INPRO Methodology and SMR: Review/recommendations for Task 2 revisions?

INPRO Group

Dialogue Forum #6: Licensing and Safety Issues for Small and Medium-Sized Reactors

Vienna, Austria, July 2013
INPRO Methodology - comprehensive, internationally agreed, technology independent (?), criteria-based sustainability assessment tool

Areas of assessment: economics, safety, waste management, proliferation resistance, physical protection, environment and infrastructure
Structure of INPRO requirements

14 Basic Principles

52 User Requirements

150 Criteria (Indicators + Acceptance Limits)

goals for development of sustainable NES

actions to be done by designer, operator or State to meet goal

metrics to check whether actions have been taken properly
Example of INPRO requirements

Area of Safety of NPP

BP1 Enhance defence in depth
- UR1.1: increase of robustness
- UR1.2: detection and interception of deviations
- UR1.3: reduction of frequency of DBA
- UR1.4: reduction of frequency of release to containment/confinement
- UR1.5: prevention of release to environment

BP2 Emphasize inherent safety and passive systems
- UR1.6: demonstration of independence of DiD levels
- UR1.7: improvement of Human Machine Interface

BP3 Radiation risk comparable to other industrial facilities

BP4 Sufficient R&D for innovative designs

Correspond to five levels of DiD
Example of INPRO requirements (cont.)

UR1.5: Prevention of release to the environment

CR1.5.1 Frequency of major release to environment < $10^{-6}$

CR1.5.2 Consequences sufficiently low to avoid necessity for evacuation. Appropriate offsite mitigation measures (e.g., temporary food restrictions) are available.

CR1.5.3 Risk comparable to facilities used for a similar purpose

A major release of radioactivity from an installation of a NES should be prevented for all practical purposes, so that NES installations would not need relocation or evacuation measures outside the plant site, apart from those generic emergency measures developed for any industrial facility used for similar purpose.
Evolution of INPRO methodology

Early versions

2003
- TECDOC-1362
  *Guidance for the evaluation of innovative nuclear reactors and fuel cycles*

2004
- TECDOC-1434
  *Methodology for the assessment of innovative nuclear reactors and fuel cycles*

Current version

2008
- TECDOC-1575
  *Guidance for the Application of an Assessment Methodology for Innovative Nuclear Energy Systems INPRO Manual -- Overview of the Methodology*

2014 -
- Planned
  *Commenced in 2012*
INPRO methodology update project

- Project initiated by INPRO Steering Committee in July 2012
  - Special request to incorporate lessons learned from Fukushima Daiichi NPP accident
- 16 Member States have confirmed interest
- Kick-off meeting: 21-23 November 2012
- 194 comments from the INPRO methodology users since 2008 in all areas are to be incorporated
  - 22 more proposals are to be covered in a separate task (focuses on concept designs)
- Updated manual on Economics in publication (June 2013);
- Draft volumes on Infrastructure, Waste management and Physical Protection are under discussion.
INPRO Methodology and SMR

• Limited experience of SMR assessments (early studies, NESA of Indonesia started in 2012, NESA of Romania started in 2013);
• Many SMRs are conceptually comparable to large scale commercially available NPPs – INPRO Methodology captures these;
  • Assessment of Gen IV reactors suggested in the framework of INPRO-GIF collaboration.
• Economics – learning curve approach needs to be further elaborated to be incorporated into the assessment method;
• Infrastructure – Does nuclear regulation properly cover, e.g. modular design including factory build and shipment?
• Safety – probability/consequence calculation issues, reference design (e.g. for operating experience data) etc.
• Potential to ship fuelled NSSS modules is special case of TNPP.
Thank you!