Contribution ID: **456** Type: **Paper**

Small modular reactor: approaches to physical protection provision

SMRs are newer generation reactors designed to generate electric power up to 300 MW, which components and systems can be shop fabricated and then transported as modules to the sites for installation as demand arises.

There is increasing interest in small modular reactors (SMRs) and their applications. Many SMRs are envisioned for niche electricity or energy markets where large reactors would not be viable.

SMRs could fulfil the need of flexible power generation for a wider range of users and applications, including replacing aging fossil power plants, providing cogeneration for developing countries with small electricity grids, remote and off grid areas, and enabling hybrid nuclear/renewables energy systems.

Currently, there are more than 50 SMR designs under development for different application.

According to the IAEA document ADVANCES IN SMALL MODULAR REACTOR TECHNOLOGY DEVELOPMENTS, there are three groups of SMR:

- land based
- marine based
- other/mobile (only project).

Despite a small amount of nuclear material used in small modular reactors, it surely needs the organization of the relevant measures of physical protection provision. Let the author briefly analize the applicability of approaches to physical protection organization, which are described in the IAEA documents of NS series, for each SMR type.

Land based small modular reactors: Russian specialists argue that the approaches to organizing physical protection of nuclear materials, which are given in the IAEA document NSS-13, are fully and completely applicable to this type of reactors. There is no fundamental difference from the organization of physical protection of reactors with the power of up to 300 MW and over 300 MW. The essential parameter is the category of nuclear material, on the basis of which, pursuant to NSS-13, a particular set of physical protection measures needs to be applied.

Marine based small modular reactors etc.:

this type of reactors requires consideration of their life cycle, which includes the following basic stages:

1) platform construction;
2) power unit (unfuelled reactor) installation;
3) transportation to the deployment site;
4) fuel loading;
5) operation.

It should be noted that stages 3 and 4 may be swapped around.

In terms of physical protection, transportable SMR concepts (Transportable and/or Floating Nuclear Power Plants (TNPPs and FNPPs respectively)) are not “traditional”nuclear facilities but are considered nuclear facilities when stationary.

If the fuel is loaded prior to the unit transportation to the operation site, its physical protection should be provided in accordance with NSS-13 and also at the operation site.

During the transportation process (either as a part of the unit of separately from in), the physical protection of nuclear materials must be provided in accordance with the Security of Nuclear Material in Transport; NSS26-G.

The methodology of design and evaluation of physical protection systems and measures are similar for each type of SMR. Each State and reactor type has its own threats in the area of nuclear security, but the methodology for developing physical protection measures, contingency plans and/or situations requiring emergency response remains the same.

Assuming that SMRs follow recommendations for a nuclear facility when operating and nuclear security guidance for nuclear materials during transportation, we can conclude that the current IAEA nuclear security documents are applicable to SMRs.

Experience in implementing nuclear security in SMRs may lead to modifications to guidance in the future. Therefore, Member States should continue collaboration in technical exchanges regarding design and evaluation for the physical protection of SMRs and IAEA should extend this experience to develop specific guidance on SMRs if needed in the future.

State

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Gender

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Track Classification: PP: Nuclear security of new nuclear technologies (e.g., small modular reactors)