



IAEA

International Atomic Energy Agency
Atoms for Peace and Development

Second Meeting of the Technical Working Group for Small and Medium-sized or Modular Reactor (TWG-SMR) Vienna, 8 – 11 July 2019

*Licensing and Regulatory Framework for SMR Deployment:
Overview of SMR Regulators' Forum*

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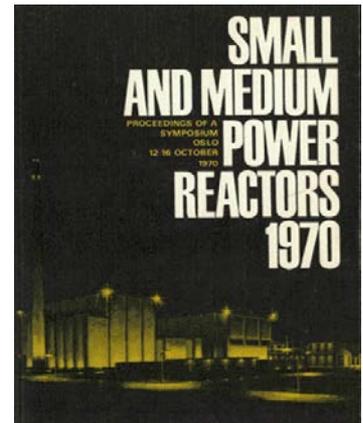
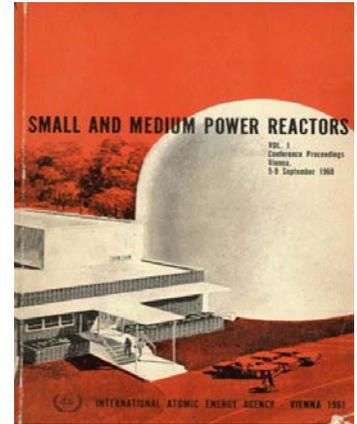
Outline

- SMR Regulatory Challenges
- SMR Regulators' Forum (SMRRF)
- Phase I (Pilot Project)
 - Graded Approach
 - Defence-in-Depth
 - Emergency Planning Zone Size
- Phase II
 - Licensing Issues
 - Design and Safety Analysis
 - Manufacturing, Commissioning and Operation



SMR Regulatory Challenges

- Large number of innovative designs (first of kind)
- Unproven technology
 - Comprehensive analyses, simulations, and testing needed to close knowledge gaps
 - New design philosophy
 - New materials
 - New safety systems strategies
- Lack of operational experience
- Regulatory processes need to be adapted, as appropriate
 - Rules and Regulation
 - Safety Requirements and Guides



Members

- Canada
- China
- Finland
- France
- Korea
- Russian Federation
- Saudi Arabia
- United Kingdom
- United States



Observers:

European Commission,
OECD Nuclear Energy Agency
CORDEL

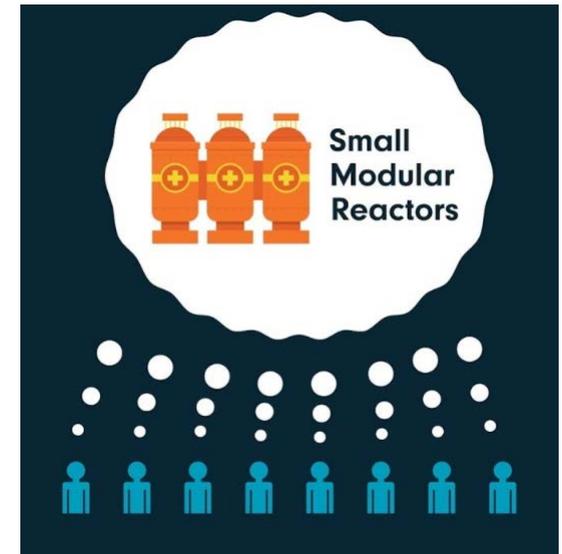


Objectives

- Share regulatory experience amongst forum members preparing to license SMRs and stakeholders;
- Identify and discuss common safety issues to recommend, if possible, common approaches for resolution;
- Capture good practices and methods; and
- Propose changes, if necessary, to national requirements and regulatory practices.

Role of the IAEA

- IAEA acts as Scientific Secretary and promote and facilitate the forum.
- IAEA develops and maintains a dedicated communication platform.
- IAEA publications on SMR designs serve as references for the discussion.



