IAEA
International Atomic Energy Agency
Atoms for Peace and Development

2022 nuclear summit
Trends in Brazilian Nuclear Market

SMR Regulation and Licensing

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SMR Regulation and Licensing Outline

- Learning objectives
- Regulatory Challenges
- Licensing of Nuclear Installations
- On-going work on SS in the IAEA
- SMR Regulators' Forum
- IAEA's NHSI

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Learning objectives

In this lecture participants will learn about:

- What are the main challenges presented by the proposed novel SMRs designs to regulators;
- Licensing of Nuclear Installations;
- IAEA activities related to SMR safety and regulation;
- The activities of the SMR Regulators' Forum; and
- The regulatory track of the IAEA's Nuclear Harmonization and Standardization Initiative

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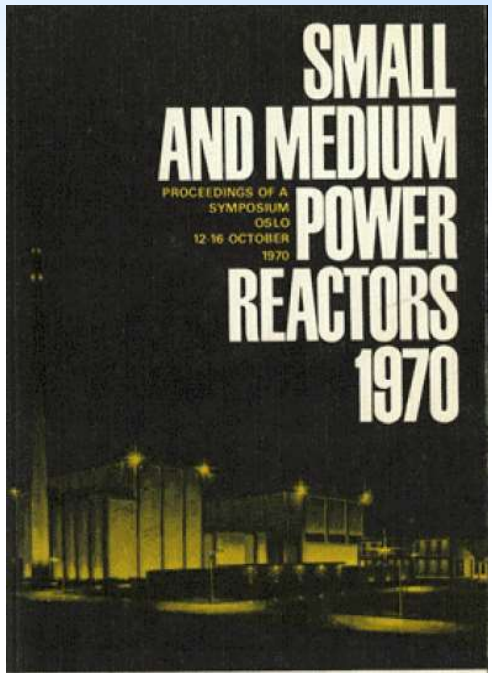
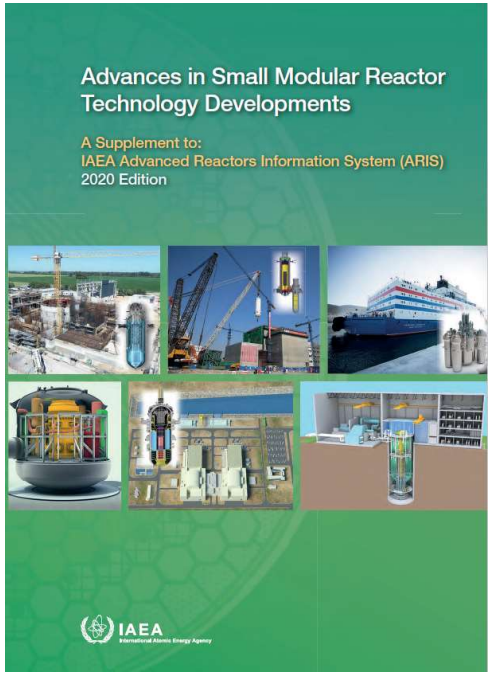
SMR Regulatory Challenges (1)

- Large number of innovative designs (first of kind)
  - IAEA booklet on SMRs (2020)
- 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
- Implications of SMR supply chain on licensee's core safety capabilities
- Faster construction time





SMR Regulatory Challenges (2)

- New deployment approaches
  - Serial production, largely in factories
  - Factory fuelling
  - Transport to final location
  - Factory (partial) commissioning
  - More than one regulatory jurisdiction involved in licensing/regulatory review

- Regulatory processes need to be adapted, as appropriate
  - Rules and Regulation
  - Safety Requirements and Guides


SMR REGULATORS' FORUM

SMR Regulators' Forum
Phase 2 Summary Report:

Covering Activities from
November 2017 to December 2020

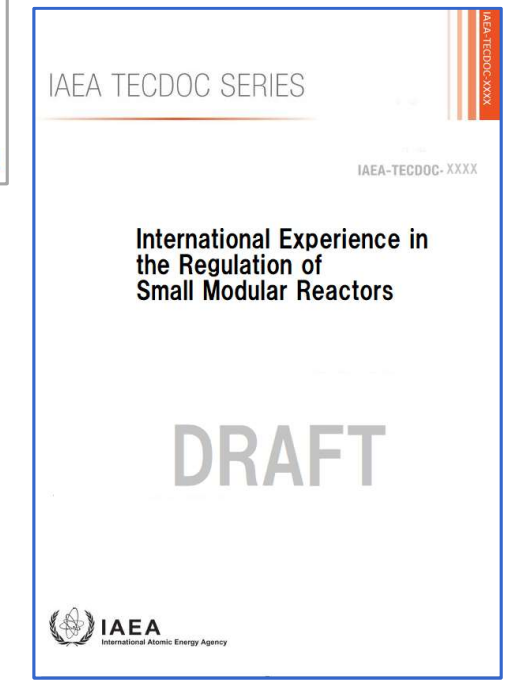
for:

