



Proliferation Resistance and Physical Protection (PR&PP) Working Group Activities

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Objectives of PRPP Working Group

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

→ PR&PP by design

- ***Assure that PR&PP 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.”

PR&PP Methodology

CHALLENGES → **SYSTEM RESPONSE** → **OUTCOMES**

Threats

PR

- Diversion/misuse
- Breakout
- Clandestine facility

PP

- Theft
- Sabotage

PR & PP

Intrinsic

- Physical & technical design features

Extrinsic

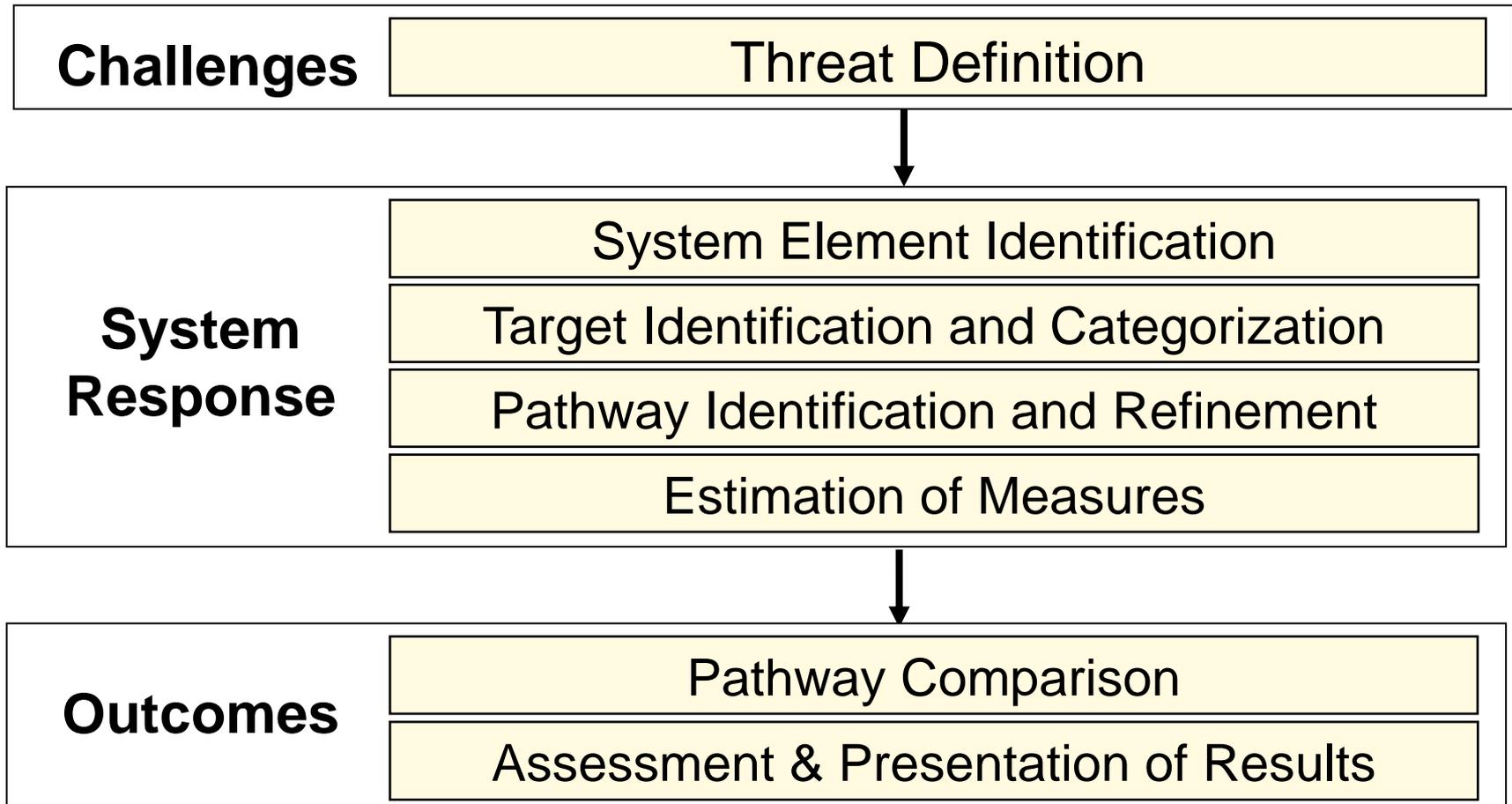
- Institutional arrangements

Assessment

Measures and Metrics

Paradigm is consistent with standard approaches to safety assessment

Evaluation Framework



Measures

Proliferation Resistance

- ***Technical Difficulty***
- ***Proliferation Cost***
- ***Proliferation Time***
- ***Material Type***
- ***Detection Probability***
- ***Safeguards Cost***

Physical Protection

- ***Adversary Success Probability***
- ***Consequence***
- ***Cost of Protection***

Major Accomplishments

- ***The Methodology: developed through a succession of revisions – currently in Revision 6 report***
- ***The “Case Study” approach: an example (sodium-cooled) reactor system was chosen to develop and demonstrate the methodology – resulted in a major report***
- ***Joint Efforts with six GIF design areas (System Steering Committees or SSCs) - resulted in a major report***