Guiding principles

The forum

- Is a regulator-to-regulator forum driven by its members
- Addresses issues proposed by any member
- Will attempt to develop consensus-based documents on technical and regulatory issues of interest to forum members
- Will take into account IAEA Safety Standards and safety objectives from other organizations such as WENRA for new reactors designs
- Will strive to avoid duplication of work done by other organizations and fora
- Draw information from existing sources where possible, including specific information discovered during design reviews by Member states and international organisations
- Establish and maintain relationships with other organizations such as NEA (e.g. MDEP, GSAR, CNRA) and WNA/CORDEL

SMR RF's definition of SMRs

- Nuclear reactors typically <300 MWe or <1000 MWt per reactor
- Designed for commercial use, i.e. power production, desalination, process heat (as opposed to research and test reactors)
- Designed to allow addition of multiple reactors in close proximity to the same infrastructure (modular reactors)
- May be light or non-light water cooled
- Advanced designs: preventive measures to reduce risk, e.g., inherently safe fuel, enhanced coolants, practical elimination of situations that leading to large releases



SMR RF's Timeline

2012

First talks about creating an international forum to discuss regulatory issues for SMRs

2013

Several IAEA MS express interest at the INPRO Dialogue Forum on Licensing and Safety Issues for SMRs

2014

The IAEA organizes 2 consultancy meetings resulting in the preparation of draft ToRs and a Pilot Project Plan

2015

The Forum begins implementation of a 2-year pilot project focused on the following subjects:
Graded Approach
Defence-in-Depth
Emergency Planning

2017

Forum defines Phase 2::
- Licensing issues
- Design and Safety Analysis
- Manufacturing, Commissioning and Operations

2018

The Forum issues the Pilot Project Report

Work on Phase 2 starts

2019

The Forum will issue interim report on Phase 2 topics



Small Modular Reactor (SMR) Regulators' Forum

Pilot Project (2015/2017)

Task-specific Working Groups

- Graded Approach
- Defence-in-Depth
- Emergency Planning Zone Size



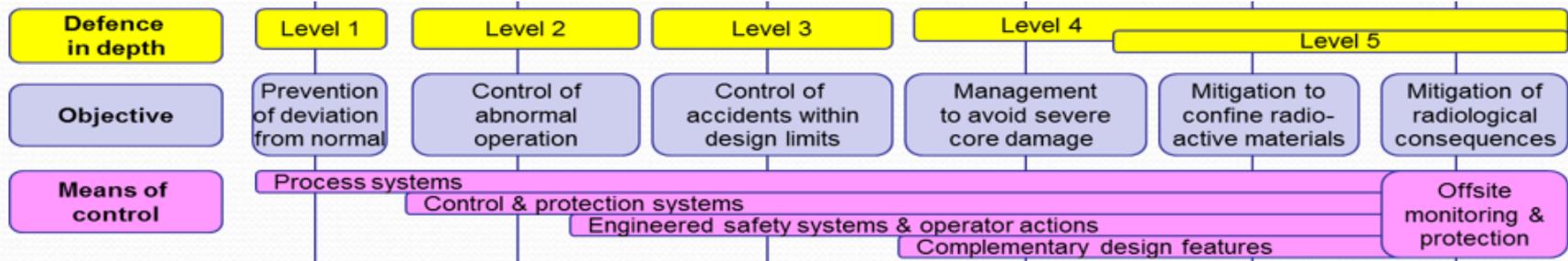
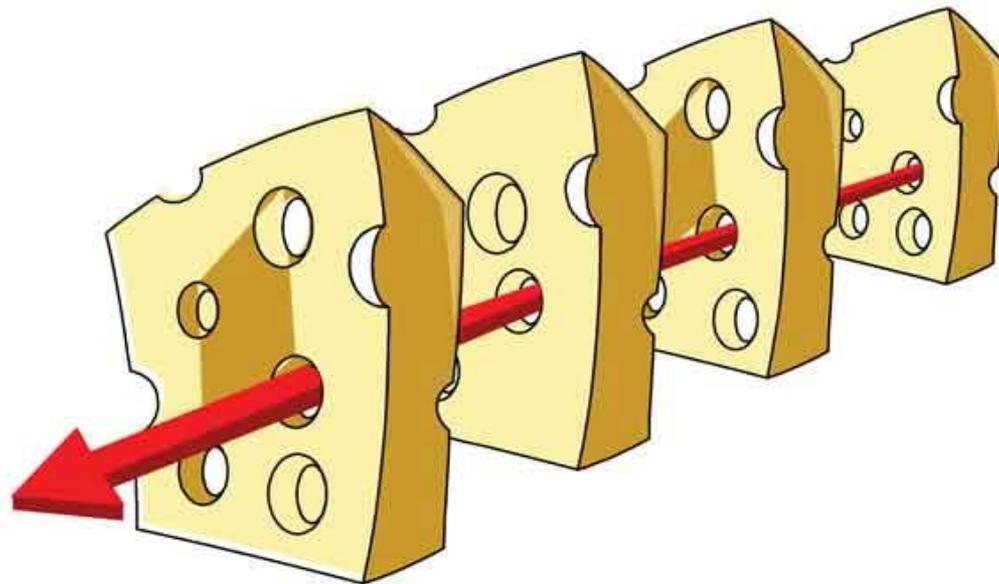
Graded Approach WG