Licensing Issues Working Group

Design and Safety Analysis Issues Working Group

Manufacturing, Construction, Commissioning, Operation Working Group

June 2021


IAEA TECDOC SERIES

IAEA-TECDOC-XXXX

International Experience in the Regulation of Small Modular Reactors

DRAFT

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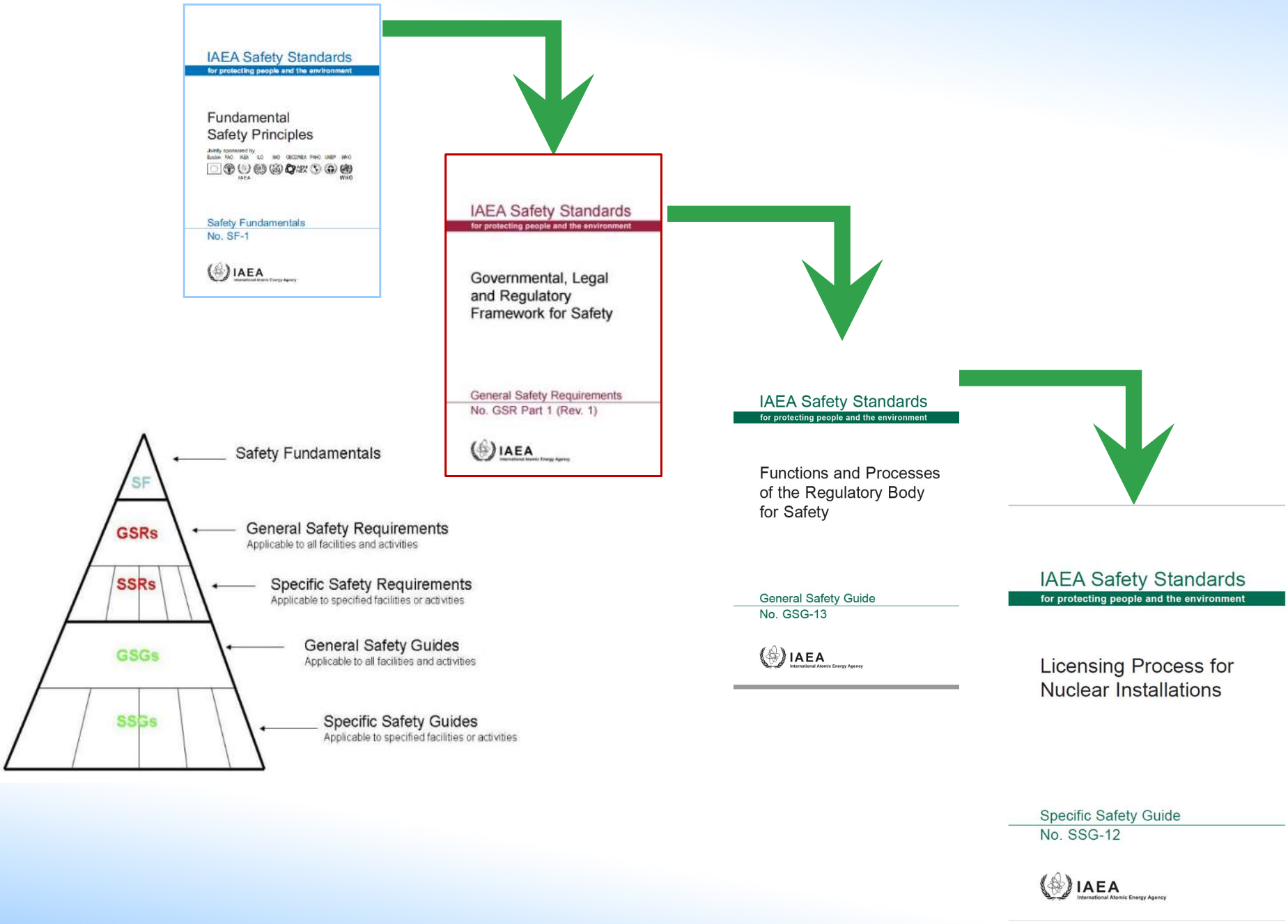
IAEA Safety Standards for NPP Licensing



Licensing - Key Definitions |1

Authorization

- The granting by a *regulatory body* or other governmental body of written permission for an *operator* to perform specified *activities.*

Licence

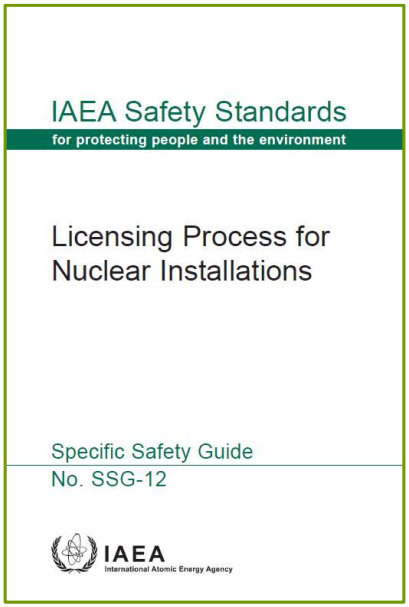
- A legal document issued by the regulatory body *granting authorization* to perform specified activities related to a facility or activity.

Licensee/Operator

- The holder of a current licence, person or organization having the overall responsibility for a nuclear installation and its activities

Licensing process (Authorization process)

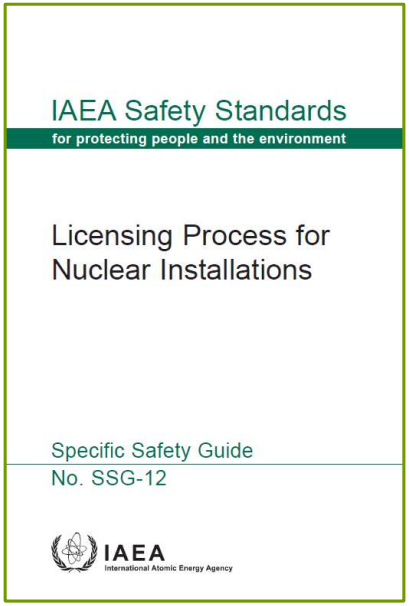
- A process through which authorizations at different stages are granted by the regulatory body during the lifetime of a nuclear installation from siting to release from regulatory control



Licensing Process: Principles

The licensing process should be:

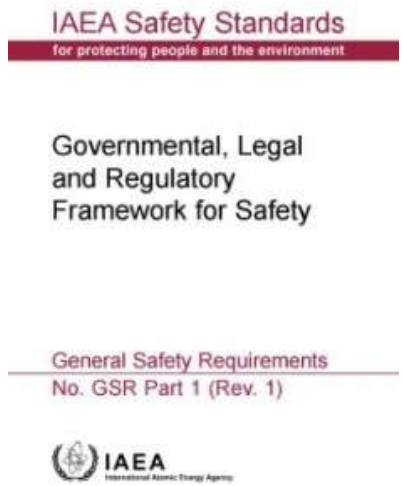
- understood by the parties concerned;
- predictable (i.e., well defined and documented, clear, transparent and traceable);
- established in the regulatory and legal framework; and
- open and transparent to the public.



