



ADVANCED REACTOR SAFEGUARDS & SECURITY

# Gen-IV Proliferation Resistance & Physical Protection Working Group Activities

*ARSS Spring Program Review, INL*

PRESENTED BY

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# PRPPWG Membership: Countries and Changes in Members



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

- **Co-Chairs: G. Renda (EC-JRC), B. Cipiti (SNL-US)**
- **Technical secretary supporting PRPPWG: S. Jeong (NEA)**
- **L. Cheng (BNL-US), Co-Chair, retired**
- **Members departures: Vladimir Artisyuk (Rosatom-Ru) => IAEA**
- **New member: Logan Scott (NNSA & ORNL-USA)**
- **New observer: Jorge Navarro (ORNL-USA)**



PRPPWG 34<sup>th</sup> meeting (Annual Meeting) at the NEA HQ in March 2024

# PRPP Working Group Objectives

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- Facilitate introduction of PRPP features into the design process at the **earliest** possible stage of concept development

## → *PRPP by design*

- Assure that PRPP results are an aid to informing decisions by policy makers in areas involving safety, economics, sustainability, and related institutional and legal issues

*“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.”*

# PRPPWG Key Points



- PR&PP considers both intrinsic features and extrinsic measures.
- Intrinsic features are typically more associated with the fuel design and unique performance of the reactor system.
- Extrinsic measures include technologies for materials accountancy, international safeguards, and physical protection system elements. This may include measurements, monitoring, and surveillance.
- So when we talk about materials accountancy or international safeguards, those aspects are part of extrinsic measures so only one part of Proliferation Resistance, but these measures are driven by the intrinsic features.

# PR&PP White Papers Update



- All six reactor technologies White Papers now updated
  - All reports can be obtained at public WEB site:

[https://www.gen-4.org/gif/jcms/c\\_9365/prpp](https://www.gen-4.org/gif/jcms/c_9365/prpp)

- 5 years, 7 GIF WG/SSCs involved, 7 public reports published, several conference papers
- Unique reference set of documents to foster PR&PP by Design into Gen-IV reactors



# PRPPWG Annual Meeting, 19-21 March 2024



## Day 1: Tuesday, 19<sup>th</sup> March.

- Pending Actions
- Preview of Work Plan
- Country Reports
- RSWG Activities
- Current State and Future Focus

## Day 2: Wednesday, 20<sup>th</sup> March.

- Siting Options Study
- IAEA INPRO PR Activities and Concerns for SMR and MR (Micro-reactors)
- 3S Collaboration with RSWG and VHTR SSC

## Day 3: Thursday, 21<sup>st</sup> March.

- PP Measures/Metrics Discussion
- Updating PRPPWG Terms of Reference
- Upcoming Events/Conferences
- PRPPWG Work Plan 2024-2026 and action list for the coming year