Main Findings

- Starting point for SMRs should be requirements for Nuclear Power Plants (NPPs);
- Graded approach can enhance regulatory efficiency without compromising safety;
- Need to determine what is necessary to demonstrate “proven-ness”; and
- IAEA should lead development of technical guidance on graded approach for NPPs.

Defence-in-Depth WG

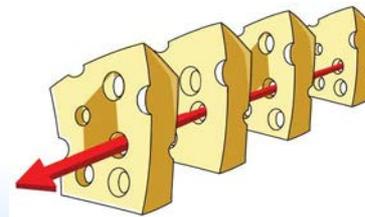
Main Findings



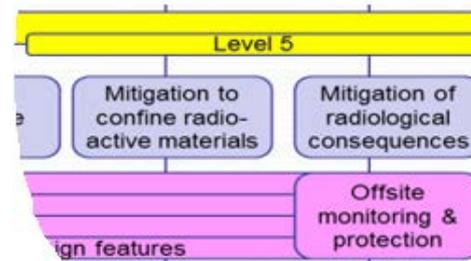
Defence-in-Depth WG

Main Findings

- Defence-in-depth (DiD) concept should be fundamental for design and safety demonstration of SMRs;
- SMR designers' efforts on DiD levels 1 and 2 reinforcement is significant.
- Regulators also want a clear demonstration of the effectiveness of the design safety features to mitigate PIE (Postulated Initiating Events) (level 3) and of the features to mitigate severe accidents (level 4) for all operating modes.
- Further guidance to help safety assessment of DiD applied to SMRs is needed.



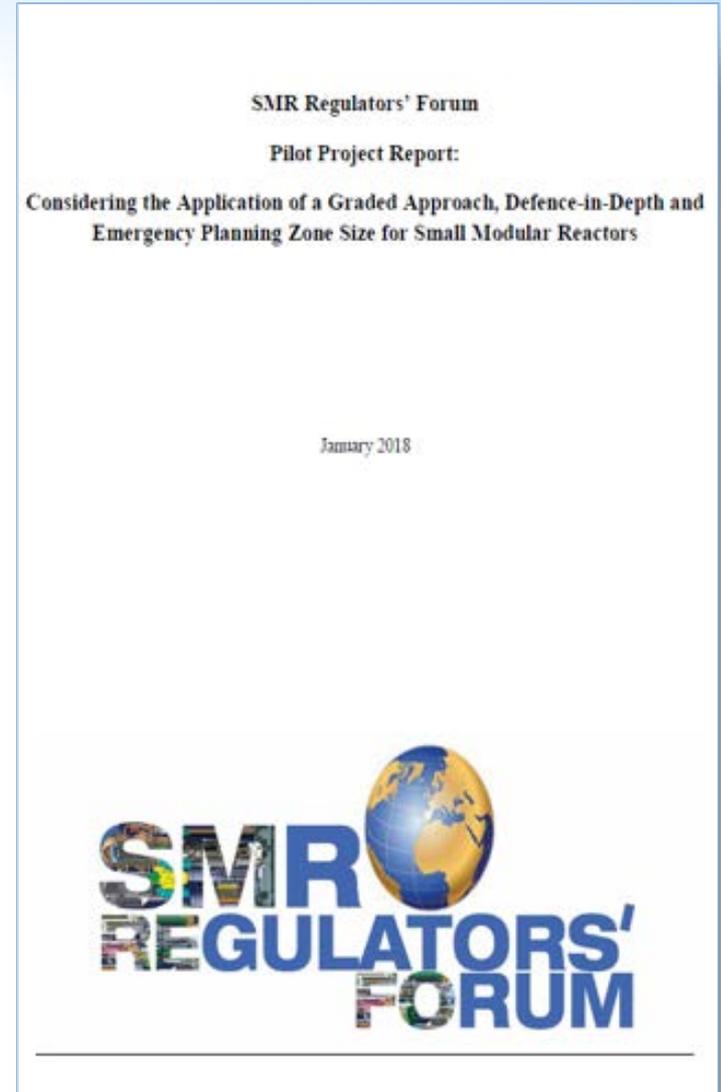
- EPZ (DiD level 5) is required but may be scalable:
 - Novel features and technology
- IAEA safety requirements and methodology for EPZ size are applicable; and
- Same SMR design may result in different EPZ size in different countries:
 - Dose criteria;
 - Policy factors; and
 - Public acceptance.



