CRP on Development of Approaches, Methodologies and Criteria for Determining the Technical Basis for Emergency Planning Zone(s) for Small Modular Reactor Deployment

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Outline:

1. Setting up the problem: current situation on EPZ for operating reactors (mostly large LWR)
2. SMR features that may impact EPZ
3. The CRP on SMR EPZ: background, objectives and expected outcomes
4. Key aspects to be taken into account for EPZ/D determination and its inclusion in CRP
EPR Requirements and SMR

- GSR Part 7 fully applicable to new reactor designs, as well other nuclear or radioactive facilities
- EPR requirements are formulated in IAEA SS on a graded approach (EP Categories)
- Hazard assessment will ultimately determine the scope of EPR arrangement, including Emergency Planning Zones and Distances (EPZ/D)
- More detailed guidance provided (in particular, for LWR) in lower level EPR guidance publications (i.e., EPR-NPP Public Protective Actions).
- Emergency planning zones and distances sizing may be influenced by both design aspects and site related aspects
Emergency planning zones and distances for LWRs
[IAEA EPR-NPP-Public Protective Actions 2013, Section 4, Fig. 4 and Table 3]

<table>
<thead>
<tr>
<th>Power MW(th)</th>
<th>Facility</th>
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<tbody>
<tr>
<td>≥ 1000 MW(th)</td>
<td>PAZ - Precautionary action zone</td>
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<tr>
<td>100 to 1000 MW(th)</td>
<td>UPZ - Urgent protective action planning zone</td>
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<td></td>
<td>EPD - Extended planning distance</td>
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<td>ICPD - Ingestion and commodities planning distance</td>
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- **PAZ**: 3 to 5 km
- **UPZ**: 15 to 30 km
- **EPD**: 100 km, 50 km
- **ICPD**: 300 km, 100 km

Severe deterministic health effects possible
Stochastic health effects possible
Reference publication for LWRs

- Overview document
- For off-site decision makers
- Addresses public protective actions for a severe emergency at a LWR
- In plain language

Published for LWRs but:
- **Basic concepts may apply to all designs**
- The suggested sizes for EPZ/D may differ for other kind of reactors, specially reactors with enhanced safety features like SMR
- No commonly accepted, technically sound methodology exists to date to define size of EPZ/D to SMR
- SMR concept encompasses very different technologies, which makes situation even more complex
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SMR features that may impact EPZ/D sizing:

1. Strengthened safety features will likely lead to lower probability of releases. However, low probability events (beyond DEC) and security events should be taken into account in the hazard assessment.

2. It’s seems likely that hazard assessment results will lead to smaller source terms. This would influence EPZ/D size, but not in a linear fashion (the closer to reactor, the lower effect of source term reduction in EPZ/D size). In addition, there are many different technologies in SMR and potential for reduction will not likely be homogenous.
SMR features that may impact EPZ/D sizing:

3. Duration of release after its onset could be likely long. That means that shift in wind direction and change in meteorological conditions may take place during the release.

Impact on the directions in which effects are possible. EPZ/D consideration of 360 degrees impact will likely continue being necessary.
SMR features that may impact EPZ/D sizing:

4. Timing of release may also be modified (to a later release). This could possibly involve certain shift of some protective actions to early phase instead urgent phase.

5. Uncertainties about emergency status and evolution will likely continue being high, specially in the first days of the emergencies. That means that Emergency Classification System still will be required.

But all the above are just “Educated Guesses”, we don’t have adequate methodology yet!!
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CRP on EPZ for SMR deployment

- **Duration:**
  - 1 January 2018 – 31 December 2020

- **RCM-1 planned to take place between next May 14-17 2018**
Background and Objective

• Main field of activity
  – To provide a forum for R&D and technical exchange for MS to address aspects of emergency preparedness & response (EPR) specific for SMR deployment, particularly the size of Emergency Planning Zones (EPZs)

• Background
  • Upon different requests from MS with near-term deployable SMR designs (China, Argentina) and newcomers interested in SMR (Indonesia, Saudi Arabia) for the Agency to provide guidance on determining the technical basis for EPZs for SMR

• Objective
  – To develop approaches and methodologies for determining the need for off-site EPR including the size of EPZs for SMRs taking account of the enhanced safety performance of SMRs and evaluating design-specific, defence-in-depth and site-specific technical basis to be provided by SMR developers, nuclear regulators, emergency planners and users/utilities
Overall Expected Outcome and Results

• Overall Expected Outcome
  – Technically sound and consistent technical basis and information that could be used as an input into the new guidance on EPR arrangements, including EPZ/D, for SMR. This includes the identification of technology specific factors for different SMR that may influence: source term and timing of the release; possible sequences to be considered for emergency classification system
  – Definition of consistent approaches, methodologies and criteria for determining the need for off-site EPR, including EPZ/D size, for SMR deployment

• Expected associated outcome
  – IAEA TECDOC and/or other publication(s) that discuss specific design and safety aspects as well as technical basis and approaches/methodologies that would enable determining the size of EPZ for SMR
CRP on EPZ for SMR deployment

- Countries Participating in the CRP:
  - Under Research Agreement: China, United Kingdom, Japan, Finland, Netherlands (representing EC through JRC-Petten), Saudi Arabia (with Republic of Korea), Canada, USA
  - Under Research Contract: Indonesia, Tunisia, Israel, China, Argentina
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Key aspects to be taken into account for EPZ determination (also for SMR)

- Hazard assessment (including very low probability events and beyond design basis accidents)
- Estimation of source term and timing
- Dose projections to the public
- Establishing criteria for implementing response actions (i.e. generic criteria)
- Evaluate effectiveness of response actions
- Consider available resources
- Integrate into overall protection strategy (size of EPZ/D will be derived)
- Adapt to local / national circumstances
- Optimize

Activities suitable for being developed under CRP

Activities that should always be developed at national level
Thank you!