Licensing Stages

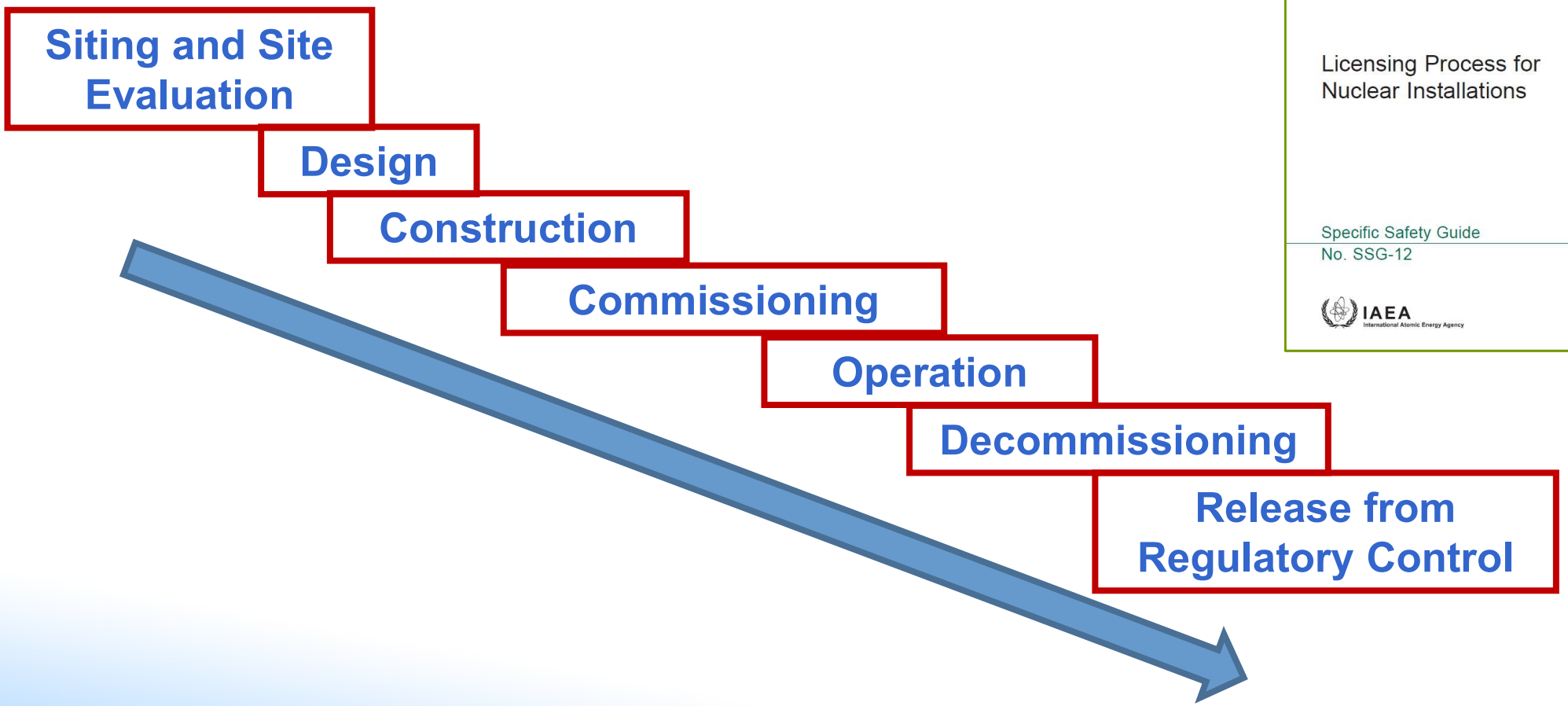
GSR Part 1 - Requirement 24:
Demonstration of safety for the authorization of facilities and activities

- **§4.29** Different types of authorization shall be obtained for the different stages in the lifetime of a facility or the duration of an activity. The regulatory body shall be able to modify authorizations for safety related purposes. *For a facility, the stages in the lifetime usually include: site evaluation, design, construction, commissioning, operation, shutdown and decommissioning (or closure).*

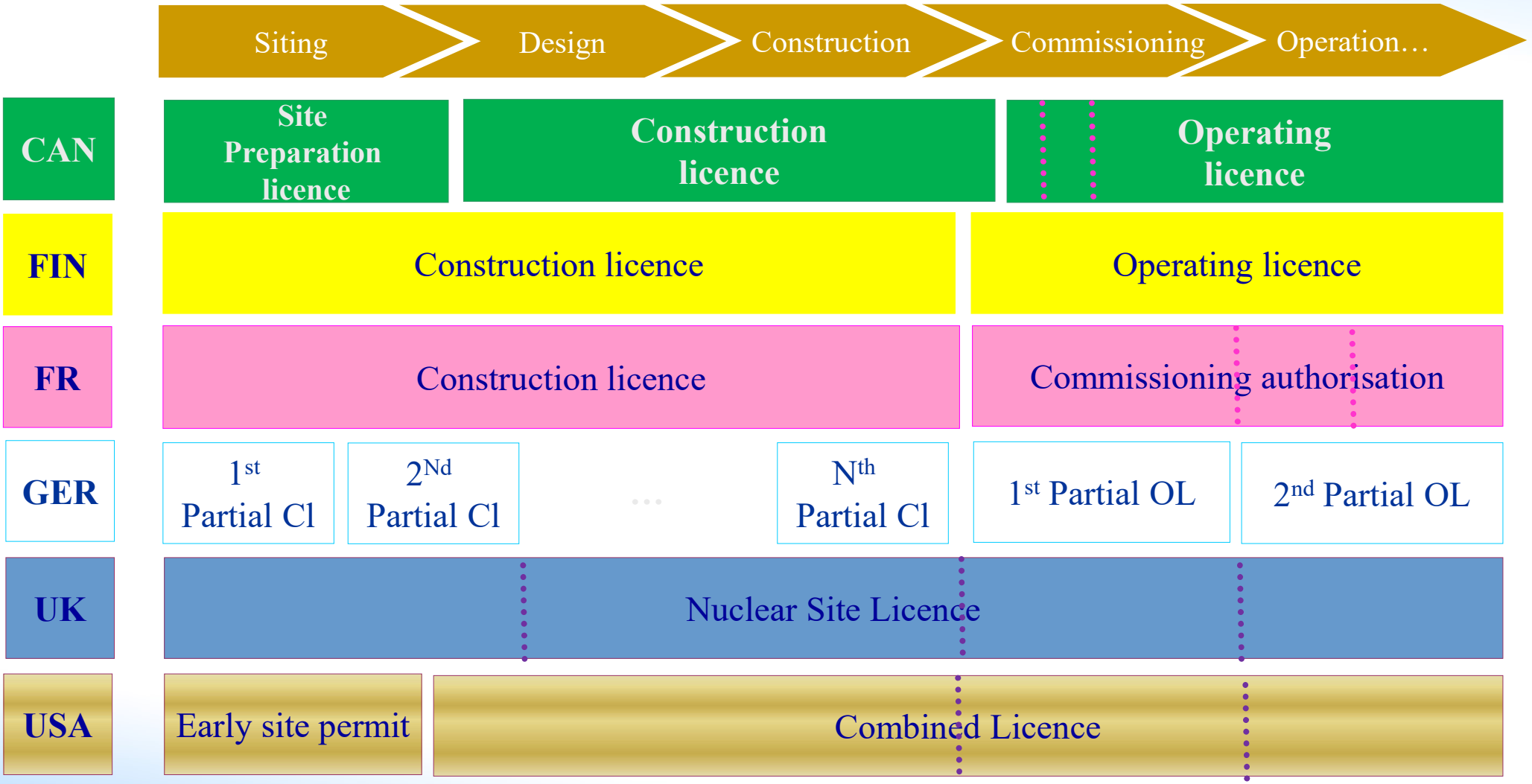


Licensing Stages for NNPs |1

Life of a nuclear installation includes 7 major steps



Different national approaches for authorization



Public Involvement During the Licensing Process

A nuclear power programme in any State cannot be treated in isolation; societal acceptance is a prerequisite for its implementation