Pilot Project Report

- Summarized accomplishments of the Forum:
 - Common positions
 - Working Group reports
 - Recommendations for future activities

- Published in January 2018



Main challenges encountered by the Regulators' Forum during the pilot phase



- Development and deployment of SMRs around the world at a very early stage in terms of maturity of technologies and varying degrees of activity occurring in Forum member countries.
 - Limited familiarity with SMR designs and availability of design information
 - Limited information about application of existing DiD requirements to SMRs
- Need: Increase of the collaboration with vendors/operators international associations (GIF, CORDEL, EUR) during the on-going phase of the project

Phase 2 Project (2018 -)

Task-specific Working Groups

- Licensing Issues
- Design and Safety Analysis
- Manufacturing, Commissioning and Operation



Phase 2: Working Groups Mandate

- Licensing Issues:
 - Discuss the impacts of outsourcing of activities considering the modular design approach
 - Explore human factors impacts of SMR novel features
- Design and Safety Analysis:
 - Follow-up on recommendations from DiD WG and support IAEA work on Graded Approach
- Manufacturing, Commissioning and Operation:
 - Examine the implications that SMR characteristics present to manufacturing, construction, commissioning and operation

WG1: Licensing issues

- The licensing of SMRs, based on innovative technologies and systems, has to be balanced against the theoretical safety benefits of being SMRs as opposed to large NPPs
- Challenges posed to many aspects of the licensing process regarding large NPPs are under discussion by the project:
 - Impact on the conduct of licensed activities (outsourcing of activities, modular design approach, strong decentralization of design and safety analyses activities, full capacity over time, off-site construction and commissioning, transportation of factory-fuelled reactors...)
 - First-of-a-kind (FOAK) designs against Nth-of-a-kinds (NOAK)
 - Technology readiness levels for different SMR technologies - impact on the information needed to support safety claims in the licensing process
 - Use of OPEX

WG2: Design and safety analysis issues



- Issues under discussion:
 - Safety criteria and requirements for passive safety systems and inherent safety features
 - Principles and requirements for the safety assessment of “multi-module” or “multi-unit” SMRs
 - Prove-ness of FOAK designs (evolutionary versus revolutionary designs)
 - Design extension conditions and practical elimination of situations that may induce large releases (concern on provision of Level 4 defence in depth measures for revolutionary designs)

WG3: Manufacturing, commissioning and operation issues

- Use of existing body of knowledge being generated from new build power plant projects / FOAK and NOAK (serial production) SMR implications
 - SMR specific construction issues and implications in the licensee oversight and regulatory inspection programs
 - Regulatory views of expected SMR commissioning issues and implications in the licensee oversight and regulatory inspection programs
 - Implications on in-service inspection programs from, for example, compact system design, sealed vessels or inaccessible systems
- Issues under discussion:
 - Potential increased ‘Intelligent Customer’ challenges
 - Codes and standards
 - Sharing of data among Licensees and information of regulators (commissioning test results, deviations, OPEX...)
 - Manufacturability



