INPRO Dialogue Forum on Legal and Institutional Issues in the Global Deployment of SMRs

INPRO « Factory Fuelled SMRs » Collaborative Project

Deployment & Implementation: a guide for users

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• Summary

• Part 1: What is this Project?
• Part 2: What are SMRs?
• Part 3: What are the Project Objective & Approach?
• Part 4: What is the Statement of this Project? (under progress)
• Conclusion
Let us know

Part 1
What is this Project?
Context of the Project – INPRO Tasks

Task 1
Global Scenarios

Task 2
Innovations

Task 3
Sustainability Assessment

Task 4
Dialogue & Outreach

2.1 Study
Back End

2.2 CP
RISC

2.4 CP
FANES

2.5 CP
WIRAF

2.3 – Collaborative Project on TNPP Phase II:

« Case Study for the Deployment for Factory Fuelled Small & Modular Reactors »
INPRO Steering Committee Decision (June 2014)

• Background
  • A preliminary study (INPRO study on Legal and institutional issues of Transportable Nuclear Power Plants) addressing the specific regulatory challenges of TNPP was performed in 2008-2013
  • It resulted in the Nuclear Energy Series Technical Report No. NG-T-3.5
    • So-called "TNPP Phase I" Project

• Statement
  • Current activity focuses on Factory Fuelled SMRs designing / deployment in countries other than the country(ies) of origin

• Decision
  • Launching a Collaborative Project with the objective to develop a “guide for users”
    • Collaborative Project on TNPP Phase II
  • To develop a guide for users (not a guideline)
    • For Deployment and Implementation of such SMRs
« Factory Fuelled SMRs » Project

• A “Core Group”
  • 7 countries
  • New-comers are welcome

• Output
  • A TECDOC series publication at 2018

• 3 Consultant Meetings
  • Kick-Off: February 2015

• 2 Extended Consultant Meetings
  • June 2016:
    • Legal / Licensing & Regulations / **Insurances**
    • “Intuitu Personae” : ASSURATOME / CEA / Rossatom / US Dept. of States / US NRC
  • November 2016: (to be held)
    • Emergency Preparedness – Safety - Environment / Physical protection / Safeguards
And Then!

Part 2
Part 2 – Factory Fuelled SMRs CP

What are FF SMRs?
Definitions (1/2)

• **SMR means**
  - Small
    - Small: less than 200 MWe *(otherwise VVERs-440 are classified as « SMRs » !?)*
    - Easily connected on an existing grid (Rule of 10% - Grid of 2 GW maximum)
    - Enabling gradual investment
    - Achieving gradual following of the shift in times of consumers behavior, for decades
    - Allowing for later choices related to the mix a country wants (no choice bindings)

  • Modular Reactor:
    - the reactor is built up offsite, in a Factory / Shipyard *(FULL modularity)*
    - This FULL modularity enables **Standardization**

• **Standardization means**
  - Industrialization / assembly-line
  - Tested on the Service Factory
    - With fuel
    - Certified by the local NRA (country of origin)
Definitions (2/2)

• Factory Fuelled means (see the following schemes)
  • At least 2 sites (very reduced civil work) (A single or 2 operator(s))
    • The power Production Site, so-called the Operating Site
    • The refuelling and maintenance Site, so-called the Service Factory

A single Service Factory can be shared by several Operating Sites

• SMR transportation between these 2 sites
  • The FF SMR is physically transportable, but is not designed to either produce energy during transportation or provide energy for the transportation itself

• For the Project: Enforcement based on 3 Case studies
  • Case Study 1 - Factory fuelled sub-surface marine-based SMR (example later used)
  • Case Study 2 - Factory fuelled floating SMR
  • Case Study 3 - A small land-based factory fuelled transportable SMR
Case Study 1 – Scheme (sub-surface marine-based SMR)
Case Study 2 – Scheme (Floating SMR)
Conclusion: FF SMRs versus Land Based SMRs and NPPs (tentative)

**Scheme of Land Based SMRs / NPPs**

(everything in the same site)

**“Land Based NUCLEAR POWER PLANT”**

**NUCLEAR ISLAND (NI)**
- Nuclear Unit: Reactor and nuclear auxiliary buildings, including safety related buildings (safeguard system building, safety related electrical and I&C building, diesel building, etc.)
- The Balance Nuclear Island (BNI), which includes the fuel building, waste building

**CONVENTIONAL ISLAND (CI)**
- Structures and systems that support power generation: the machine hall & turbine generator (TG), steam and water supply systems, electrical building (non-safety related)

**BALANCE of PLANT (BOP)**
- Supplemental systems and structures required during plant operations: plant cooling components (e.g. cooling towers) and service water supply, water outlets, maintenance building, power delivering platform, offices, etc.
Conclusion: FF SMRs versus Land Based SMRs and NPPs (tentative)

