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

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Presented at:
Session I-2 2015 GIF Symposium, Chiba, Japan, May 19, 2015
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

Challenges
- Threat Definition

System Response
- System Element Identification
- Target Identification and Categorization
- Pathway Identification and Refinement
- Estimation of Measures

Outcomes
- Pathway Comparison
- Assessment & Presentation of Results
### 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


Thank you very much for your attention

ありがとうございます。
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