Training Course
on the IAEA Safety Standards Overview

IAEA Activities toward the Application of Safety Standards to Advanced Reactor Designs

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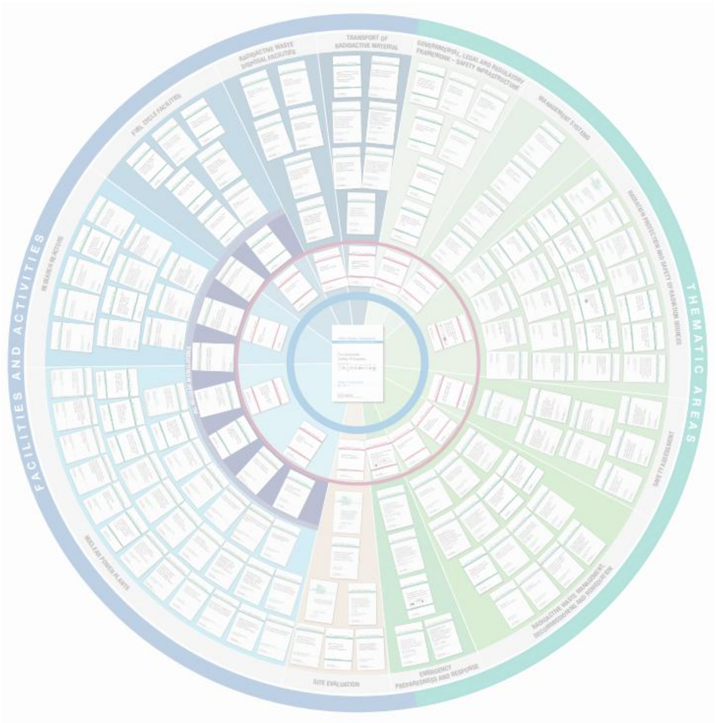
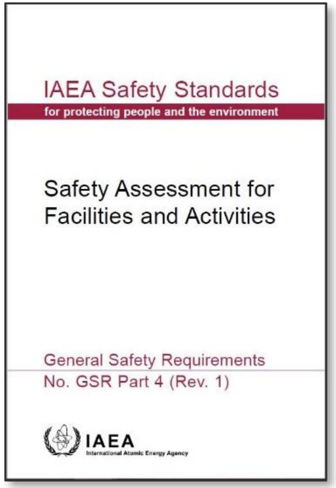
04 - 07, August 2026

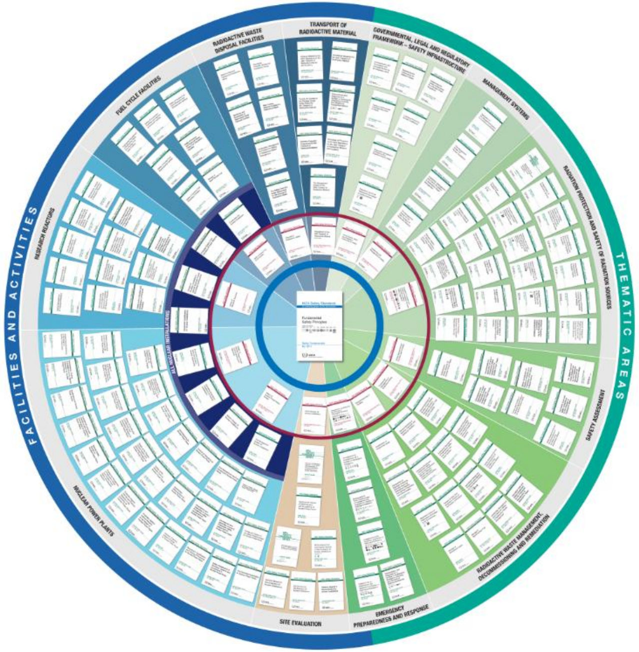
Outline

- BACKGROUND
- PREPARATORY WORK
- PLAN OF REVIEW & ACTIVITIES
- CONCLUSIONS



Background





1.6. It is expected that this publication will be used **primarily for land based stationary nuclear power plants with water cooled reactors designed for electricity generation or for other heat production applications** (such as district heating or desalination). This publication may also **be applied, with judgement, to other reactor types, to determine the requirements that have to be considered in developing the design.**

Objective and Scope

The DS562 was initiated:

- To establish design requirements for the structures, systems and components of a nuclear power plant, as well as for procedures and organizational processes important to the safety of the design that are required to be met for safe operation, transport relocation, including propulsion and for preventing events that could compromise safety, or for mitigating the consequences of such events, were they to occur.
- To complement requirements in SSR-1 (Rev.1) and SSR-2/2 (Rev.2)
- To provide basis for the process of review and assessment of the design as required in GSR Part 4 (Rev.1)
- To promote technical consistency in the level of safety among design organizations and to support regulatory authorities, technical support organizations and licensees involved in the licensing process of reactor designs
- To keep the extant philosophy of technology-neutral, technology-inclusive, and technology-specific requirements
- To provide a standard framework to facilitate a regulatory review of a design or a peer review of national design safety requirements and their applications

Objective and Scope

Target audience: Organizations involved in design, manufacture, construction, modification, maintenance, relocation, commissioning, operation, and decommissioning for nuclear power plants (e.g. regulatory bodies, NPP Operators, TSOs, design organizations)

Installations covered: All NPPs (e.g. electrical generation, process heat, desalination, marine propulsion) used for civil purposes

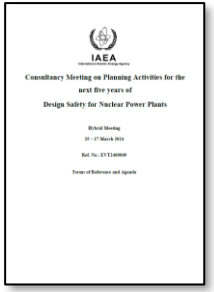
Major themes to be covered:

1. Water-cooled reactors, including advanced water-cooled reactors;
2. Non-water-cooled reactors, including gas cooled reactors, liquid metal cooled reactors, and molten salt cooled reactors;
3. Different neutron spectrum reactors, including thermal, and fast;
4. Different fuel types, categorized by their physical form including solid fuels and molten salt fuel;
5. Modularization and modularity of reactor designs, enabling geographical relocation;
6. Different power outputs, ranging from large to small or micro reactors;
7. Transportable NPPs (see proposed definition in footnote 2 of the DPP DS562);
8. Nuclear power plants with different deployment options, including remote locations (off-grid) and operation, and underground installation.

Review Committees involved: NUSSC, EPReSC, RASSC, WASSC, NSGC, TRANSSC

Preparatory work conducted & References for planning activities

- Brainstorming and seminar sessions with the SAS team.



IAEA

International Atomic Energy Agency

Consultancy Meeting on Planning Activities for the next five years of Design Safety for Nuclear Power Plants

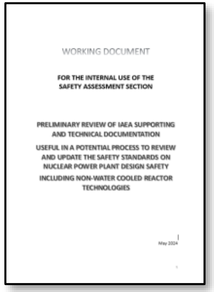
Hybrid Meeting

25 – 27 March 2024

Ref. No.: [illegible]

Terms of Reference and Agenda

- Consultancy meeting with external experts, including NUSSC representatives, GIF representatives and international experts.

