IAEA TC Project INT/4/142: Promoting Technology Development and Application of Future Nuclear Energy Systems in Future Nuclear Energy Systems in Developing Countries

Workshop on IAEA Tools for Nuclear Energy System Assessment for Long-Term Planning and Development

IAEA, 20–23 July 2009

Overview of the INPRO Methodology in the area of Safety

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Overview on INPRO methodology in the area of Safety

- **Basis** of INPRO requirements:
  - IAEA safety standards, in particular the **Fundamental Safety Principles;**
  - **Utility requirements**, e.g. EPRI Advanced Light Water Reactor Utility Requirements, EU Utility Requirements, etc.
  - **Extrapolation** of current trends assuming a large increase of NP in the 21st century.
- **Goal** of INPRO requirements:
  - Guidance for the designer how to improve safety design.

Overview on INPRO methodology in the area of Safety

- Reference design necessary for assessment:
  - Operating unit/facility end of 2004.
- INPRO has developed 4 basic principles (BP) in this area, applicable to both reactors and fuel cycle facilities.

Relation between INPRO basic principles (BP1 to BP4) in the area of safety and Fundamental Safety Principles (FSP)

	FSP3	FSP5	FSP6	FSP7	FSP8	FSP9
BP1					X	X
BP2		X				
BP3			X	X		
BP4	X	X				

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- **BP1 (defence in depth):** *Installations of an Innovative Nuclear Energy System shall incorporate* ***enhanced defence-in-depth*** *as a part of their fundamental safety approach and ensure that the levels of protection in defence-in-depth shall be more independent from each other than in existing installations.*
  - **BP1 has 7 associated user requirements (UR1.1.to UR1.7).**
  - **UR1.1 to UR1.5 cover level 1 to 5 of the defence in depth concept (DID).**
  - **UR1.6 asks for increased independence of DID levels.**
  - **UR1.7 requires adequate human machine interface.**

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- **BP2 (Inherent safety):** *Installations of an INS shall excel in safety and reliability by incorporating into their designs, when appropriate,* ***increased emphasis on inherently safe characteristics and passive systems*** *as a part of their fundamental safety approach.*
  - **BP2 has one associated user requirement :**
  - **UR2.1 encourages elimation/minimization of hazards by incorporating inherent safe characteristics and/or passive systems, when appropriate**.

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- **BP3 (Risk of radiation):** *Installations of an INS shall ensure that the* ***risk from radiation exposures*** *to workers, the public and the environment during construction/ commissioning, operation, and decommissioning,* ***are comparable to the risk from other industrial facilities used for similar purposes****.*
  - **BP3 has two user requirements based on the concept of optimization of radiation protection to reduce the health hazards.**
  - **UR3.1 aks to use automation, remote maintenance and operational experience to reduce *occupational dose*.**
  - **UR3.2 asks for reduction of *public dose*.**

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- **BP4 (RD&D):** *The **development of INS shall include** associated Research, Development and Demonstration (**RD&D**) work **to bring the knowledge** of plant characteristics and the capability of analytical methods used for design and safety assessment **to at least the same confidence level as for existing plants.***
  - **BP4 has 4 user requirements (UR).**
  - **UR4.1 aks for establishing an adequate safety basis before commercial deployment;**
  - **UR4.2 asks for achieving thorough understanding of all physical and engineering phenomena;**
  - **UR4.3 asks to check the necessity of a pilot plant;**
  - **UR4.4 asks to use, where feasible, deterministic and probabilistic methods in safety analysis**

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- The INPRO assessor(s) may not perform himself the analysis necessary to support the assessment. However, he/they will need the capability to evaluate whether the evidence used for that purpose is appropriate
- Good knowledge of IAEA Safety Standards is necessary to apply the INPRO methodology in the area of Safety
- The Department of Nuclear Safety and Security of the IAEA provides services to help Member States develop capability to apply the Safety Standards http://www-ns.iaea.org/training/default.htm

Thank you for your attention