All three reports can be obtained at:

https://www.gen-4.org/gif/jcms/c_9365/prpp

PR&PP Methodology

- *A systematic approach to evaluating vulnerabilities in designs with respect to the PR&PP goals.*
 - *It provides the assessment approach that ensures that assessors “did not do things wrong.”*
- *The most comprehensive evaluation methodology for any technology, although conceived for GIF goals.*
- *A complete evaluation framework; specificity of techniques needs to be determined by users.*
- *Freely available on the GIF public website*

Implementation Activities Within National Programs

- **USA**

- **Comparison of alternative fuel separation technologies (relative to PUREX)**
 - **COEX, UREX, pyroprocessing**
 - **Primarily improvements regarding non-state actors**
 - **Potential measurement challenges for large bulk facilities**
- **Multi-laboratory assessment of reactor designs**
 - **SFR, HTGR, HWR, LWR**
- **SMR Princeton study**
 - **Gen II vs SMR (LWR and fast-spectrum)**

Implementation Activities Within National Programs (cont'd)

- **Japan**

- **Evaluation of the methodology (JAEA and U. Bologna)**
- **Comparison of SFR and LWR (presented Oct. 23 at 2014 IAEA SG symposium)**
- **Important to consider PR measures in a particular order**
- **Difficulty incorporating impact of Additional Protocol**
- **Facilitated a better understanding of PR and how the methodology can help meet researchers' needs**

Implementation Activities Within National Programs (cont'd)

- **Canada**
 - **Pre-licensing assessment of two advanced CANDU designs (ACR-1000 and EC6)**
 - **“Pared-down” PR&PP approach, incorporating designer, SSAC and IAEA**
 - **Design improvements identified**

Implementation Activities Within National Programs (cont'd)

- **Europe**

- **“Collaborative Project for a European Sodium Fast Reactor” (CP-ESFR): study of impact of alternative core design options (another pared-down PR&PP application)**
- **MYRRHA (Belgium) – accelerator-driven research reactor: comparison with existing high flux test reactor and study of impact of alternative design variations.**

Workshops on PR&PP

- ***Purpose: to familiarize non-experts on methodology and its applications. Industry, government, academics, and GIF member community attended.***
- ***Upcoming workshop***
 - ***UC Berkeley host, November 2015***
 - ***Students and scholars in Nuclear Science and Security Consortium***
- ***Previous workshops and joint meetings with users and stakeholders: 2004 (USA), 2006 (Italy), 2006 (Japan), 2008 (South Korea), 2011 (Japan), 2012 (Russia), 2013 (IAEA), 2014 (France); with GIF-RSWG: 2003, 2012***

Related Activities with IAEA

- ***Interaction between GIF and the IAEA's INPRO program***
 - ***PRPPWG and INPRO's PROSA (Proliferation Resistance and Safeguardability Assessment) project***
 - » ***The IAEA/INPRO methodology for non-proliferation provides “rules of good practice” for design concepts. It thus provides a checklist that ensures that technology assessors “did things right.”***
 - » ***The GIF/PR&PP methodology is a systematic approach to evaluating vulnerabilities in designs. It thus provides the assessment approach that ensures that assessors “did not do things wrong.”***

- ***Safeguards by Design ongoing at IAEA and in various countries***

PR&PP Considerations

- ***Emerging need for simplified scoping of PR&PP evaluation that can be implemented at early design stages and with limited efforts.***
- ***Not advisable to simplify the methodology for generic application, but...***
- ***Possibility to tailor the needed approaches to the specific needs.***

Path Ahead

- **Continue to work with GIF system designers and SIAP as designs mature.**
- **Continue to interact with other GIF cross-cutting working groups**
 - *e.g. upcoming combined meeting with Reactor Safety Working Group, UC Berkeley, November 2015*
- **Continue to encourage Safeguards by Design**
- **Continue interactions with IAEA (INPRO International Project on Innovative Nuclear Reactors and Fuel Cycles)**
 - *complementary approaches*
- **Continuing to engage new potential users and raise awareness of the methodology**

For more Information

https://www.gen-4.org/gif/jcms/c_44998/faq-on-proliferation-resistance-and-physical-protection

Thank you very much for your attention

ありがとうございました。

BACK UP

PRPPWG Membership: Countries and Organizations

- ***Canada***
- ***China***
- ***Euratom***
- ***France***
- ***IAEA - Observer***
- ***Japan***
- ***NEA - Secretariat***
- ***Republic of Korea***
- ***Russia***
- ***USA***

PRPP Working Group: Terms of Reference

- **Advise** *the PG and EG on PR&PP issues related to Gen IV nuclear energy systems*
- **Maintain capability** *to perform or direct PR&PP studies on request of GIF*
- **Monitor** *the integrity and quality of PR&PP evaluations for GIF (peer review on request)*
- **Maintain configuration control** *over the PR&PP methodology, its documentation and revisions*
- **Strengthen the link** *with Gen IV system designers, in particular with GIF SSCs*
- **Promote and facilitate** *early consideration of PR&PP in the development and design of Gen IV systems*
- **Maintain cognizance** *of related GIF activities, e.g., safety, economics*
- **Maintain cognizance** *of and interactions with non-GIF activities such as IAEA initiatives and specific national initiatives*
- **Promote** *PR&PP goals and broad acceptance of the PRPP methodology*