



ADVANCED REACTOR SAFEGUARDS

# Gen-IV PR&PP

*International Interfaces*



PRESENTED BY

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ARS&S Fall Working Group Meeting  
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# GIF PRPP Working Group



GIF is a framework for international co-operation in research and development for the next generation of nuclear energy systems

- GIF Proliferation Resistance and Physical Protection (PRPP) Working Group supports GIF technology goal for PR&PP – making GEN IV systems least desirable target for diversion, misuse, theft and sabotage.
- The working group is engaged with IAEA in safety, safeguards, and security (3S).
- It works with Gen-IV reactor designs to explore safeguards and security by design (SSBD)
- It studies emerging PRPP issues when transitioning from design to deployment

# PRPPWG Membership



- Canada
- China
- Euratom
- France
- IAEA - Observer
- Japan
- NEA - Secretariat
- Republic of Korea
- Russia
- South Africa
- UK
- USA

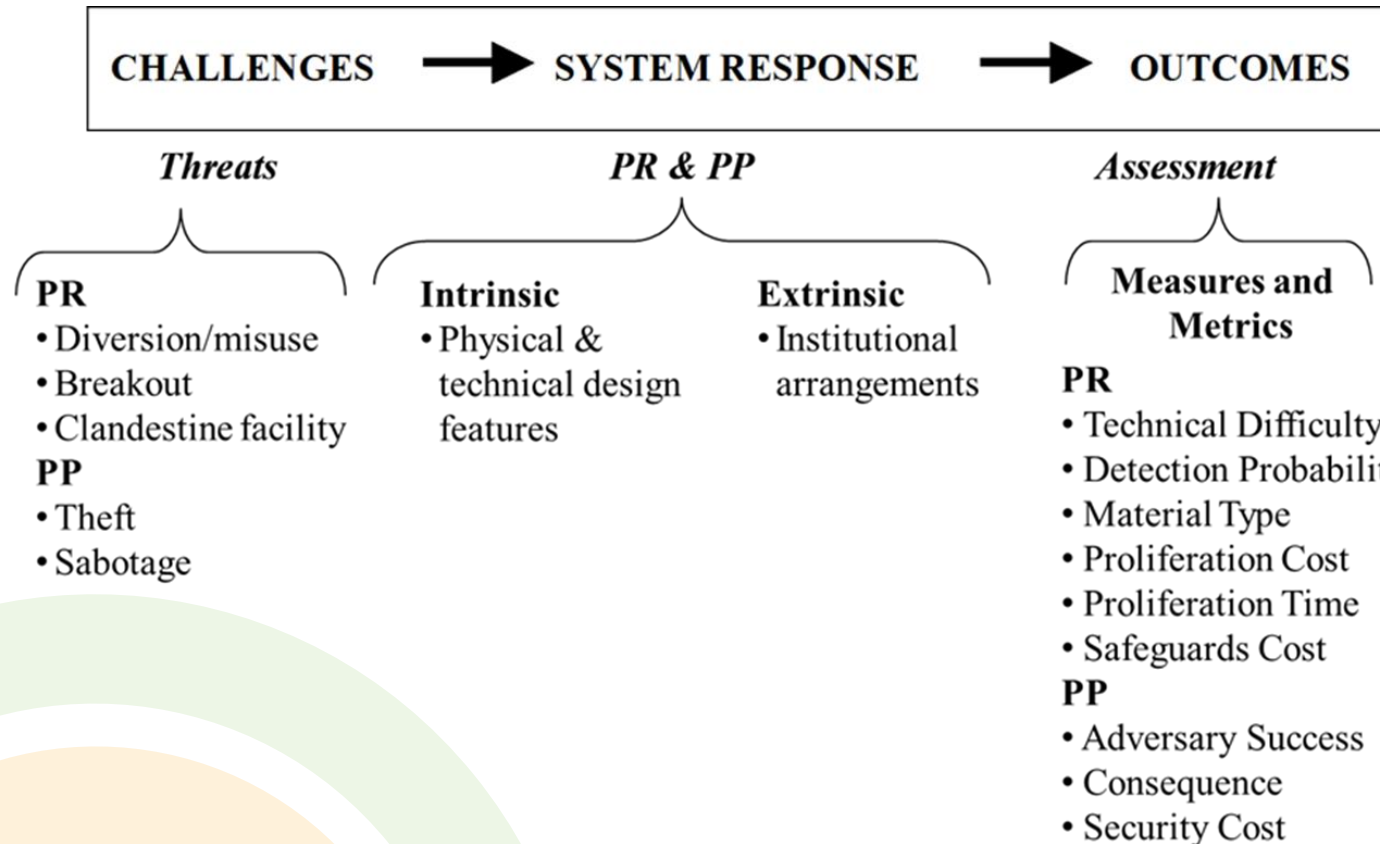
- *Co-Chairs: L. Cheng (BNL-US), G. Renda (EC-JRC), B. Cipiti (SNL-US)*
- *Technical secretary supporting PRPPWG: S. Jeong (NEA)*
- *New IAEA observer:Carolynn P. Scherer*