For gaining true acceptance, the public should be given an opportunity to gain a realistic and credible picture of the benefits as well as the risks involved, and of the environmental impacts of the operation of the nuclear power plant and the associated activities.

GSR Part 1 - Requirement 36

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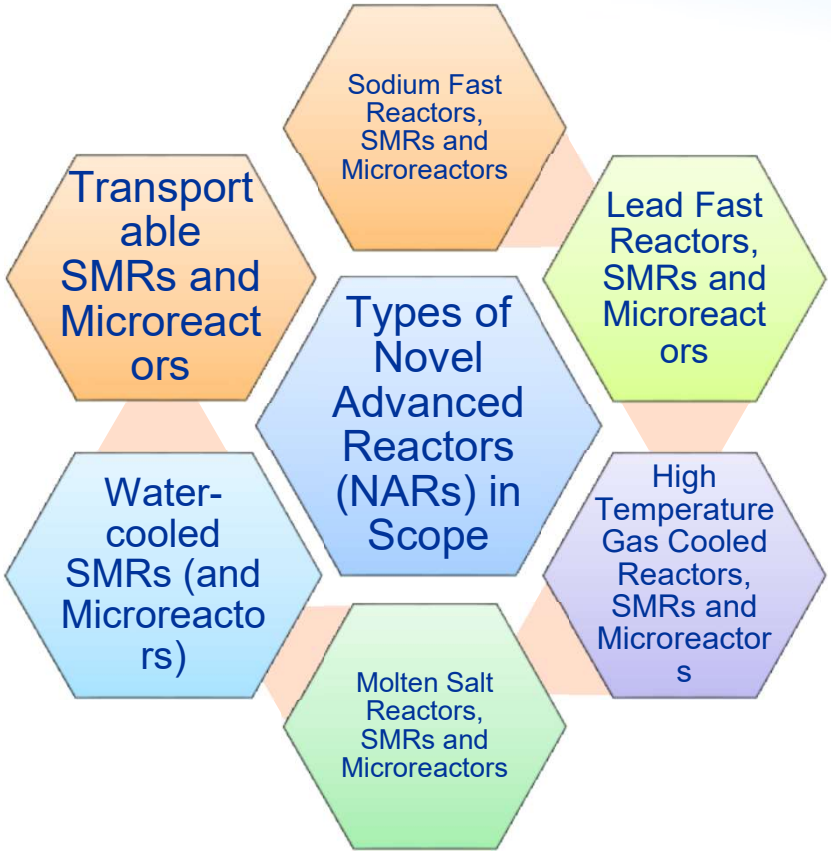
Background

- Growing interest in these technologies due to
- many factors

- Novel advanced reactors can be very different
- from the current operating fleet:
  - Different neutron spectrum
  - Different coolants and moderators
  - Simplified designs and passive means to maintain safety
  - Advances in engineering, materials, manufacturing
  - Serial factory, modular construction and standardization
  - Deployment models and transportation

- Are IAEA safety standards currently in use
- sufficient and relevant to ensure the safety of
- these innovative designs?

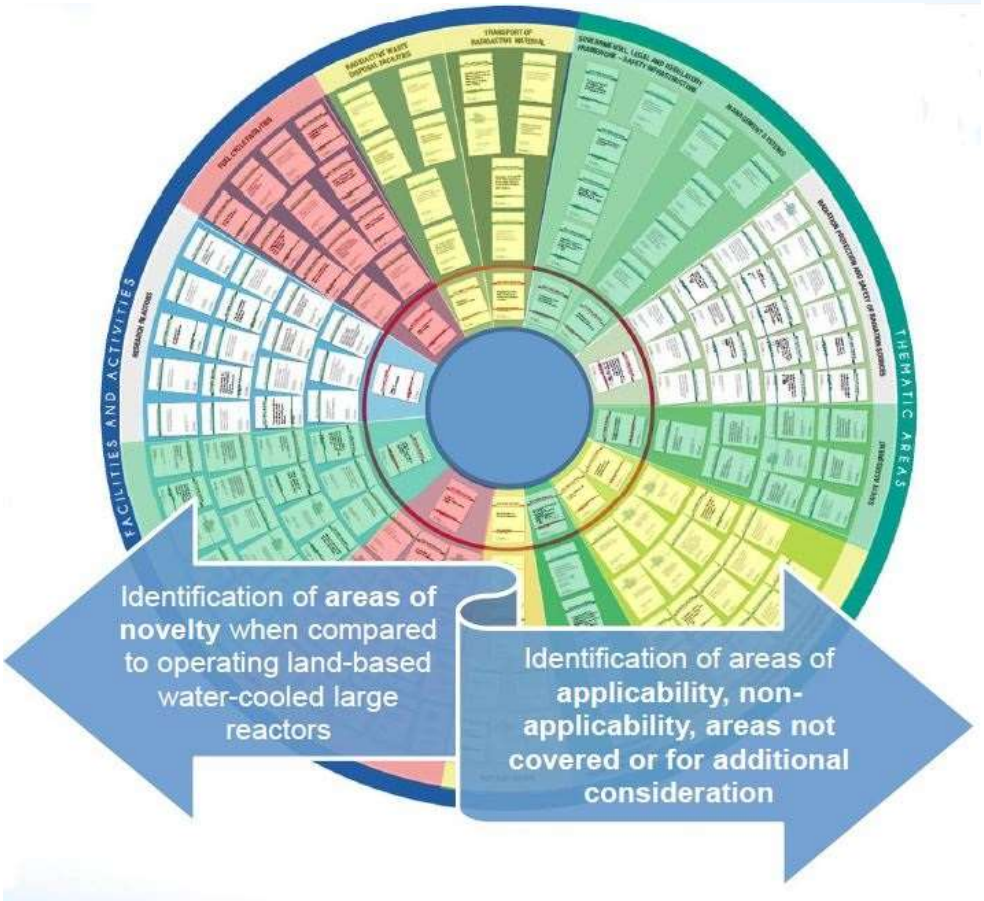


Safety Standards Applicability Review

- The IAEA has completed the review of applicability of Safety Standards to Novel Advanced Reactors throughout lifecycle