Any Land Based SMRs / NPPs
- NI, CI and BOP are grouped in the same site

Factory Fuelled SMRs (transportability)
- Nuclear Unit & BNI are separated in 2 sites
  - Service Factory & Operating Sites
  - The Service Factory (BNI) is shared by several Operating Sites
- BOP is “spread” within these 2 sites

“Land Based NUCLEAR POWER PLANT”

NUCLEAR ISLAND (NI)
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What are the Project Objective & Approach?
Overall – Objective & Approach (1/2)

• An Overall Objective
  • To examine, in details, legal and institutional issues for export deployment of a Factory Fuelled SMR and to investigate other aspects of transportable and modular reactor facilities

• To achieve this objective, the FF SMRs Collaborative Project will
  • Fill the gaps identified in the international nuclear laws to cover the operational cycle of factory fuelled SMRs and all its life cycle, including the construction phase and the training
  • Fill the gaps identified regarding the fuel loaded NPPs transport and the international law, including cases of fuel loaded SMR transport through the territorial seas and territories of a third country. International Maritime Organization/IAEA agreements, recommendations and documents would be reviewed and non-covered issues will be solved
  • Propose solutions in relation with the control supervision and its continuum over all the life-cycle, both in relation with Utilities and Authorities
  • Determine the possible responsibilities schemes between the authorities and any stakeholders, including emergency crisis and civil liability
  • Determine the possible adapted Licensing process
Overall – Objective & Approach (2/2)

- Internal activities of the Core Group (Consultant’s Meetings)
- Questioning External Experts to get their feedback (Extended CMs)
  - Including Insurances: the fundamental issue for a Project

- No Project without Insurances (Pool of Insurances)
  - Land Based NPPs
  - Land Based SMRs
  - Factory Fuelled SMRs

- Insurantial engineering survey
  - Overall Acceptability (local environment, population, economy, industry, agriculture…)
  - Legal issues (international regimes, national issues, national law & regulation …)
  - Nuclear safety (design, operations and culture)
  - Radioprotection and radiological environment
  - Emergency Preparedness
  - Physical protection
  - Safeguards
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  - Land Based NPPs
  - Land Based SMRs
  - Factory Fuelled SMRs
  
  This IAEA Publication will be considered by insurances as « Usable »

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  - Safeguards
Activities Taking into Considerations the Milestones: to be adapted for FF SMRs (Supplier & Host States Authorities, Customer & Designer)
And now the rest!

Part 4
Part 4 – Factory Fuelled SMRs CP

Statement of the Project

(not fully adopted – in progress)
1. INTRODUCTION
   - 1.1. Background
   - 1.2. Objective
   - 1.3. Scope
   - 1.4. Structure

2. DEFINITIONS

3. REFERENCE CASES
   - 3.1. Assumptions
     - 3.1.1. Identifying necessary host country interactions with the service facility country
     - 3.1.2. Identifying transferred liability between parties, including accidents and malfunctions at site, service facility and in transit
   - 3.2. Reference scenarios for deployment
     - 3.2.1. Case Study 1 - Factory fuelled sub-surface marine-based SMR
     - 3.2.2. Case Study 2 - Factory fuelled floating SMR
     - 3.2.3. Case Study 3 - A small land-based factory fuelled transportable SMR - not harmonized
   - 3.3. Conclusions (Comparison – Similarities and Differences)
Adopted Content – Summary (2/3)

• 4. LICENCING PROCESS FOR FACTORY FUELLED SMRs
  • 4.1. Licensing steps for the service facility, transport and the operating site
  • 4.2. Host country interactions with the service facility country
  • 4.3. Liability transfer between parties, including accidents and malfunctions at site, service facility and in transit
  • 4.4. Transportation of SMRs
  • 4.5. Conclusion on licensing issues

• 5. SPECIFIC ISSUES RELATING TO NUCLEAR SAFETY FOR FF SMRs
  • 5.1. Introduction
  • 5.2. Applicability of the IAEA safety standards
  • 5.3. Safety issues related to the siting, design and operation
  • 5.4. Building capacity in regulatory bodies
  • 5.5. Building capacity in codes and standards organizations
  • 5.6. Safety regulation of components
  • 5.7. Emergency planning – onsite and offsite
  • 5.8. Training FF SMRs operating and maintenance staff
  • 5.9. Conclusion on safety issues
• 6. PHYSICAL PROTECTION ISSUES RELEVANT TO FF SMRs
  • 6.1. Physical protection at site, service facility and in transit – including characterizing
  • 6.2. Set of Threats, Design Basis Threat examples (onshore an offshore DBTs)
  • 6.3. Conclusion on physical protection Issues

• 7. SAFEGUARDS ISSUES RELEVANT TO FF SMRs
  • 7.1. Application of IAEA safeguards
    • 7.2.1. Countries under different safeguards agreements
    • 7.2.2. Authority to receive and verify design information and material inventory in the Service facility state
    • 7.2.3. Ability to receive and verify design information and material inventory in the Host state
    • 7.2.4. New technologies (e.g. satellite imaging)
    • 7.2.5. New policies (e.g. reduce reliance on reverification)
    • 7.2.6. Repatriation of spent fuel from the Host state to the Service facility
  • 7.2. Conclusion on safeguards issues
Convention on Safety