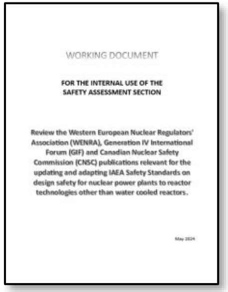


WORKING DOCUMENT

FOR THE INTERNAL USE OF THE SAFETY ASSESSMENT SECTION

PRELIMINARY REVIEW OF IAEA SUPPORTING AND TECHNICAL DOCUMENTATION USEFUL IN A POTENTIAL PROCESS TO REVIEW AND UPDATE THE SAFETY STANDARDS ON NUCLEAR POWER PLANT DESIGN SAFETY INCLUDING NON-WATER COOLED REACTOR TECHNOLOGIES

May 2024



WORKING DOCUMENT

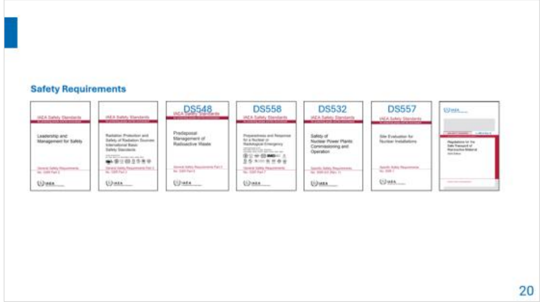
FOR THE INTERNAL USE OF THE SAFETY ASSESSMENT SECTION

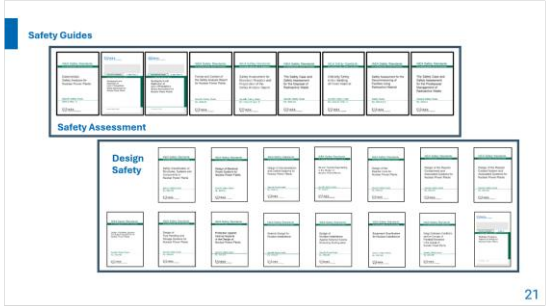
Review the Western European Nuclear Regulators' Association (WENRA), Generation IV International Forum (GIF) and Canadian Nuclear Safety Commission (CNSC) publications relevant for the updating and adapting IAEA Safety Standards on design safety for nuclear power plants to reactor technologies other than water cooled reactors.

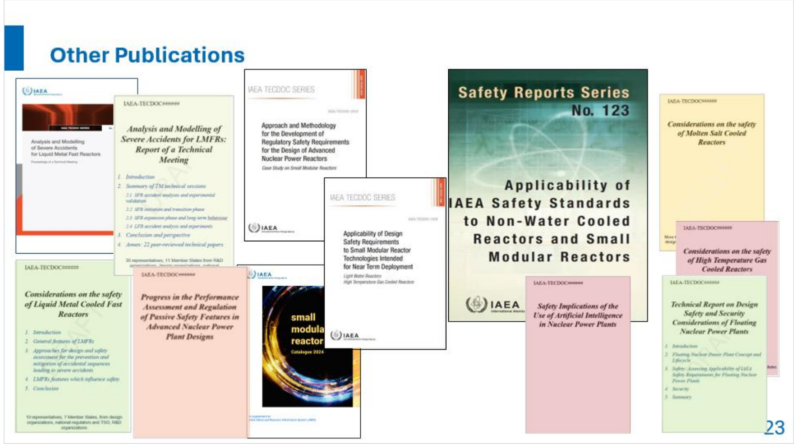
May 2024

- Gap analysis conducted on the current collection of relevant safety standards for design safety and safety assessment, including consulting supporting documents such as SRSs and TECDOCs, as well as international regulations and guidance, such as WENRA, GIF, CNSC, etc.

Interfaces with Existing and/or Planned Publications







IAEA:

- TECDOC-1406
- TECDOC-1536
- TECDOC-1569
- TECDOC-1674
- TECDOC-1753
- TECDOC-1791
- TECDOC-1912
- TECDOC-1936
- TECDOC-2021
- NW-T-1.14 (Rev.1)
- NR-T-1.18
- NG-T-3.5
- NR-T-1.19
- NP-T-4.1
- NP-T-4.2
- NF-T-4.1
- NP-T-1.6

National Regulatory Docs:

NP-022-17 & NP-029-17 (RF)
US NRC RG 1.232 (Rev.0) (USA)
CNSC REGDOC-2.5.2 (Canada)

Safety Reports from GIF:

- A Risk-Informed Framework for Safety Design of Gen IV Systems (2023).
- Safety Design Guidelines on Structures, Systems and Components for Gen IV Sodium-cooled Fast Reactor Systems (2024).
- Safety Design Criteria for Gen IV Very High Temperature Reactor System (2023).
- Safety Design Criteria for Generation IV Gas-Cooled Fast Reactor System (2022).
- Gas-Cooled Fast Reactor System Safety Assessment (2022).
- Safety Design Criteria for Gen IV Sodium cooled Fast Reactor System, Rev. 1 (2017).
- Safety Design Criteria for Gen IV Lead-cooled Fast Reactor System (2021).
- Safety Design Guidelines on Safety Approach and Design Conditions for Gen IV Sodium-cooled Fast Reactor Systems (2016).

Proliferation Resistance & Physical Protection (PR&PP) Reports from GIF:

- Molten Salt Reactors – PR&PP White Paper (2023)
- Very High Temperature Reactors – PR&PP White Paper (2022)
- Gas Fast Reactors – PR&PP White Paper (2022)

International Maritime Organization:

- Code of Safety for Nuclear Merchant Ships: Adopted in 1981

Other Publications

24

Structure in accordance with DPP

1. INTRODUCTION
2. APPLYING THE SAFETY PRINCIPLES AND CONCEPTS TO THE DESIGN OF NUCLEAR POWER PLANTS
3. MANAGEMENT OF SAFETY IN DESIGN OF NUCLEAR POWER PLANTS
4. PRINCIPAL TECHNICAL REQUIREMENTS IN THE DESIGN OF NUCLEAR POWER PLANTS
5. GENERAL NUCLEAR POWER PLANT DESIGN
6. DESIGN OF SPECIFIC NUCLEAR POWER PLANT SYSTEMS: TECHNOLOGY INCLUSIVE
7. DESIGN OF SPECIFIC NUCLEAR POWER PLANT SYSTEMS: SPECIFIC CHARACTERISTICS (to take account of different design characteristics as presented in the Scope section of this DPP)
8. DEFINITIONS USED IN THE DESIGN OF NUCLEAR POWER PLANTS
9. APPENDICES (if needed, for instance, to provide traceability and consistency of requirements among different technologies and applications, or to explain further the interfaces between safety and security and safety safeguards)
10. REFERENCES
11. ANNEXES (IF NEEDED)
12. CONTRIBUTORS TO DRAFTING AND REVIEW

Planned Schedule

STEP 1: Preparing a DPP	DONE
STEP 2: Approval of DPP by the Coordination Committee	July 2025
STEP 3: Approval of DPP by the relevant review Committees	November 2025
STEP 4: Approval of DPP by the CSS	March 2026
STEP 5: Preparing the draft	3Q 2026
STEP 6: Approval of draft by the Coordination Committee	3Q 2028
STEP 7: Approval by the relevant review Committees for submission to Member States for comments	4Q 2028
STEP 8: Soliciting comments by Member States	1Q 2029
STEP 9: Addressing comments by Member States	1Q 2030
STEP 10: Approval of the revised draft by the Coordination Committee Review in NSOC-SGDS (Technical Editorial review)	1Q 2030
STEP 11: Approval by the relevant review Committees	2Q 2030
STEP 12: - Submission to the CSS - Submission in parallel and approval by the Publications Committee - MTCD Editing - Endorsement of the edited version by the CSS	4Q 2030
STEP 13: Establishment by the Publications Committee and/or Board of Governors (for SF and SR only))	1Q 2031
STEP 14: Target publication date	2Q 2031