- Working with more than 150 experts from 30 countries and 40 organizations, **including representatives of the SMR Regulators Forum**

- Safety Standards generally applicable, some areas of non-applicability (technology specific) and gaps will be captured in a **Safety Report**



Development of future program of work on Novel Advanced Reactors Safety

Next Steps Proposal for the revision of IAEA Safety Standards

- A prioritized program of work to develop the necessary guidance and support for the safety standards implementation to novel advanced reactors, based on:
  - The review of applicability of the safety standards to novel advanced reactors (it provides a detailed mapping of applicability)
  - Recommendations from SMR Regulators' Forum
- In close collaboration with the Safety Standards Committees and Commission and the CSS Strategic Planning Working Group
- Reflecting Member States' needs and priorities

Licensing Process for Nuclear Installations – SSG-12 Revision

- Changes needed to provide suitable recommendations for the application of the Safety Requirements to the licensing of small modular reactors (SMRs). For example:
  - Changes in the licensing process when considering newly proposed deployment models for SMRs (such as factory fuelling and transportation to the final destination in a different State)
  - Additional guidance for collaboration between regulatory bodies when a licensing process may be applied to SMR components or to transportable SMRs by two or more jurisdictions simultaneously

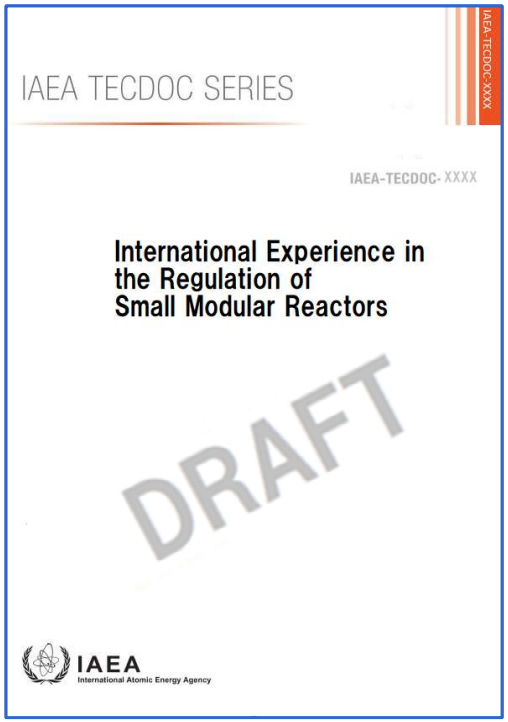
"Deployment model" is understood as the approach taken for the deployment of a NPP that will impact the general ownership of the NPP, the responsibility for the lifetime of the NPP including operation, decommissioning and management of spent fuel and radioactive waste, and the responsibility for liability for nuclear damage in case of a nuclear accident.

Licensing Process for Nuclear Installations – SSG-12 Revision

- Address potential changes or adjustments to the licensing process in the case of licensing of first of a kind (FOAK) reactors (DPP under development Safety demonstration of first of a kind technology in reactor designs).
- New Appendixes with:
  - Recommendations to support regulatory bodies collaboration to reduce regulatory duplication, while maintaining independence and levels of due diligence.
  - Recommendations to reduce regulatory burden for designs that have been licensed by the regulatory body of one State which is proposed for a licence in a different State.

Gathering Experience in Regulating SMRs

- Compiling experience of Member States which:
  1. have gone through the process of licensing and regulating SMRs; or
  2. have worked intensively in preparing to licensing SMRs
- Developed a complete set of questions about challenges in different areas and how they resolved them
- The questionnaire covered challenges to framework, safety requirements, licensing process and regulatory approach, inspection, security, safeguards, etc



Expected to be published soon as TECDOC

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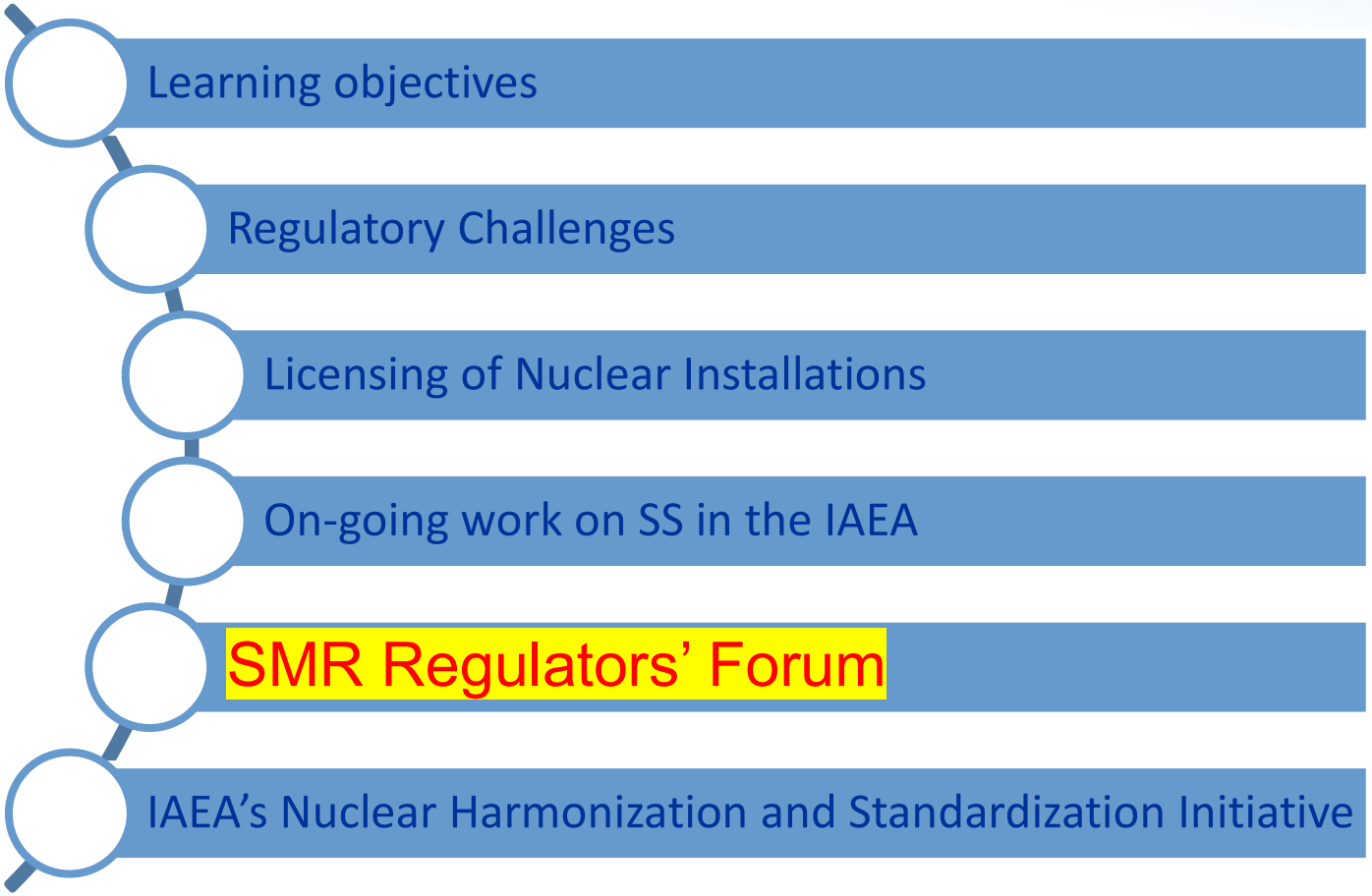


