

IAEA Safety Standards for the Regulation of Research Reactors

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IAEA

International Atomic Energy Agency

Contents

- IAEA safety standards for research reactors (RRs)
- IAEA safety standards for regulation of RRs
- Supporting IAEA documents
- Concluding remarks

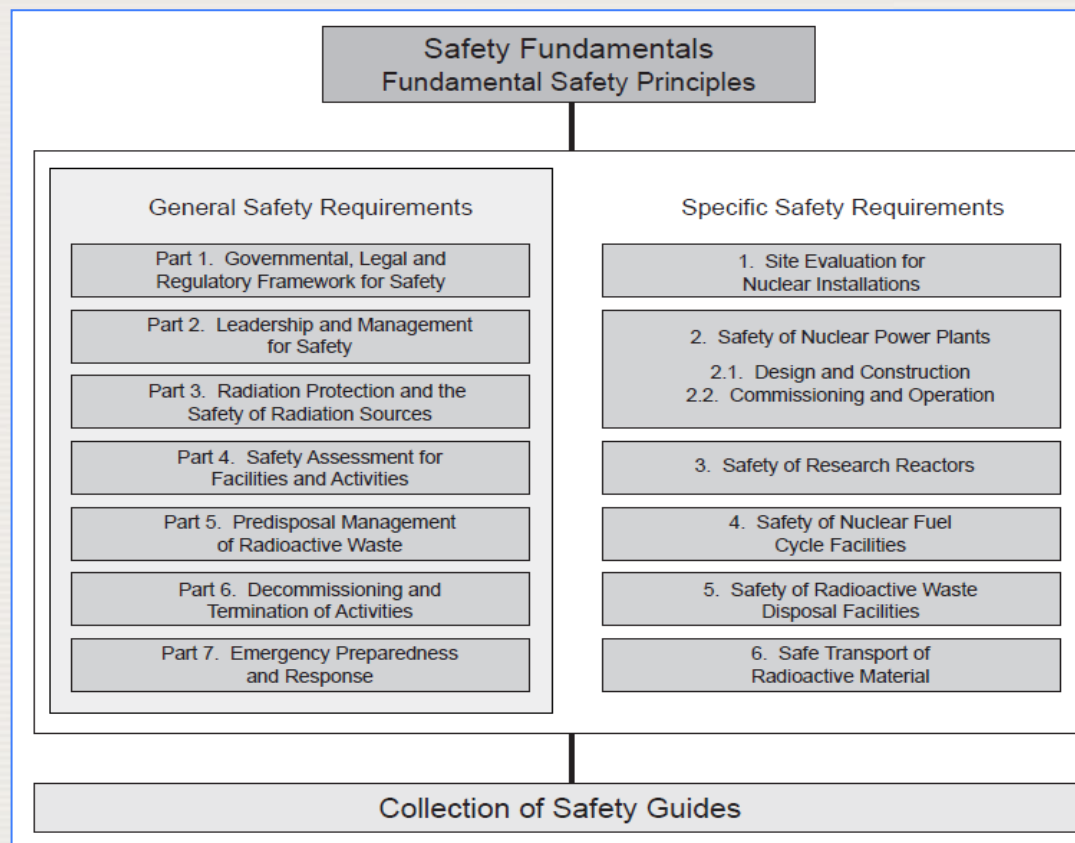
Categories and Structure of the IAEA Safety Standards

- Two categories
 - Thematic: Areas of a cross-cutting nature
 - Facility-specific: Nuclear power plants (NPPs), research reactors (RRs), fuel cycle facilities, etc.
- The structure consists of thematic safety standards and facility-specific safety standards

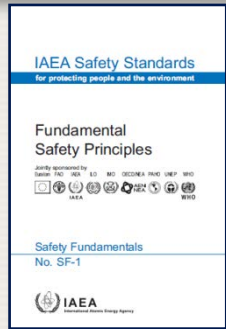


Long-term Structure of the IAEA Safety Standards

- The structure ensures a logical relationship between the IAEA Safety Standard “Fundamental Safety Principles (SF-1),” and the IAEA Safety Requirements and Safety Guides

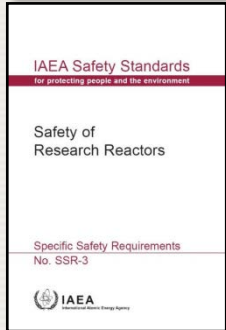


IAEA - Safety Standards Pyramid



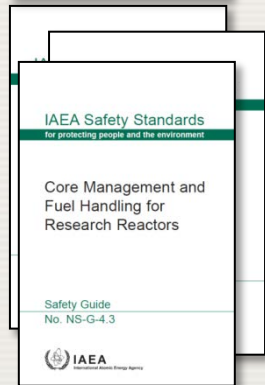
Fundamentals

Objectives, concepts, principles



Requirements

Requirements that must be met (“shall”)



Guides

Recommendations (“should”)