# Generation IV PR&PP Siting Study for SMRs and Microreactors



## 1. Introduction

## 2. Siting Options Considered

## 3. PR&PP Analysis of Siting Options

### 3.1. Siting in Remote Locations

### 3.2. Siting Near Population Centers (Cities/Universities/Industrial Complexes )

### 3.3. Floating or Underwater Power Stations

### 3.4. Civilian Marine Propulsion

## 4. Crosscutting Topics

### 4.1. Single vs. Multi Modules

### 4.2. Water vs. Air Cooling

### 4.3. Gen-IV vs. LWR Designs

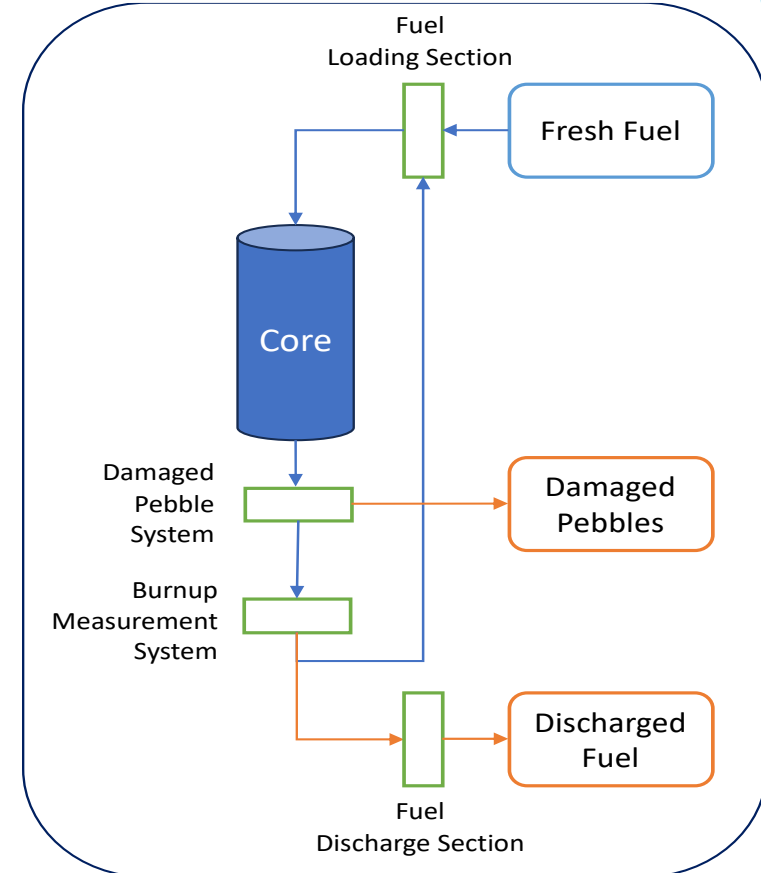
## 5. Conclusions

## 6. References

# PRPPWG/RSWG/VHTR SSC Collaboration on 3S for Gen IV Reactors



- Collected relevant existing documentation on System description 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)
- Beginning to evaluate 2S interfaces and where there may be tension or alignment

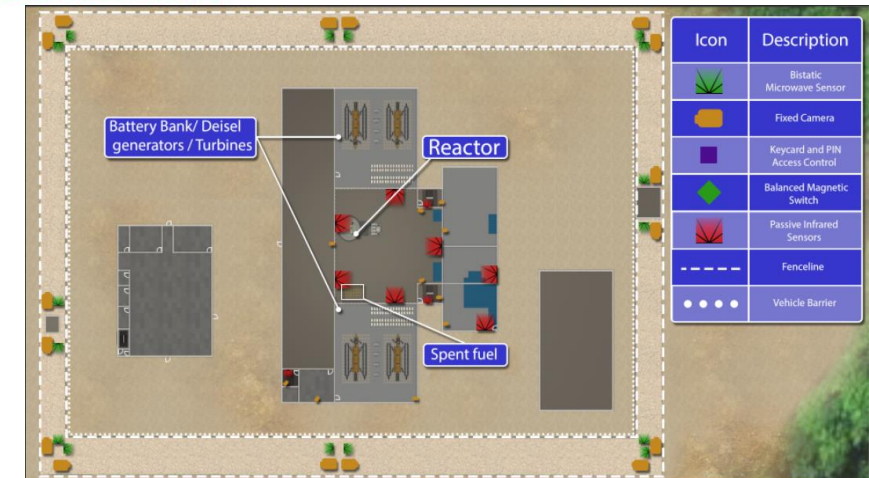
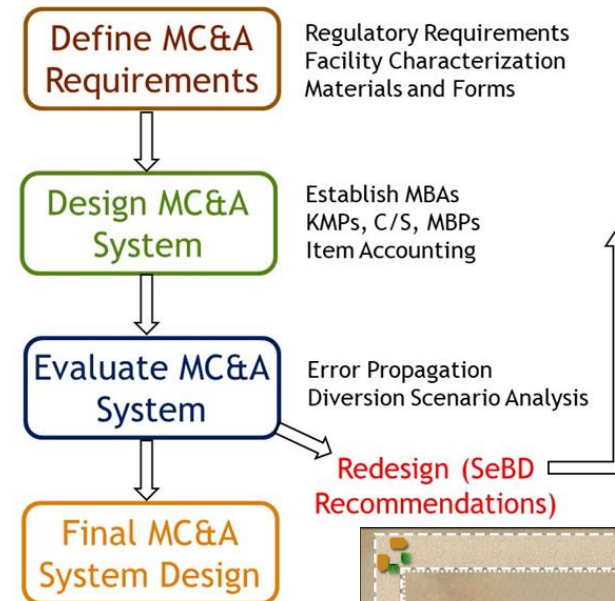




# PRPPWG/RSWG/VHTR SSC Collaboration on 3S for Gen IV Reactors: Security Description



- Based on Design and Evaluation Process Outline (DEPO) process
- Key theft targets include fresh, spent, and damaged fuel
- Sabotage targets include the reactor core, control systems, and potential indirect targets that could cause a radioactive release.
- Protected area with reactor building, fuel handling building, control room, as well as entry control points, guard towers, and perimeter fencing.



# 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

# Summary: PRPPWG Work Plan 2024-2026



- **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.**
- **3S activity with VHTR SSC and RSWG: higher priority for the group. We have started to draft sections on implementation of safeguards and security for the model pebble bed VHTR.**
- **Examine various siting options for SMRs and microreactors and its effect on PR&PP. Floating and transportable reactors that we will loop into this activity.**
- **Work with the Education and Training Working Group to provide more opportunities to give seminars. We'll also look at organizing workshops within our countries on PRPP related topics (after the methodology update is complete).**
- **Liaise with the Economics Modeling Working Group on how to help inform their models with PR&PP related data.**