What Is the Forum?

Regulator-to-Regulator group with 10 participating countries

Members

- Canada
- China
- Finland
- France
- Japan
- Korea
- Russian Federation
- South Africa
- United Kingdom
- United States

Observers:

- European Commission (JRC)
- OECD Nuclear Energy Agency
- WNA-CORDEL

SMR REGULATORS' FORUM

Terms of Reference

Small Modular Reactor (SMR) Regulators' Forum

March 2021

Purpose

To identify, enhance understanding of and address key regulatory challenges that may emerge in future SMR regulatory discussions. This will help enhance safety, security, efficiency in SMR regulation, including licensing, and enable regulators to inform changes, if necessary, to their requirements and regulatory practices.

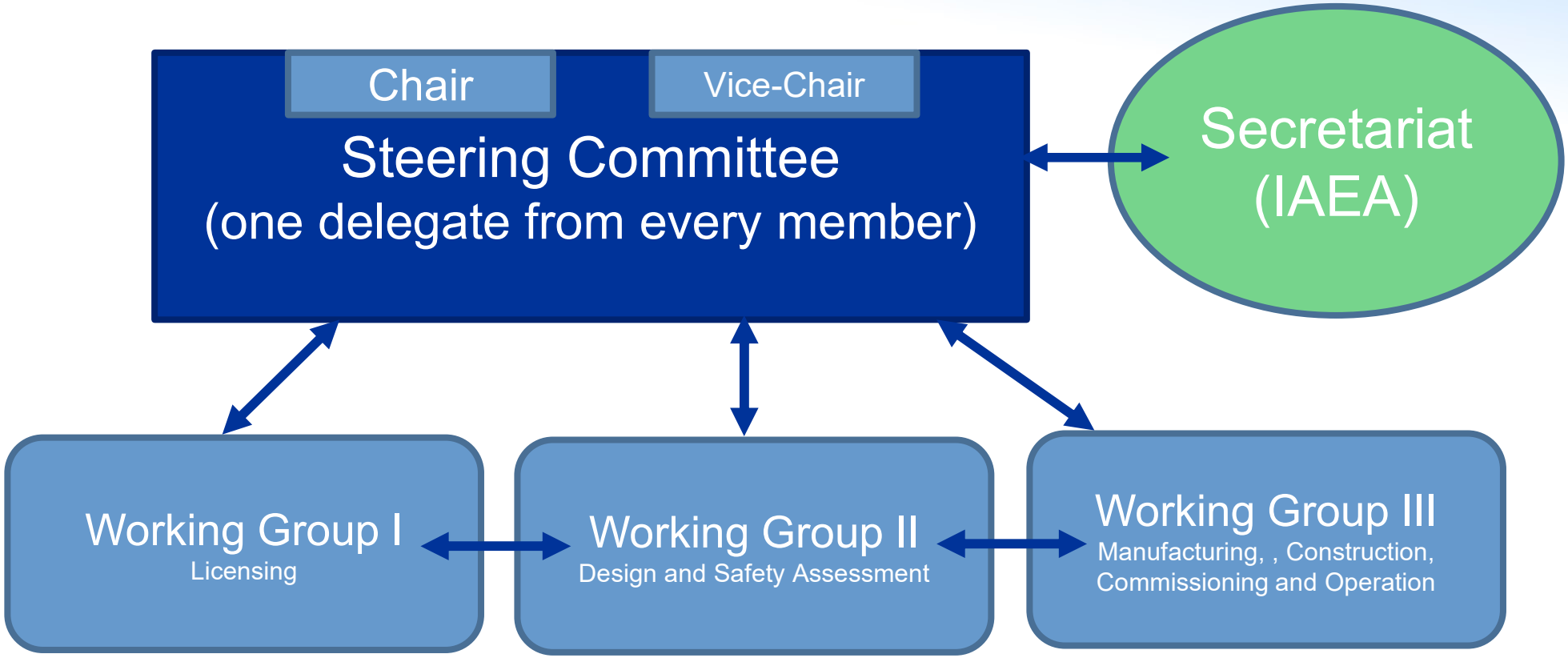
Background

The idea of establishing an international forum for regulators to discuss issues associated with regulation of SMRs was first raised in mid-2012 after bilateral discussions between the U.S. and Canada. At the INPRO Dialogue Forum on Licensing and Safety Issues for Small and Medium-sized Reactors (SMRs), held in Vienna in July/August 2013, there was explicit interest expressed by a number of the International Atomic Energy Agency (IAEA) Member States to evaluate and discuss the benefits of forming a regulators' forum which would specifically address regulatory issues in safety and licensing of SMRs.

The IAEA was considered to provide a long term vision to maximize Member State participation and to provide an efficient means to apply lessons learned from discussion into the IAEA global safety framework. The intent was to work cooperatively with other regulatory forums investigating the impacts of new reactor technologies on regulation.