Note: It is proposed to keep the Committees regularly informed on the progress of the drafting to overcome potential challenges or difficulties that might appear

Planned Schedule

Requirements and Safety guides	2025				2026				2027				2028				2029				2030				2031				2032				2033				2034				2035			
	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4	Q1	Q2	Q3	Q4
SSR-2/1 (Rev.1) Design requirements		1	2	3	4	4	5	5	5	5	5	5	5	6	7	7	8	8	8	8	9, 10	11	12	12	13	14																		
SSG-30 Safety Classification of SSCs						1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14																			
SSG-34 Electrical systems								1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14																	
SSG-38 Construction of Nuclear Installations										1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14															
SSG-39 Instrumentation and control								1	2	3	4	4	5	5	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14															
SSG-51 Human Factors Engineering												1	2	3	4	4	5	5	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14											
SSG-52 Reactor core design						1	2	3	4	4	5	5	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14																	
SSG-53 Reactor containment						1	2	3	4	4	5	5	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14																	
SSG-56 Reactor coolant						1	2	3	4	4	5	5	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14																	
SSG-62 Auxiliary systems														1	2	3	4	4	5	5	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14									
SSG-63 Fuel handling and storage								1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14																	
SSG-64 Internal hazards														1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14											
SSG-69 Equipment qualification																		1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14							
SSG-88 Practical elimination																						1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14			
SSG-90 Radiation protection																		1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14							
SSG-61 Safety Analysis report																		1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14							
SSG-XX Transportable NPPs: Design																1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14									
GSR Part 4 (Rev.1) Safety assessment						1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	13	14																		
SSG-2 (Rev.1) Deterministic safety analysis												1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14													
SSG-3 (Rev.1) Level 1 PSA																																												
SSG-4 (Rev.1) Level 2 PSA	12	12	14																													1	2	3	4	4	5	5	5	5	5	6	7	7
SSG-X (L3PSA) Level 3 PSA	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14																									
SSG-X (DS537) Safety demonstration	7	8	9, 10	9, 10	11	12	14																																					
SSG-25 (Rev.1) Periodic safety review	7	7	8	9, 10	9, 10	11	11	12	12	4																																		
SSG-54 Accident management												1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	14													
SSR-XX (New safety requirements Fusion)												1	2	3	4	4	5	5	5	5	5	6	7	7	8	8	9, 10	11	12	12	13	14												

Methodology for the revision

1st: The requirement in this para is a technology neutral / inclusive and is fully applicable to all reactor technologies and land base and transportable. It can be kept as it is.

2nd: The requirement in this para is not technology inclusive but only minor changes in the wording are needed to make it fully applicable.

3rd: The requirement in this para is technology specific for WCR land base. It is kept as it is. Equivalent requirement for other reactor technologies or for transportable reactors should be developed.

Examples of Modifications (C1)

Requirement 2: Management system for plant design

The design organization shall establish and implement a management system for ensuring that all safety requirements established for the design of the plant are considered and implemented in all phases of the design process and that they are met in the final design.

3.2. The management system shall include provision for ensuring the quality of the design of each structure, system and component, as well as of the overall design of the nuclear power plant, at all times. This includes the means for identifying and correcting design deficiencies, for checking the adequacy of the design and for controlling design changes.

Examples of Modifications (C2, C3)

Requirement 4: Fundamental safety functions

Fulfilment of the following fundamental safety functions for a nuclear power plant shall be ensured for all plant states: (i) control of reactivity; (ii) removal of heat from the reactor core and from the fuel ~~store~~ in any other location; and (iii) confinement of radioactive material, shielding against radiation and control of planned radioactive releases, as well as limitation of accidental radioactive releases.

4.1. A systematic approach shall be taken to identifying those items important to safety that are necessary to fulfil the fundamental safety functions and to identifying the inherent features that are contributing to fulfilling, or that are affecting, the fundamental safety functions for all plant states including for transportable nuclear power plants during transport, installation and reinstallation.

4.2A. For reactor designs where the fuel or fission products are removed from the reactor core during operation, the generate heat that shall be removed as part of fundamental safety function (ii).

Examples of Modifications (C3)

Requirement 13: Categories of plant states

Plant states shall be identified and shall be grouped into a limited number of categories primarily on the basis of their frequency of occurrence at the nuclear power plant.

5.1. Plant states shall typically cover:

(a) Normal operation;

(b) Anticipated operational occurrences, which are expected to occur over the operating lifetime of the plant, including those associated with relocation, installation, and reinstallation phases for transportable nuclear power plants and modular designs;

(c) Design basis accidents;

(d) Design extension conditions, including ~~accidents with core melting~~ conditions which could evolve towards severe accidents scenarios that are not considered within the practical elimination concept.

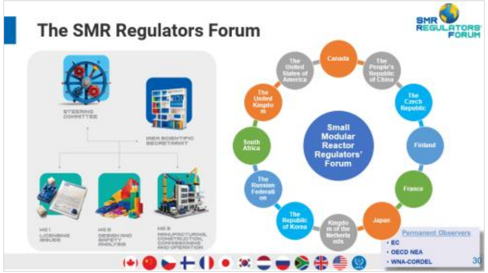
Examples of Modifications (C3)

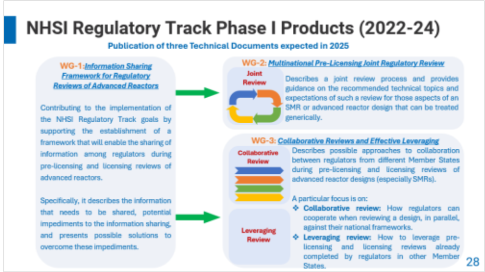
Requirement 46: Reactor shutdown

Means shall be provided to ensure that there is a capability to shut down the reactor of the nuclear power plant in operational states and in accident conditions, and that the shutdown condition can be maintained even for the most reactive conditions of the reactor core.

6.7. The effectiveness, speed of action and shutdown margin of the means of shutdown of the reactor shall be such that the specified design limits for fuel are not exceeded, even in the event of external hazards or due to changes in the relative position of the nuclear reactor during normal operation or accident conditions other than severe accidents. For transportable reactors including floating reactors, changes in orientation relative to the horizon shall be considered in the design basis for the means of shutdown.

Other activities





Concluding remarks

The revision of IAEA Safety Standards for Design Safety of Nuclear Power Plants and supporting activities for incorporating advanced reactor designs

- **Aims at maintaining the objective oriented technology neutral, technology inclusive, technology specific requirements and design specific recommendations approach for all reactor technologies and applications** commensurate with the level of knowledge and operating experience to maintain a high level of safety that can reasonably be achieved in the design of nuclear power plants, to meet the fundamental safety objective and in compliance with the ten safety principles

- **NHSI, NEXSHARE and SMR Regulators' Forum platforms support collaboration and information sharing to enable safe deployment of advanced reactor designs**

- **The Nuclear Safety Assessment Academy provides a comprehensive training programme for safety assessment engineers** to facilitate capacity building in Member States for conducting the safety assessment of advanced reactor designs in NPP

Thank you!