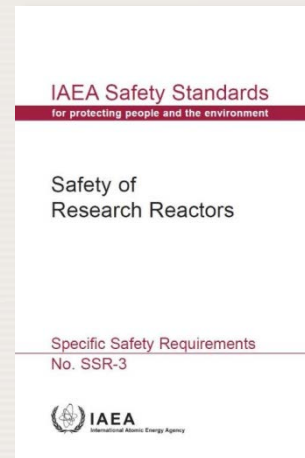
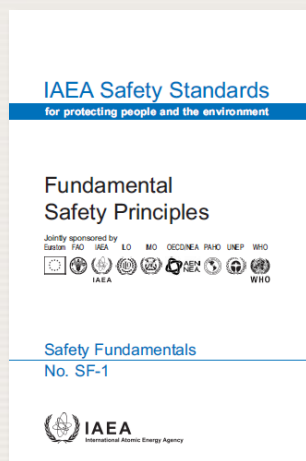
IAEA Safety Standards for Research Reactors

- Safety Standards for RRs reflect international consensus on what constitutes a high level of safety
 - Basis for IAEA safety review services and assistance
 - Cover all areas important to the safety of RRs
 - Provide guidance for effective implementation of the “Code of Conduct on the Safety of Research Reactors”
 - Should be used by all organizations involved in RRs, including the OO, RB, users, designers and vendors
 - Use regulatory language to facilitate their incorporation into national safety regulations and guides

IAEA safety standards for regulation of RRs

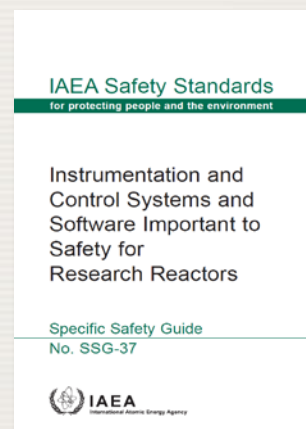
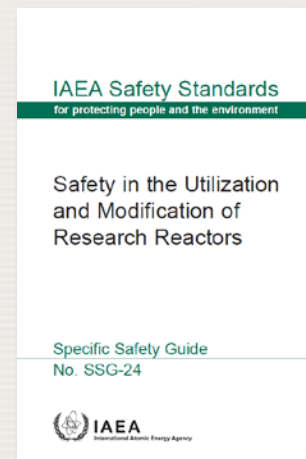
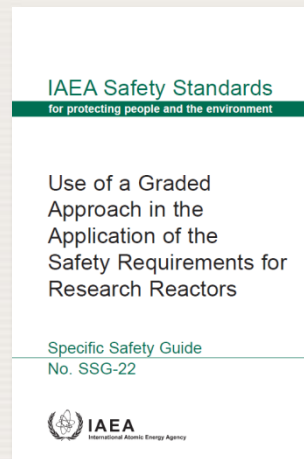
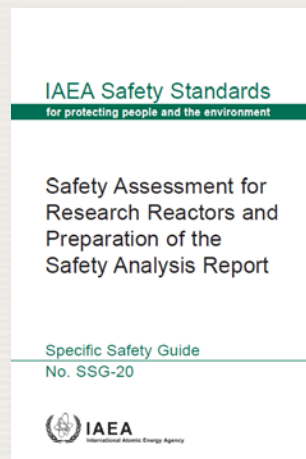
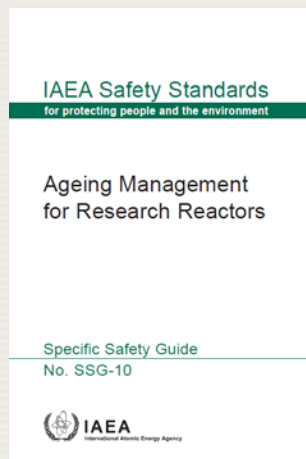
- SSs specific to RRs and other SSs related to regulation of nuclear facilities can be used for developing the regulatory framework for RRs
- SSR-3 specifies the safety requirements for RRs, which should be adapted for the specific needs of the Member State and its facilities
- SSG-22 should be used to apply a graded approach to requirements listed in SSR-3
- SSG-20 provides guidance on safety analysis and the contents of the safety analysis report for various stages in the RR lifetime.

IAEA Safety Standards for Research Reactors



IAEA Safety Standards for protecting people and the environment	IAEA Safety Standards for protecting people and the environment	IAEA Safety Standards for protecting people and the environment	IAEA Safety Standards for protecting people and the environment	IAEA Safety Standards for protecting people and the environment	IAEA Safety Standards for protecting people and the environment
Commissioning of Research Reactors	Maintenance, Periodic Testing and Inspection of Research Reactors	Core Management and Fuel Handling for Research Reactors	Operational Limits and Conditions and Operating Procedures for Research Reactors	The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors	Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors
Safety Guide No. NS-G-4.1	Safety Guide No. NS-G-4.2	Safety Guide No. NS-G-4.3	Safety Guide No. NS-G-4.4	Safety Guide No. NS-G-4.5	Safety Guide No. NS-G-4.6
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IAEA Safety Standards for Research Reactors



SSR-3: Safety of Research Reactors

SSR-3, *Safety of Research Reactors*

- Basis for safety of RRs and subcritical assemblies
- Provide a basis for safety assessment at all stages in the lifetime of a RR
- Establish requirements related to regulatory control, management of safety, site evaluation, design, operation and decommissioning
- Emphasis is placed on the safety requirements that shall be met rather than on the ways in which they can be met
- Includes design extension conditions as a replacement for beyond design basis accidents.

