japan)	
		NHDD, KAERI (Korea)	
	Pebble bed	Xe-100, X-Energy (US)	Expect some PR&PP differences between the prismatic block and pebble bed design.
		HTR-PM (China)	

1. [www.gen-4.org/gif/jcms/c\\_40413/evaluation-methodology-for-proliferation-resistance-and-physical-protection-of-generation-iv-nuclear-energy-systems-rev-6](http://www.gen-4.org/gif/jcms/c_40413/evaluation-methodology-for-proliferation-resistance-and-physical-protection-of-generation-iv-nuclear-energy-systems-rev-6)

2008-2011. The white papers were included as individual chapters of an integrated report that was published in 2011 and is available on the GIF website.<sup>2</sup> The papers are being updated according to a revised, common template. The current update reflects changes in designs, new tracks that were added (see Table PRPP-1) and advancements in the designing of the six GIF systems, with enhanced intrinsic PR&PP features.

Individual white papers, after endorsement by both the PRPPWG and the responsible SSC/pSSC, will be transmitted to the EG for approval and published as GIF documents. Cross-cutting PR&PP aspects that transcend all six GIF systems are also being investigated. The plan is to complete the white paper updates in 2021. Below is a summary status of each white paper as of the end of 2020.

- LFR – paper endorsed by the PRPPWG and the LFR pSSC; EG completed review.
- SFR – paper endorsed by the PRPPWG and the SFR SSC; EG completed review.
- SCWR – paper incorporated comments from the SSC and endorsed by the PRPPWG; awaiting endorsement by the SSC.
- MSR – paper incorporated comments from the pSSC and endorsed by the PRPPWG; awaiting endorsement by the SSC.
- VHTR – PRPPWG presented a draft of the white paper at the last VHTR SSC meeting (October 2020); the final draft is being reviewed and revised by the PRPPWG before being released to the SSC for endorsement.
- GFR – early draft reviewed by the PRPPWG and the GFR SSC; a final draft is under preparation to incorporate comments from the PRPPWG and the GFR SSC.

The PRPPWG holds monthly teleconferences to report on the progress of group and member activities. In 2020, Russia appointed Mr Vladimir Artisyuk from Rosatom as a new member of the PRPPWG.

The group maintains an annually updated bibliography of official publications, of publications referring to the PR&PP methodology and of relevant issues. The latest edition, revision 7, was published in March 2020. It is available on the GIF website.<sup>3</sup>

The PRPPWG maintains regular exchanges with the IAEA International Project on Innovative Nuclear Reactors and Fuel Cycles (INPRO) and the agency's Department of Safeguards. An IAEA representative participates regularly in the PRPPWG activities. The PRPPWG made a presentation at the 14<sup>th</sup> GIF-IAEA Interface meeting on 8 July 2020, highlighting collaboration on the INPRO PR methodology that the IAEA plans to update, as well as on emerging safeguards issues related to the deployment of small modular reactors and micro reactors. Collaboration with the RSWG was strengthened through personal exchanges at each group's meeting. PRPPWG representatives attended the 31<sup>st</sup> and 32<sup>nd</sup> meetings of the RSWG. A discussion was initiated to explore the interfaces between safety, security and safeguards.

The group held its 31<sup>st</sup> annual meeting on 9-11 December 2020 via video conference. All member countries, including, for the first time, China and South Africa, attended the meeting and delivered country reports. Representatives from the IAEA and the RSWG also participated. The meeting was dedicated to discussing the advancement of the white papers, planning of new activities – namely cross-cutting topics from the white papers – and developing the work plan for the period 2021-2022.



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2. [www.gen-4.org/gif/jcms/c\\_40414/proliferation-resistance-and-physical-protection-of-the-six-generation-iv-nuclear-energy-system](http://www.gen-4.org/gif/jcms/c_40414/proliferation-resistance-and-physical-protection-of-the-six-generation-iv-nuclear-energy-system).

3. [www.gen-4.org/gif/jcms/c\\_101559/gif-prppwg-bibliography](http://www.gen-4.org/gif/jcms/c_101559/gif-prppwg-bibliography).