Safety-Standards.Contact-Point@iaea.org

Annex

Safety Requirements

IAEA Safety Standards
for protecting people and the environment
Leadership and Management for Safety
General Safety Requirements
No. GSR Part 2
IAEA

IAEA Safety Standards
for protecting people and the environment
Radiation Protection and Safety of Radiation Sources: International Basic Safety Standards
Jointly sponsored by EC, FAO, IAEA, ILO, OECD/NEA, PAHO, UNEP, WHO
General Safety Requirements Part 3
No. GSR Part 3
IAEA

DS548
IAEA Safety Standards
for protecting people and the environment
Predisposal Management of Radioactive Waste
General Safety Requirements Part 5
No. GSR Part 5
IAEA

DS558
IAEA Safety Standards
for protecting people and the environment
Preparedness and Response for a Nuclear or Radiological Emergency
Jointly sponsored by the FAO, IAEA, ICAO, ILO, IMO, INTERPOL, OECD/NEA, PAHO, CTBTO, UNEP, OCHA, WHO, WMO
General Safety Requirements
No. GSR Part 7
IAEA

DS532
IAEA Safety Standards
for protecting people and the environment
Safety of Nuclear Power Plants: Commissioning and Operation
Specific Safety Requirements
No. SSR-2/2 (Rev. 1)
IAEA

DS557
IAEA Safety Standards
for protecting people and the environment
Site Evaluation for Nuclear Installations
Specific Safety Requirements
No. SSR-1
IAEA

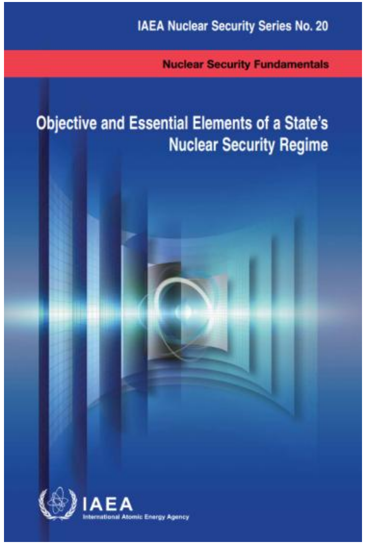
IAEA
IAEA SAFETY STANDARDS
No. SSR-6 (Rev. 2)
Regulations for the Safe Transport of Radioactive Material
2025 Edition
SPECIFIC SAFETY REQUIREMENTS

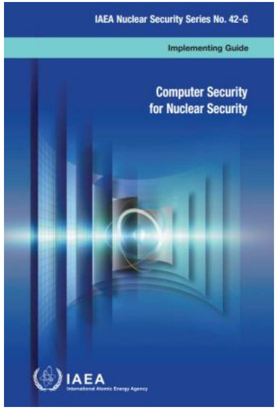
Safety Guides

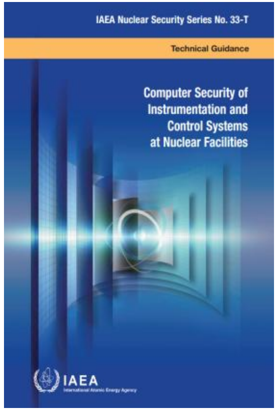
Safety Assessment

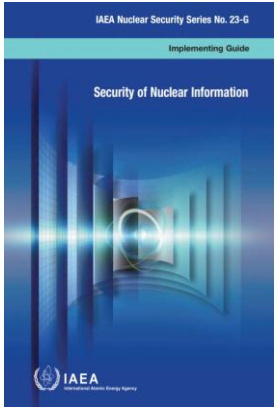
Design Safety

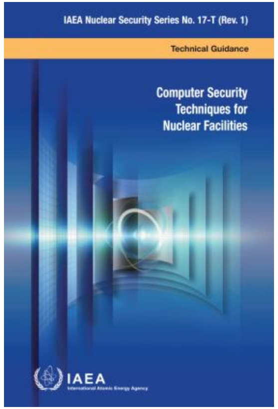
Security Series











Safety / Security Documents

DS533/NST067 Management of the interfaces between nuclear and radiation safety and nuclear security

Other Publications

IAEA

IAEA TECDOC SERIES

Analysis and Modelling of Severe Accidents for Liquid Metal Fast Reactors

Proceedings of a Technical Meeting

IAEA-TECDOC######

Analysis and Modelling of Severe Accidents for LMFRs: Report of a Technical Meeting

1. *Introduction*
2. *Summary of TM technical sessions*
   - *2.1 SFR accident analyses and experimental validation*
   - *2.2 SFR initiation and transition phase*
   - *2.3 SFR expansion phase and long-term behaviour*
   - *2.4 LFR accident analysis and experiments*
3. *Conclusion and perspective*
4. *Annex: 22 peer-reviewed technical papers*

30 representatives, 11 Member States from R&D organizations, design organizations, national …

IAEA-TECDOC######

Considerations on the safety of Liquid Metal Cooled Fast Reactors

1. *Introduction*
2. *General features of LMFRs*
3. *Approaches for design and safety assessment for the prevention and mitigation of accidental sequences leading to severe accidents*
4. *LMFRs features which influence safety*
5. *Conclusion*

10 representatives, 7 Member States, from design organizations, national regulators and TSO, R&D organizations

IAEA-TECDOC######

Progress in the Performance Assessment and Regulation of Passive Safety Features in Advanced Nuclear Power Plant Designs

IAEA TECDOC SERIES

IAEA-TECDOC-2010

Approach and Methodology for the Development of Regulatory Safety Requirements for the Design of Advanced Nuclear Power Reactors

Case Study on Small Modular Reactors

IAEA

IAEA

A supplement to: IAEA Advanced Reactors Information System (ARIS)

IAEA TECDOC SERIES

IAEA-TECDOC-1936

Applicability of Design Safety Requirements to Small Modular Reactor Technologies Intended for Near Term Deployment

Light Water Reactors
High Temperature Gas Cooled Reactors

IAEA

Safety Reports Series No. 123

Applicability of IAEA Safety Standards to Non-Water Cooled Reactors and Small Modular Reactors

IAEA International Atomic

IAEA-TECDOC######

Safety Implications of the Use of Artificial Intelligence in Nuclear Power Plants

IAEA-TECDOC######

Considerations on the safety of Molten Salt Cooled Reactors

More … design…

IAEA-TECDOC######

Considerations on the safety of High Temperature Gas Cooled Reactors

…itutes

IAEA-TECDOC######

Technical Report on Design Safety and Security Considerations of Floating Nuclear Power Plants

1. *Introduction*
2. *Floating Nuclear Power Plant Concept and Lifecycle*
3. *Safety: Assessing Applicability of IAEA Safety Requirements for Floating Nuclear Power Plants*
4. *Security*
5. *Summary*

Other Publications

IAEA:

- TECDOC-1406
- TECDOC-1536
- TECDOC-1569
- TECDOC-1674
- TECDOC-1753
- TECDOC-1791
- TECDOC-1912
- TECDOC-1936
- TECDOC-2021
- NW-T-1.14 (Rev.1)
- NR-T-1.18
- NG-T-3.5
- NR-T-1.19
- NP-T-4.1
- NP-T-4.2
- NF-T-4.1
- NP-T-1.6

National Regulatory Docs:

NP-022-17 & NP-029-17 (RF)
US NRC RG 1.232 (Rev.0) (USA)
CNSC REGDOC-2.5.2 (Canada)

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- Safety Design Criteria for Gen IV Very High Temperature Reactor System (2023).
- Safety Design Criteria for Generation IV Gas-Cooled Fast Reactor System (2022).
- Gas-Cooled Fast Reactor System Safety Assessment (2022).
- Safety Design Criteria for Gen IV Sodium cooled Fast Reactor System, Rev. 1 (2017).
- Safety Design Criteria for Gen IV Lead-cooled Fast Reactor System (2021).
- Safety Design Guidelines on Safety Approach and Design Conditions for Gen IV Sodium-cooled Fast Reactor Systems (2016).