PRPPWG 33<sup>rd</sup> meeting at the IAEA HQ in January 2023



# PRPP Methodology - Assessment Paradigm



- Decomposes nuclear system into system elements to permit pathways analysis
  - Materials, facilities, processes, fuel cycle facilities, reactors, storage for fresh and spent fuel, nuclear research facilities, transportation links, etc.
- Considers the location of operations and materials, their accessibility and characteristics, and elements such as
  - Material Balance Areas (MBAs),
  - Key Measurement Points (KMPs),
  - Safeguards and physical protection systems.
- Identifies interfaces with other (nuclear) systems that are not part of the Gen IV system being evaluated.

Proliferation, theft and sabotage involve **competing actors**. Important to recognize actors' perspectives and the human interplay.

# Feedback from the GIF Industry Forum (Oct 2022)

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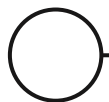
- PR&PP aspects for SMRs and Microreactors
- Explore PR&PP considerations for various siting options (remote, coastal, city, industrial complex, etc.)
- Evaluation PR&PP for floating & transportable reactors (Gen-IV designs)
- Training the next generation (encourage more student, more interactions with university programs, interface with GIF ETWG)
- Collaborative work with EMWG, staffing costs (security and safeguards)

# Major Accomplishments in FY23

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- Participated in the GIF Industry Forum.
- First in-person meeting since 2019.
- Published the PRPP White Paper Crosscut report (March 2023).
- Finalized the MSR white paper (previously published SFR, LFR, SCWR, GFR and VHTR).
- Bibliography (2023 edition); to be published soon.
- Special Panel at the 2023 INMM/ESARDA Joint Annual Meeting
- Contribution to the Joint IAEA-GIF Workshop on the Safety of Non-Water-Cooled Reactors
- 3S collaboration with other GIF working groups and designers.
- Started reviewing the PP measures/metrics of the PRPP methodology.



# PRPP Work Plan 2023-2025

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- Follow up interactions with the GIF System Steering Committee (SSC)
  - Consider prevalent or special PR&PP features for SMRs, micro-reactors, transportable cores, and non-electric applications of nuclear energy.
  - Consider various siting options for SMRs (coastal, remote, city, industrial complex) and effects on PR&PP
- Re-examine the PRPP Evaluation Methodology
  - Consider a training workshop to acquaint new members with the methodology
  - Develop guidance for designers, such as a template for reduced scope evaluation
  - Explore economic benefits of SBD
  - Investigate commonalities, synergies and conflicts between safety, safeguards and security (3S)
- Continue collaboration with the IAEA

# Proposed Physical Protection Measures/Metrics



Probability of adversary success (PAS)