As a result, consultancy meetings, facilitated by the IAEA, were held in Vienna 18-20 February 2014, and 22-24 July 2014. The outcome of these consultancy meetings was an agreement to organize a Small Modular Reactor Regulators' Forum on a 2 year pilot basis. A draft Terms of Reference (ToR) and draft Pilot Project Plan, including the scope of the working groups, were also produced and were subsequently accepted by the members of the forum at the initial meeting.

Structure of the Forum



Objectives of the Forum

- Share regulatory experience amongst Forum members preparing to:
  - Facilitate efficient, robust, and thorough regulatory decisions
  - Encourage enhanced nuclear safety and security
  - Facilitate international cooperation among regulators performing SMR-related assessments
- Identify and discuss common safety issues that may challenge regulatory reviews associated with SMRs and, if possible, recommend common approaches for resolution
- Advise IAEA on the need for revision of development of new IAEA publications on safety of SMRs

Outcomes of the Forum

- Position statements on regulatory (policy and technical) issues
- Makes suggestions for revisions of IAEA documents, especially on potential enhancements to the IAEA Safety Standards with respect to SMRs
- Generation and sharing of information that regulators may use to enhance their regulatory framework
- Description of regulatory challenges and discussion on path forward
- Suggestions for high level issues to be raised to international codes and standards organizations for dispositioning

Stress the importance of a Member State's effective & independent regulatory function

Examples of near-term versus long term regulatory areas of interest

<u>Near-term – First of a Kind</u>

- Leveraging information between regulators based on experience
- Implications of modular design and modular construction
- Key areas of regulatory interest in licensing process/conduct of regulated activities
- Factors in risk-informed assessment of safety claims and evidence (use of Graded Approach)

<u>Long-term – "Nth" of a Kind</u>

- Mutual recognition of regulators' assessment/ Joint assessments/ Collaboration
- Serial manufacturing/construction
- Transportable factory fueled reactors
- Improving sharing of experience on regulatory oversight
- Enhancing and aligning requirements and guidance using case studies and experience

Areas of technical work of the Forum

- **Phase 1 (2015 - 2017)**
  - Graded Approach
  - Defence-in-Depth
  - Emergency Planning Zone Size

Phase 2 (2018 - 2020)

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

Phase 3 (2021 – 2023)

- Mutual recognition of regulators' assessment/ Joint assessments/ Collaboration
- Security/Safeguards by design, interface with safety
- Containment/confinement
- Regulatory oversight of long lead SSC procurement
- Organizational stakeholders' capabilities

Phases 1 and 2 Report Issued

SMR Regulators' Forum

Pilot Project Report:

Considering the Application of a Graded Approach, Defence-in-Depth and Emergency Planning Zone Size for Small Modular Reactors

January 2018

SMR REGULATORS' FORUM

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SMR Regulators' Forum
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June 2021

Phase 3 Licensing WG

In Progress Now

- Framework for mutual recognition of regulators' assessment/joint assessments collaboration

- Implications of SMR supply chain on licensee's core safety capabilities
- Harmonization

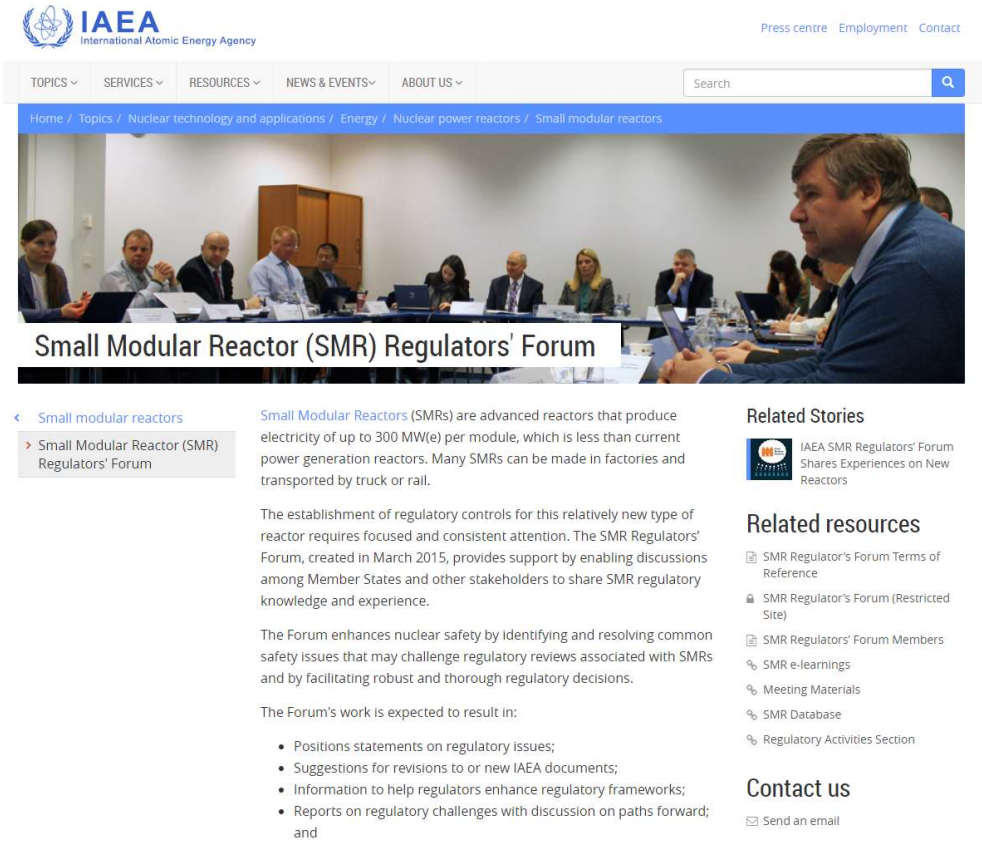
Promotion of the Forum's Work to Other MSs

- Organized as Regional WSs
- Target audience: Regulators in NPP embarking or expanding MS

Region	Date	Host	Country
West Asia/Africa	12 - 2021	EMRC	Jordan
Africa – French language	05 - 2022	AMSSNuR	Morocco
East Asia/Oceania	11 - 2022	APRPANSA	Australia
Latin America	12 - 2022	ARN	Argentina
Europe	01 - 2023	ANVS	Netherlands