Proliferation Resistance & Physical Protection (PR&PP) Reports from GIF:

- Molten Salt Reactors – PR&PP White Paper (2023)
- Very High Temperature Reactors – PR&PP White Paper (2022)
- Gas Fast Reactors – PR&PP White Paper (2022)

International Maritime Organization:

- Code of Safety for Nuclear Merchant Ships: Adopted in 1981

Other recent publications

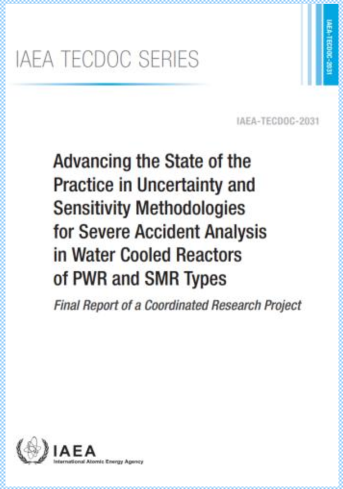
Coordinated Research Project (CRP) I31033

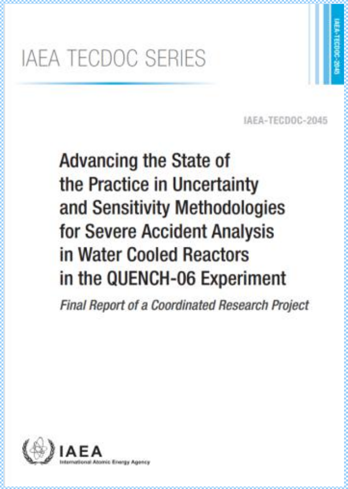
TECDOC-2031 “Advancing the State of the Practice in Uncertainty and Sensitivity Methodologies for Severe Accident Analysis in Water Cooled Reactors of PWR and SMR Types: Final Report of a Coordinated Research Project” (2023)

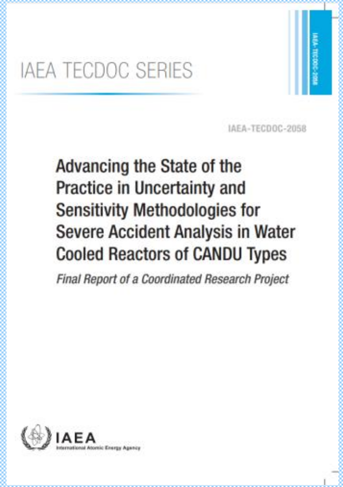
TECDOC-2045 “Advancing the State of the Practice in Uncertainty and Sensitivity Methodologies for Severe Accident Analysis in Water Cooled Reactors in the QUENCH-06 Experiment: Final Report of a Coordinated Research Project” (2024)

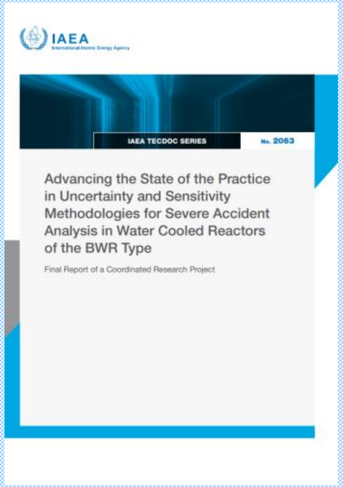
TECDOC-2058 “Advancing the State of the Practice in Uncertainty and Sensitivity Methodologies for Severe Accident Analysis in Water Cooled Reactors of CANDU Types: Final Report of a Coordinated Research Project” (2024)

TECDOC-2063 “Advancing the State of the Practice in Uncertainty and Sensitivity Methodologies for Severe Accident Analysis in Water Cooled Reactors of the BWR Types: Final Report of a Coordinated Research Project” (2024)









Ongoing activities to support fuel development (1/2): Water-Cooled Reactor fuels

Accident Tolerant Fuels

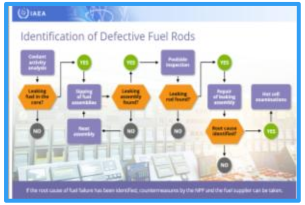
- **CRP T12032** on "*Testing and Simulation of Advanced Technology and Accident Tolerant Fuels* (ATF-TS)" (2020-2024)
- TECDOC on "*Modelling of Severe Accident in Water-Cooled Reactors with Accident Tolerant Fuels*" (in progress, plan 2026)
- TM on the "*Advanced Technology Fuels: Progress on their Design, Manufacturing, Experimentation, Irradiation, and Case Studies for their Industrialization, Safety Evaluation, and Future Prospects*" (2025)

Fuels for recycling/multi-recycling

- TECDOC on "*Mixed Oxide Fuels Design, Operation and Management*" (in progress)
- IAEA publications on "*Challenges and Opportunities in Reprocessed Uranium Fuels*"

Conventional Water-Cooled Reactor fuels

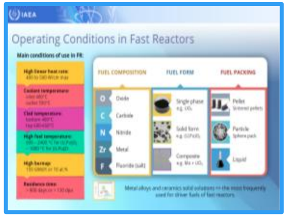
- TECDOC on "*Review of Fuel Failures in Water Cooled Reactors* (2016–2020)" (in progress)
- TECDOC on "*Advances in Nuclear Fuel Fabrication Technologies for Power Reactors*" (in progress)
- IAEA TECDOC on "*Structural Behaviour of Fuel Assemblies in Water Cooled Reactors*" (in progress)
- TM on "*Advances in Fuel Design, Manufacturing and Examinations for Pressurized Heavy Water Reactors*" (November 2024, Argentina)



Ongoing activities to support fuel development (2/2): Innovative GEN-IV and SMR fuels

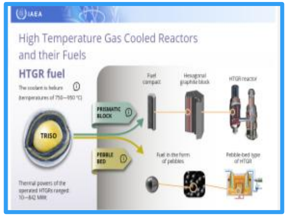
Water-cooled SMR fuels

- Workshop on "*Core and Plant Simulation with an Emphasis on Fuel Behaviour in Light Water Reactor Based Small Modular Reactors*" (to compare results of SMR fuel behaviour simulation, common analysis), February 2024 (TECDOC, in progress)



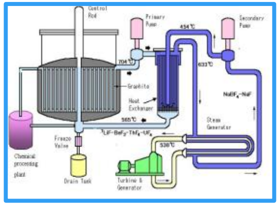
Fast reactor fuels

- **CRP T12031** on "*Fuel Materials for Fast Reactors (**FMFR**)*" (2019-2023: Final report in progress)
- IAEA NES report on "*Nuclear Fuel Technologies for Liquid Metal Cooled Fast Reactors (LMFRs)*" (in progress)
- International Workshop on the "*Behaviour of Liquid Metal Cooled Fast Reactors Fuels*" (2025)