Consequence (C)

Physical protection resources (PPR)

Dispersability (D)

Volatile liquid or gas, Solid high dispersal, solid medium dispersal, solid low dispersal, and robust solid not dispersible in air

Energetic mechanisms (EM)

Multiple energetic mechanisms (phase change, zircaloy oxidation and hydrogen production), Single energetic mechanisms (sodium), no energetic mechanisms

Inherent coolability (IC)

Dependent on power supply with low redundancy and water as UHS (ultimate heat sink), Dependent on power supply with high redundancy and water as the UHS, independent of power supply but water is UHS, independent of power supply and air is the UHS

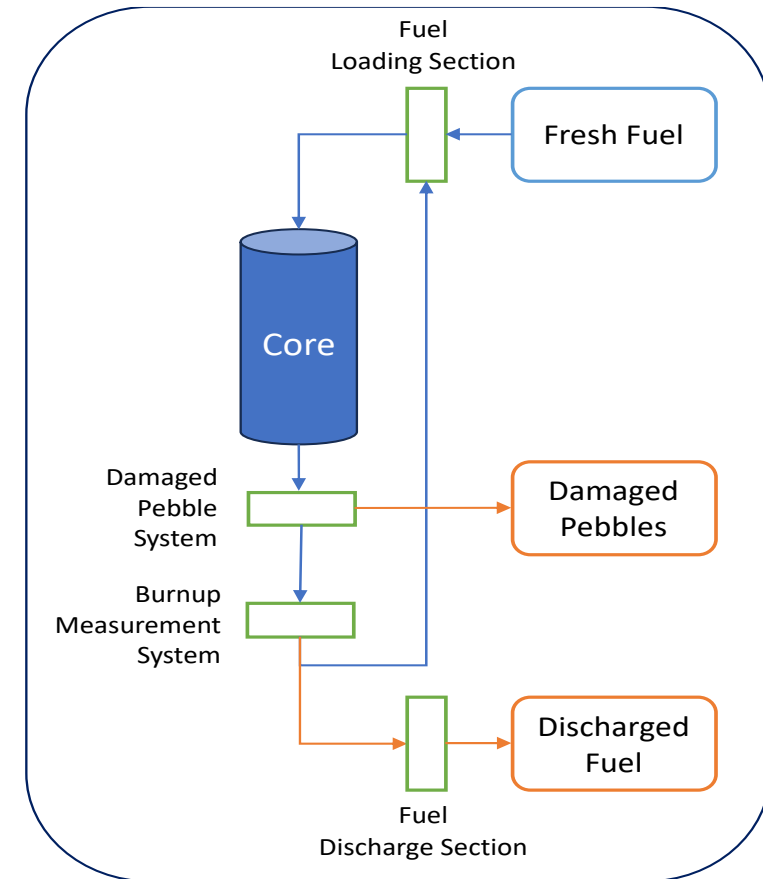
Newly proposed metrics Under evaluation



# 3S Collaboration for Gen-IV Reactors



- Collaboration among PRPPWG, Risk & Safety Working Group (RSWG) and the VHTR SSC
- Collected relevant existing documentation on System description of an example PBR and existing info/studies on safety, security and safeguards
- Identified and reviewed main documents in terms of relevance
- Drafted a system description (VHTR SSC)
- Drafted security description (PRPPWG)
- Reviewed existing information against a Safeguards Design Information Questionnaire (DIQ) (PRPPWG)



# Next Steps

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- 3S activity with VHTR SSC and RSWG: high priority for the group.
- Revisit the PRPP Methodology and plan for an update both to reflect new thinking, changing world conditions, and to help provide background for new members.
- Examine various siting options for SMRs and microreactors and their effect on PR&PP (floating and transportable reactors among potential focus).
- Continue engagement with the IAEA on initiatives to investigate 3S interfaces and interactions in Novel Advanced Reactors.