Phase 2 Project

- Interim report expected to be published by end of 2019
- Final report to be published by end 2020

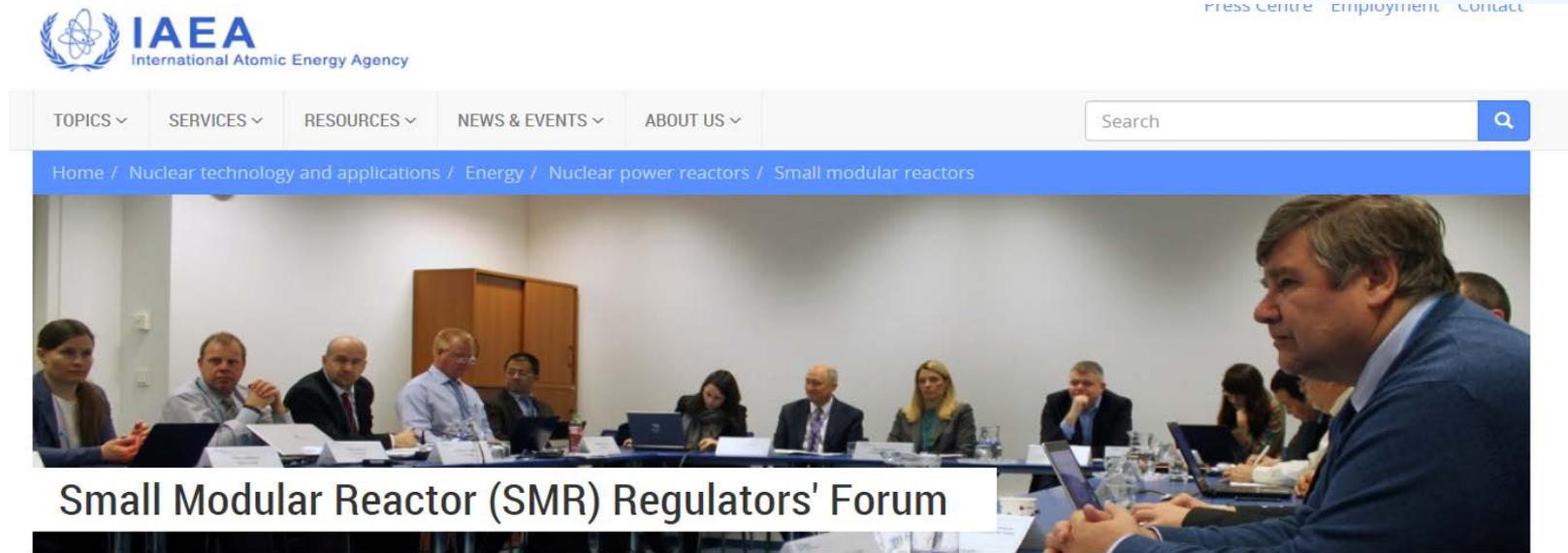
SMR Regulators' Forum
Phase 2 Project INTERIM Report:
Considering Licensing issues, Design and Safety Analysis and
Manufacturing, Commissioning and Operations

November 2019



Want to learn more?

<https://www.iaea.org/topics/small-modular-reactors/smr-regulators-forum>



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Small Modular Reactor (SMR) Regulators' Forum

Small modular reactors

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[Small Modular Reactors](#) (SMRs) are advanced reactors that produce electricity of up to 300 MW(e) per module, which is less than current power generation reactors. Many SMRs can be made in factories and transported by truck or rail.

The establishment of regulatory controls for this relatively new type of reactor requires focused and consistent attention. The SMR Regulators' Forum, created in March 2015, provides support by enabling discussions among Member States and other stakeholders to share SMR regulatory knowledge and experience.

The Forum enhances nuclear safety by identifying and resolving common safety issues that may challenge regulatory reviews associated with SMRs and by facilitating robust and thorough regulatory decisions.

Related resources

- 📄 [SMR Regulator's Forum Terms of Reference](#)
- 🔒 [SMR Regulator's Forum \(Restricted Site\)](#)
- 🔗 [Meeting Materials](#)
- 🔗 [SMR Database](#)
- 🔗 [Regulatory Activities Section](#)





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Thank you!