Gas-cooled SMR fuels

- TECDOC on "*Coated Particle Fuels for High Temperature Gas-Cooled, Small Modular Reactors – Progress in Design, Manufacturing, Experimentation, Modelling and Analysis Technologies*" (preparation to publishing)
- **CRP T12034** on "*Fuel Modelling Exercises for Coated Particle Fuel for advanced reactors including SMR*" (RCM-1 on 11-15 March 2025)



Molten salt SMR fuels

- New Simulation tool module development for MSR with relevant fuel cycle
- International Workshop on Simulation Codes for Advanced Nuclear Fuel Cycle Scenarios (2025)

Post-Irradiation Examination for SMR fuels

- **CRP T12033** on "*Standardization of Subsized Specimens for Post-Irradiation Examination and Advanced Characterization of Fuel and Structural Materials for Small Modular Reactor and Advanced Reactor Applications (**PIE for SMR**)*" (RCM-1 October 2024)

NHSI Regulatory Track Phase I Products (2022-24)

Publication of three Technical Documents expected in 2025

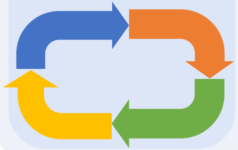
WG-1: *Information Sharing Framework for Regulatory Reviews of Advanced Reactors*

Contributing to the implementation of the NHSI Regulatory Track goals by supporting the establishment of a framework that will enable the sharing of information among regulators during pre-licensing and licensing reviews of advanced reactors.

Specifically, it describes the information that needs to be shared, potential impediments to the information sharing, and presents possible solutions to overcome these impediments.

WG-2: *Multinational Pre-Licensing Joint Regulatory Review*

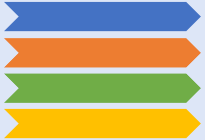
Joint Review



Describes a joint review process and provides guidance on the recommended technical topics and expectations of such a review for those aspects of an SMR or advanced reactor design that can be treated generically.

WG-3: *Collaborative Reviews and Effective Leveraging*

Collaborative Review



Leveraging Review

Describes possible approaches to collaboration between regulators from different Member States during pre-licensing and licensing reviews of advanced reactor designs (especially SMRs).

A particular focus is on:

- **Collaborative review:** How regulators can cooperate when reviewing a design, in parallel, against their national frameworks.
- **Leveraging review:** How to leverage pre-licensing and licensing reviews already completed by regulators in other Member States.

NHSI RT Phase II Activities (2025-end 2026)

Activity 2

SMR Regulation and Cooperation Hub

Activity 3

Implementation of NHSI Processes
Multinational pre-licensing joint regulatory review pilot project (depends on request)

Activity 4

Step-by-step blueprint to establish a global review framework

Focus on implementation of Phase I processes, gathering and analyzing cooperation feedback and disseminating information on regulation.

SMR REGULATORS' FORUM

Annual meeting open to all NHSI RT participants hosted by the **SMR Regulators' Forum** to exchange and gather lessons learned on regulatory cooperation and to discuss activities.

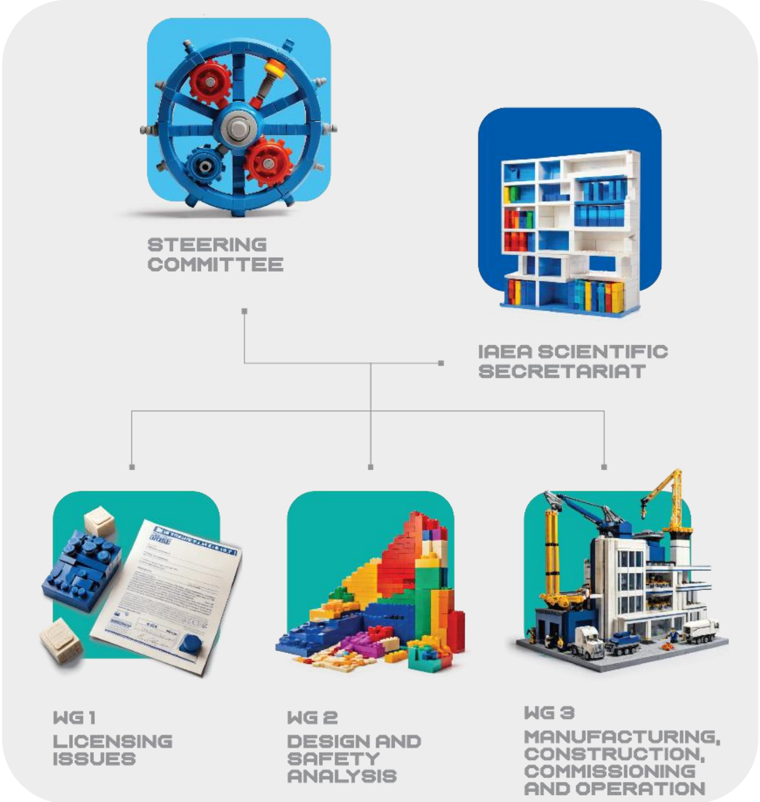
Activity 1

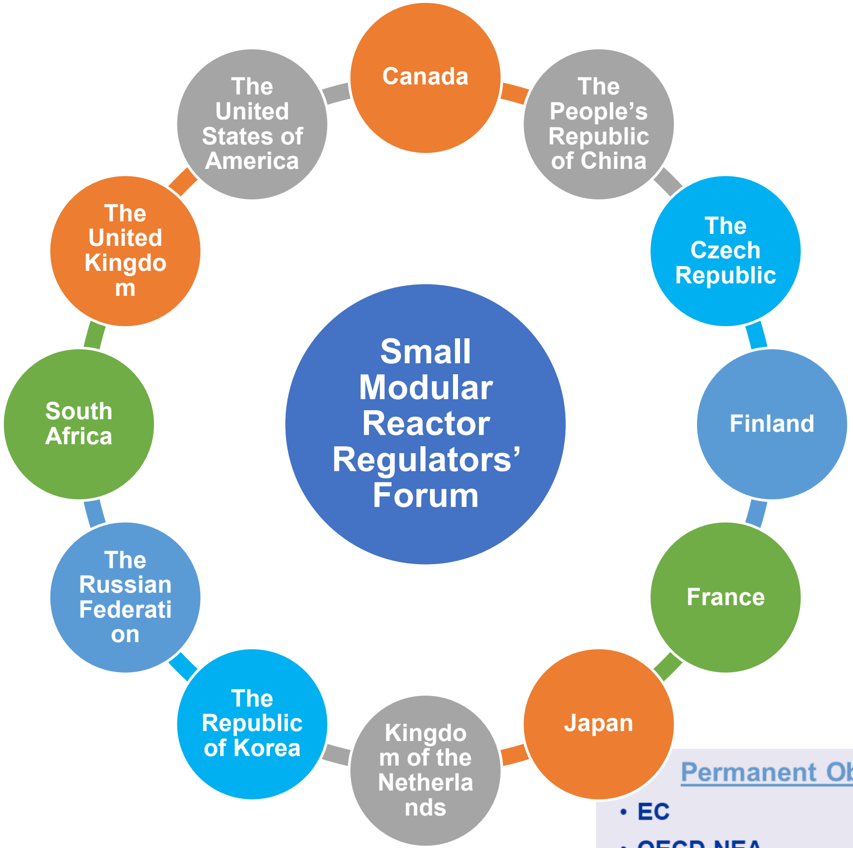
Regulatory Cooperation Toolkit

Activity 5

Security of SMRs Working Group

The SMR Regulators Forum





Permanent Observers

- EC
- OECD NEA
- WNA-CORDEL

The SMR RF Topics by Phases of Work

SMR REGULATORS' FORUM

Phase 1 (2015 – 2017)

