# *Related Efforts and Future Activities*

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# *Questions and Issues That Technical Proliferation Risk Assessments Can Inform*

- ***Relative advantages of alternative nuclear energy systems***
- ***System architecture (e.g. once through vs. closed fuel cycles)***
- ***International arrangements vs. national programs***
- ***Energy-Environment-Economics-Nonproliferation-Security-Safety Trade-offs***

➢ ***<u>Many stakeholders</u>…information needs to be presented to each user in an understandable way***

# *Evaluations should consider…*

- ***Country Context***
  - ***Objectives***
  - ***Capabilities***
  - ***Strategies***
- ***System design features relevant to PR&PP***
- ***Safeguards and Security Contexts***
- ***Policy considerations***
- ***3 Stages for Evaluation: Acquisition, Processing, Weaponization (not usually)***

# *Assessment Methodologies*

- ***Gen IV PR&PP Evaluation Methodology***
- ***IAEA INPRO Methodology***
- ***MAUI variants***
- ***SAPRA***
- ***Adaptations from Reactor Safety Arena***
- ***Older approaches:***
  - ***NASAP/INFCE***
  - ***TOPS***

# *What we learned from Reactor Safety*

- ***WASH-1400 provided risk perspective, departing from and adding to deterministic, prescriptive perspective***
- ***It helped to set safety goals when requested by Congress in the aftermath of TMI-2 accident***
- ***It highlighted the gaps in risk analysis:***
  - ***Human Factors***
  - ***Core melt and containment response***
  - ***Data Needs***
  - ***Common cause failures, dependencies***

→ ***Lessons for PR&PP Area?***

→ ***Can we risk-inform this area as we do Safety?***

# *Enabling "Safeguards-by-Design"*

- ***Designers need to be informed about "safeguardability" of their product***
- ***Optimization of inherent features and extrinsic measures***
- ***Need a comprehensive tool, but with flexibility to make user-dependent decisions that account for design constraints and operational goals***
- ***PRPP methodology provides this utility***

# *Studies Performed**

- ***ESFR: Example Sodium Fast Reactor w/fuel cycle***
- ***PRR-1: UREX1a, COEX, PUREX***
- ***PRR-2: UREX suite, COEX, Pyro, PUREX***
- ***PRR-3: SFR, VHTR, CANDU, ALWR***
- ***SMR: Integral PWR, Barge Reactor***

***ESFR performed by international group; others by U.S. participants for NNSA***

# *Observations from Evaluation Process*

- ***Multiple pathways/scenarios highlight fact there are no simple answers to the relative PR&PP advantages of different processes***
- ***Even a qualitative analysis is useful for informing decision-makers on "big picture"—e.g., for which threat scenarios do particular process characteristics make a difference, and how, and where do they not.***
- ***Useful framework for integrating key findings and insights from multiple, more narrowly focused, technical studies***

# *The Policy-Technology Nexus*

- ***Policy** informs the statement of the questions to be addressed*
- ***Technical** evaluations are performed to provide clear statements of alternatives (indicating and displaying degrees of differentiation)*
- ***Policy** is then used again to help choose among the alternatives defined in the results*

***Do not** infuse technical evaluation portion with subjective notions from policy*

# *Possible Future Applications for PR&PP*

- ***Enhancing GIF Designs***
- ***Enabling "Safeguards by Design"***
- ***Guiding Future Global Fuel Cycle Architectures***
- ***Integration of PR&PP with Other Performance Objectives***
- ***PR&PP methodology as a Quality Assurance Tool***
  ***-benchmark standard***