• Due to the definitions (« fixed facility »)
  • Drafters of the convention intended not to cover power transportable installations
  • As far as a SMR is a power installation, it is not covered
  • However, the facilities for management of radioactive waste or spent fuel which are directly related to a SMR are covered (the Service Factory)
  • Or you think the immersed and floating nuclear unit is « fixed »

• All kinds of SMRs could fall under the term of “facilities », as mentionned within
  • The Fundamental Safety Principles
  • General Safety Requirements

• Any principles provided within the safety convention has to be applied on FF SMRs
  • Even if the Convention definition does not include « transportable nuclear reactors » !!!
Convention on Transport & Regimes

- INF (IMO)
  - The fuel loaded in the SMR may be considered as a package of nuclear fuel and, as such, as an INF Cargo

- IAEA Safety requirements TS-R-1
  - The barge of the floating SMR is a vessel and the SMR may be considered as its cargo.
  - But, the floating SMR itself cannot be seen as a vessel since its purpose is not to carry cargo (nuclear fuel)

- FF SMRs fall under its terms and no additional wording is required
Liabilities – Third party for Nuclear Damage

- Paris & Vienna Conventions
  - To crisp the situation!

- Possibility to integrate SMRs in the scope of application of these 2 conventions

- With regard immersed and floating FF SMRs
  - It may be wondered whether provisions of this convention which include considerations of site can apply
  - May a site be other than terrestrial? (consideration related to the définitions)
Emergency Preparedness & Response

- Convention on Assistance in Case of a Nuclear Accident or Radiological Emergency

- Convention on Early Notification of a Nuclear Accident
  - The Convention on the Physical Protection of Nuclear Material and Nuclear Facilities
  - The IAEA Nuclear Security Fundamentals
  - The Nuclear Security Guidance Series

- FF SMRs fall under its terms and no additional wording is required
Physical Protection (1/2)

• Rests on the well recognized basic principle of nuclear security,
  • i.e., that the responsibility for the establishment, implementation and maintenance of a physical protection regime within a State Party rests entirely with that State

• The application of existing physical protection recommendations, would appear **sufficient to address the known concerns**.
  • The Convention on the Physical Protection of Nuclear Material and Nuclear Facilities
  • The IAEA Nuclear Security Fundamentals
  • The Nuclear Security Guidance Series

• Transit of nuclear material between States has long been dealt with
  • Agreement that the Supplier State would be responsible for physical protection during all transit would appear appropriate.
  • Potential for sabotage and the potential consequences of a malicious sabotage act, vice theft, would be a principal driver for security during transport.
Physical Protection (2/2)

- **Physical protection of a land based FF SMR should present no unique physical protection problems**
  - Some design features, such as in ground deployment, might create additional physical protection barriers but also concerns for response to an attack.

- **Physical protection of a barge mounted or submerged FF SMR requires careful consideration**
  - Intrusion detection, physical barriers and response to a threat created by the possibility of submerged access to the facility.
  - May prove desirable to incorporate design features into the FFS to harden it against attack beyond what would be normal for a nuclear power plant.
Safeguards (1/2)

• The Supplier State, the Host State and the IAEA all have different rights and obligations
  • Supplier State **MAY** make a facility eligible for safeguards, but need not, and the IAEA **MAY** select it, but need not
  • Host State **MUST** make the facility eligible for safeguards and the IAEA **MUST** select it

• Because the Host State will receive from the Shipping State a manufactured, sealed facility containing nuclear material:
  • The Host State will not have the ability to report to the IAEA on facility design and nuclear material inventory
  • The IAEA will not have access it the Host State to either the facility or material for verification of design and material inventory.
Safeguards (2/2)

• The Supplier State will need to provide the Host State with sufficient information on the design, manufacturing, assembly and operation of the reactor module and access to verify that information so that the Host State can satisfy its reporting requirements to the IAEA.

• The Supplier State will need to provide the IAEA with sufficient access to the manufacturing and assembly processes and the fueling, defueling and refueling operations to verify that the design information and that the material content of the reactor is as reported.

• The IAEA will need to take advantage of its opportunities to verify design information, make material measurements, and apply containment/surveillance (C/S) measures to adequately safeguard the reactor in the Host State.
  • It MAY wish to develop and apply new technologies.
TNP & ICSANT

- Treaty on the Non-Proliferation of Nuclear Weapons (TNP)
  - It encompasses FF SMRs

- International Convention for the Suppression of Acts of Nuclear Terrorism (ICSANT)
  - Precisely applicable to SMRs, both during initial transport of the non-fuelled SMR and during the whole cycle of the operation of the fuelled SMR
Conclusion
Conclusion: What do we want?

- To develop a Guide for users
- « Certified » by insurances
- Based on Treaties & Conventions
- Mentioning how they are used and applied for factory Fuelled SMRs
Thank you for Attention

Questions