- Graded Approach
- Defence-in-Depth
- EPZ Size

Phase 2 (2018 – 2020)

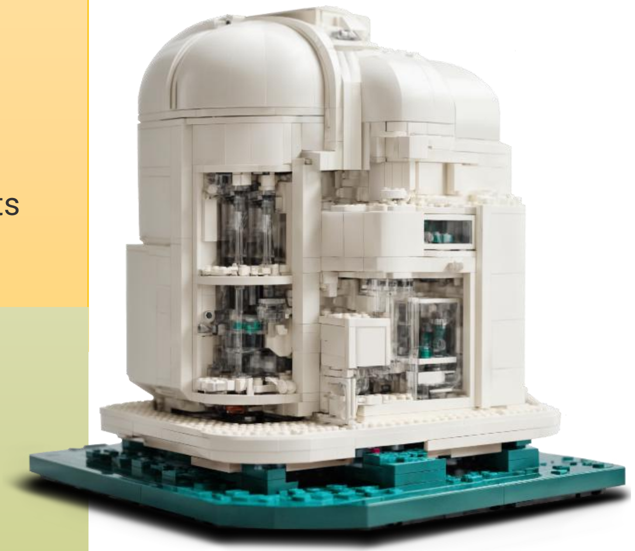
- Licensing Issues
- Design and Safety Analysis
- Manufacturing, Commissioning and Operation

Phase 3 (2021 – 2023)

- Mutual recognition of regulators' assessments/Joint assessments/Collaboration
- Safety, Security and Safeguards from a regulatory perspective
- Containment/confinement
- Regulatory considerations in pre-licensing engagement for long-lead requests and items
- Conduct of authorised activities: Impact on stakeholders' organisational

Phase 4 (2024 – 2026) – current phase

- Leveraging other regulators' reviews (NHSI WG3)
- Mechanistic source term (DSA)
- Continuation of 3S topics (DSA)
- Manufacturing and deployment in the absence of a licensee (MCCO)
- Construction oversight (MCCO)
- Organizational capability of a new licensee (no prior nuclear experience) (MCCO)



SMR RF Phase 4 Progress

SMR REGULATORS' FORUM

DSA WG

- Continuation of 3S topics just started focusing on remote locations
- Mechanistic source term work advanced, questionnaire responses received, the common positions include consideration of:
  - Scenario Identification
  - Phenomena Identification and Ranking
  - Source Term Calculation – Code Qualification
  - Sensitivity and Uncertainty Analysis
  - Existing IAEA Guidance

MCCO WG

- Manufacturing and deployment in the absence of a Licensee, examples of topics under consideration:
  - Codes and standards
  - Standardization of supply chain
  - Manufacturing in the absence of licensee
  - Fleet Approach
  - Need for third party accredited oversight bodies
  - Maintenance once on the shelf
- Construction oversight
  - Focus on how licensee will reconcile quality documents that were produced without their involvement
  - Innovative construction techniques
  - Licensee capability to oversee main contractor and rest of the supply chain
- Organisational capability of a new licensee (no prior nuclear experience)
  - Definition of capability and how it is assessed
  - Safety Culture
  - Shared services model and intelligent customer
  - Vendor organisation's capability

SMR RF and NHSI Partnership

SMR REGULATORS' FORUM

Expected Outputs

- Proven practical guidelines and tools for using leveraging approaches and for drafting regulatory reviews that can be more easily leveraged.
- Proven approaches to reach regulatory equivalency, focusing on areas of regulatory difference with examples of application.

The toolkit is not a publication, specific tools and examples will be available electronically complementing the publications developed in NHSI phase I.

Benefits

- Increase global regulatory efficiency and consistency by rapid implementation of leveraging processes.
- Regulatory review reports that are more widely used and understood by regulatory bodies in different Member States.
- Regulatory bodies can accept alternative approaches used in other Member States.

Delivery Plan

- **End of 2024:** Scope, workplan and identification of application examples.
- **Q2 2026:** Development of guidelines and tools based on application examples.
- **Q3 2026:** Review and finalization of the work.

SMR RF Educational Workshops

The Australia Workshop (Source: IAEA)

Region	Host	Dates
West Asia/ Africa	Jordan	December 2021
Asia-Pacific	Australia	November 2022
Latin America	Argentina	December 2022
Africa	Morocco	October 2023
Europe	Czechia	December 2023
Latin America	Brazil	October 2024
Asia	India	December 2024
Africa	South Africa	June 2025

The Argentina Workshop (Source: ARN)

The Morocco Workshop (Source: AMSSNuR)

The Czechia Workshop (Source: IAEA)

The Brazil Workshop (Source: CNEN)

Nuclear Safety Assessment Academy

Week 1 Assessment of Engineering Aspects Important to safety

Week 2 Deterministic Safety Analysis

Week 3 Level 1 Probabilistic Safety Assessment

Week 4 Level 2 Probabilistic Safety Assessment

Combine theoretical, cases studies and practice

NHSI INDUSTRY TRACK TW 3 → NEXSHARE

Background – NSHI Topic 3 : Experimental Testing and Validation for Design and Safety Analysis Computer Codes

The focus of this Topic was to establish a global cooperation mechanism for experiments and code validation for SMRs, between entities operating experimental facilities, technology holders and potentially TSOs.

The **general objectives** of Topic are to:

- **Share information on existing experimental programs. Identify potentials for resource sharing and synergies.**
- **Provide greater reach and enhanced utilization of existing experimental facilities.**
- Provide greater confidence on data and codes used in safety cases.
- Reduce costs and increase schedule certainty of experiments and code validation needed for SMRs.

Phase I (2023-2024)

Phase II (2025-2026)

During the **first phase**, we have established a network to serve as a global cooperation mechanism for experiments and code validation sharing (**NEXSHARE**).

Note: sharing information on experiment and code validation does not necessarily mean sharing data, but identifying what is available, what work is being conducted, what are the gaps and what facilities are currently available. Agreeable conditions for sharing (data or resource) are to be established between interested parties.

What is NEXSHARE – Members

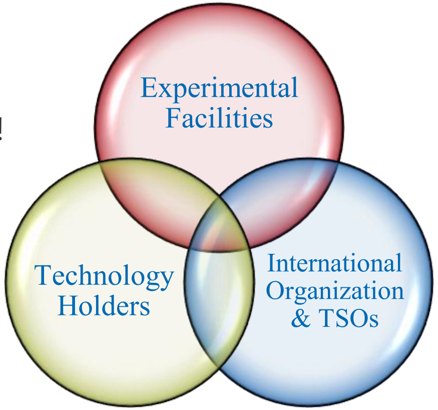
What is NEXSHARE:
An International community of professionals promoting information sharing and collaborations on experimental programmes, code validation, and available experimental facilities for SMRs.