SMR Regulator's Forum Web Page

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



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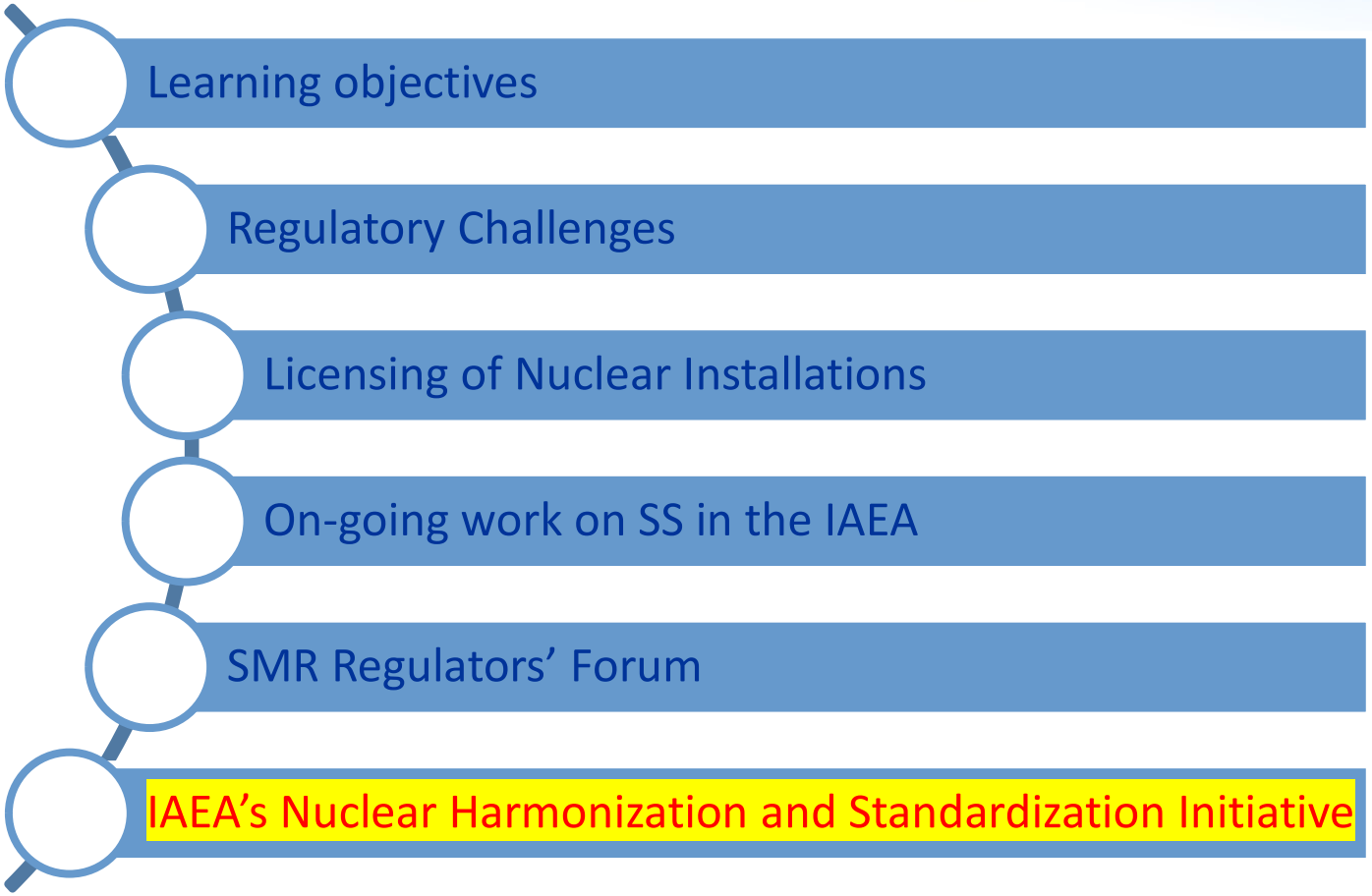

IAEA's Nuclear Harmonization and Standardization Initiative (NHSI)

- A roadmap with concrete actions and milestones for technology holders and operators

- A roadmap with concrete actions and milestones for increasing regulatory collaboration towards global harmonisation in the pre-licensing process, and international certification of selected SMR designs

IAEA's Nuclear Harmonization and Standardization Initiative (NHSI)

Next step:

- A Conference to be called for June in Vienna of representatives of both tracks (Regulatory and Technology tracks) to discuss options and potential path of the initiative to produce concrete roadmaps and interface between them

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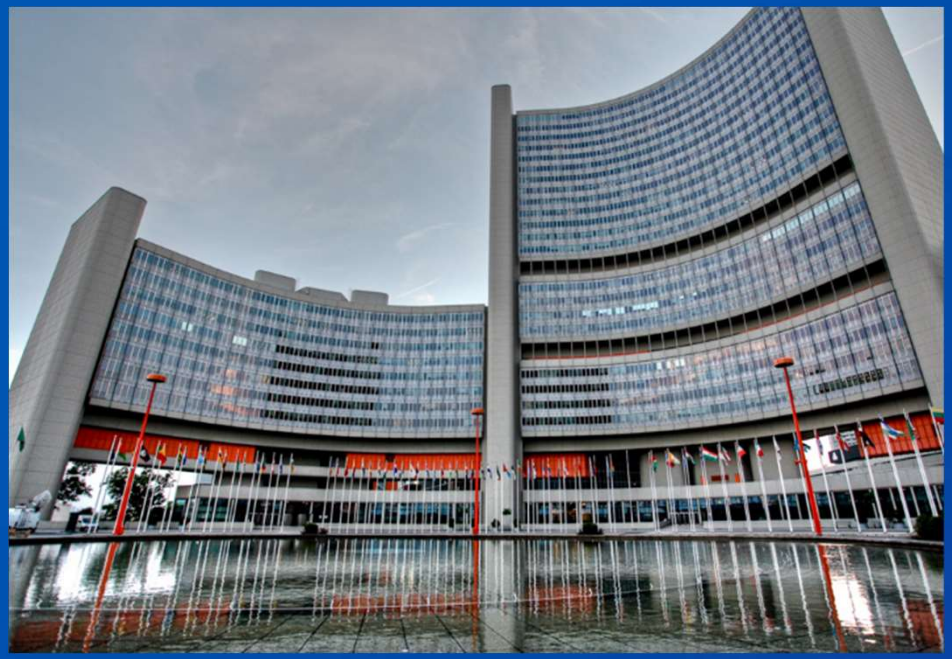

Thank you!

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