It is comprised of:

Members:

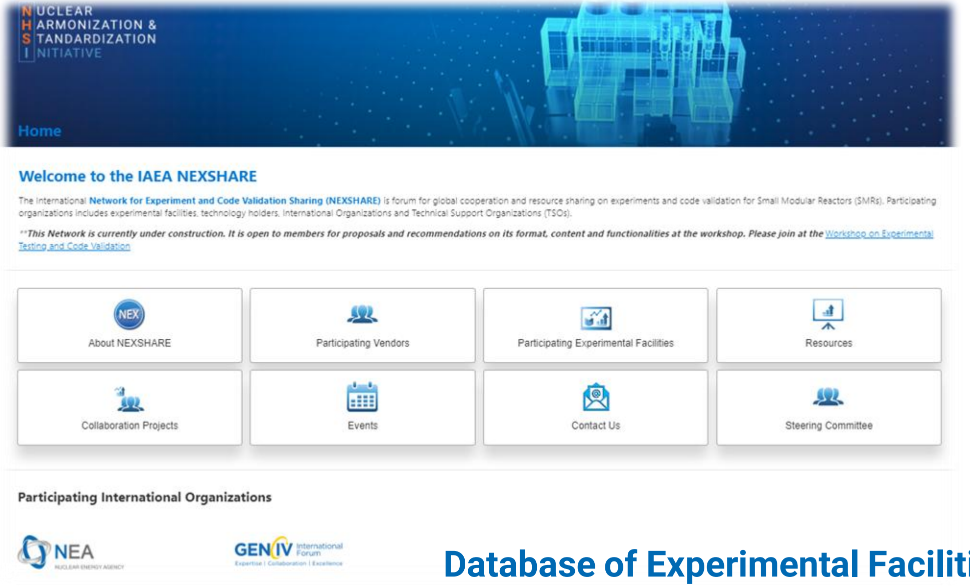
- ✓ Design Organizations: 21 participating organization from 13 MS, and more to come!
- ✓ Experimental Facilities & Codes Developers
- ✓ TSO
- ✓ International Organizations:

  In collaboration with the OECD/NEA, the GEN-IV Forum and EPRI for further synergies



Technologies included: Water Cooled, Molten Salt, High Temperature Gas Cooled, Liquid Metal Fast Reactors.

NEXSHARE – Web Interface and Database



Web Interface / Portal:

- Centralizes / links to the information, events, publications and projects, from different organizations, that are relevant to the topic.
- Means to contact the members and create opportunities for sharing and initiating bilateral collaborations.

Database of Experimental Facilities Applicable to SMRs

- Available from the NEXSHARE web interface.
- Continuously expanded and updated.
- Built on projects from / with the collaboration of the OECD/NEA and Gen-IV Forum.
- Participating facilities provided their description, contact details and information on the type of experiments available, QA program and IP considerations.

NEXSHARE – Events and Publications

Events and Publications: to support the Network by providing a platform for information exchange

First Version of a NEXSHARE Brochure

First Workshop (18-21 June 2024) **& launch of NEXSHARE:**

- ✓ Great example of collaboration between the IAEA, OECD/NEA and GIF.
- ✓ Discussed the different experimental testing and code validation programmes, industry and regulatory perspectives on code usage and validation for SMRs, and potential for collaborations.
- ✓ Discussed the next steps for the Network and Questionnaire was sent for feedback

NEXSHARE – Events and Publications

Outcomes/Recommendations from the NEXSHARE Workshop (18-21 June 2024)

- Positive feedback: workshop to be repeated every 2 years at external organization & combined with a visit
- Suggested to extend of the database to other areas (e.g. environmental qualification, fuel, etc.)
- An important portion of the participants are interested in working on a specific topic
- New features/activities of NEXSHARE recommended:
    - Launch benchmarking activities or CRP on code validation. Conduct a code mapping.
    - Forming working groups or meeting groups/chats (put up questions, share ongoing work).
    - Planning events such as industry conferences, training workshops, or networking sessions.
    - Increase promotion of the network.

Next Steps for NEXSHARE

Now that the Network is established, the next phase will focus on expanding the network, add functionalities and launch technology-specific collaborative work under the umbrella of NEXSHARE.

Planning for the Phase II is ongoing based on the feedback from the Workshop. The plan is expected to be ready for approval at the First NEXSHARE Steering Committee in December 2024.

NEXSHARE Phase II

International Collaboration

- ✓ Continue alignment with international organizations and projects.
- ✓ More organizations to join for increased international collaboration.

Network Expansion

- ✓ Continue to populate the portal and its database.
- ✓ Consolidation with existing IAEA databases.
- ✓ Add functionalities to further facilitate access / sharing of experiments and collaborations.

Technology-Specific Work

- ✓ Form Working Groups to produce technology-specific deliverables.
- ✓ Detailed workplans under definition based on industry needs.

Information Sharing

- ✓ Articles in journals and conferences.
- ✓ 2nd NEXSHARE Workshop planned in 2026.
- ✓ Chat groups, webinars, etc.

Next Steps for NEXSHARE (..more details)

Expansion of the Database of Experimental Facilities:

- Consolidation with existing IAEA database (e.g. LMFNS, SANIS, GCR)
- Continue to populate the database
  - Foreseen collaboration with OECD/NEA activities to expend the database for WCR (e.g. CCVM)
  - Expansion to Advanced Reactors
  - Expansion to Fuels

New functionalities:

- How to simplify finding existing experiments (e.g. AI-based search engine)
- Easy means to contact members, initiate discussions/questions/chats
- Calls for collaborations, increased vendor's participation

2nd Workshop:

- Expected to be held at the OECD/NEA in 2026.

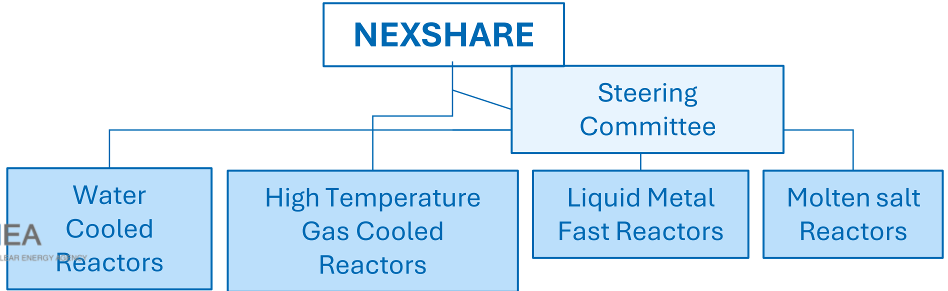
Next Steps for NEXSHARE (working groups)

Example of potential scope for HTGR, MSR, LMFR (plan to be approved at the 1st SC Meeting, Dec 2024)

- Complete the database of experimental facilities and merge with existing ones (if applicable).
- Document research priorities and need for experiments for the technology (vendors' participation needed, build on past projects).
- Technology-specific code mapping and potential code development activity or benchmark/CRP.
- Potential focussed CMs/TM/webinars.
- Strong collaboration with GIF and the applicable IAEA Technical Working Groups.

Potential scope(s) for WCR (plan to be prepared early 2025)

- Strong collaboration with NEA for alignment with their ongoing/future activities on the topic (NEA chairing applicable scope).
- Careful planning with external organizations is needed to create synergies between projects.
- Avoiding duplication is crucial.



Join the Network

Please join the Network:

[NEXSHARE - Home (iaea.org)]()

NEXSHARE.Contact-Point@iaea.org