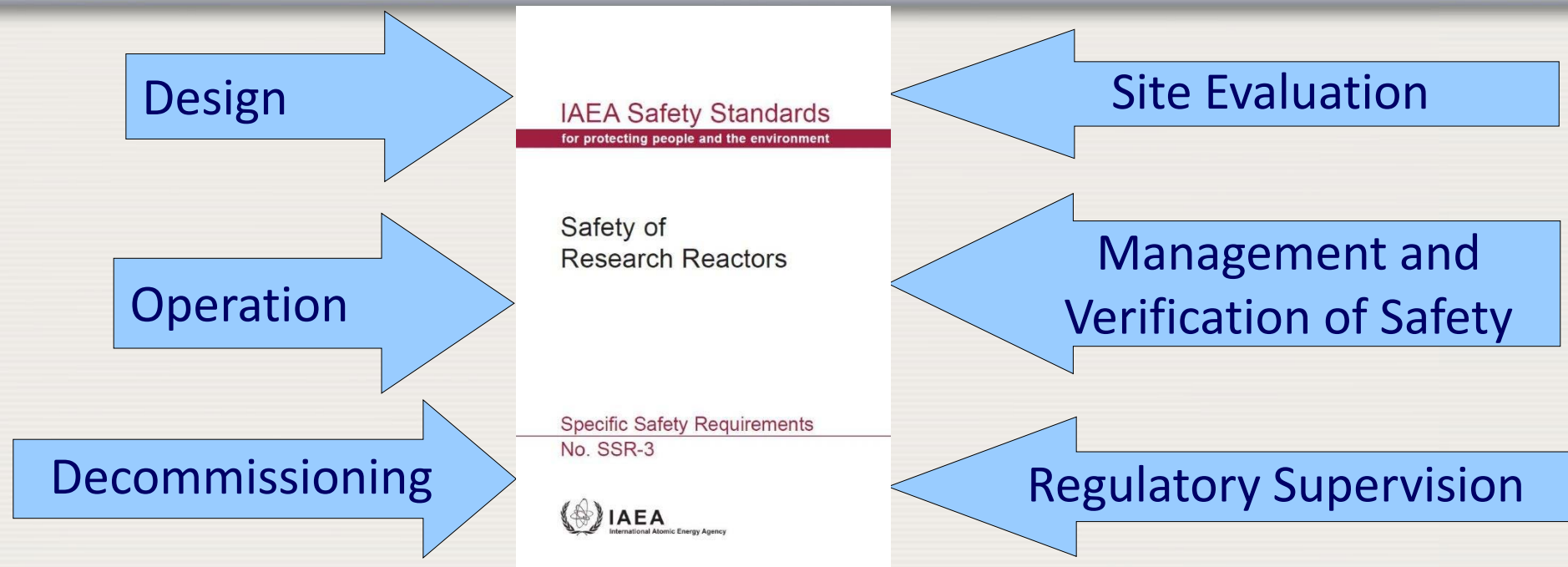
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Safety of
Research Reactors

Specific Safety Requirements
No. SSR-3



SSR-3: Safety of Research Reactors



RRs with power levels in excess of several tens of megawatts, fast reactors, and RRs using an experimental device, such as a high-pressure and temperature loop or a cold neutron source, may require application of safety standards for NPPs or additional safety measures

Using SSR-3 for regulatory requirements for RRs

- SSR-3 is general → covers all types and power levels of RRs
- The requirements must be adapted in a specific manner to fit the needs of the MS.
- Regulatory requirements should be clear and specific so the OO understands what is expected
- Regulatory requirements should be written so that determination of compliance is straightforward and not subject to interpretation
- For a variety of facilities, regulatory requirements should cover all facilities or specific requirements should be developed for different categories of facilities

NS-G-4.1: Commissioning of RRs

- Provides guidance on preparation and implementation of a commissioning programme;
- Can also be used for
 - Re-commissioning of a RR after an extended period of shutdown
 - Commissioning of a new experimental device
 - Commissioning of a modification with major safety significance



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Commissioning of Research Reactors

Safety Guide

No. NS-G-4.1



NS-G-4.2: Maintenance, Periodic Testing and Inspection of RRs

- Provides guidance on preparation and implementation of maintenance, periodic testing and inspection programmes;
- Covers topics related to
 - Preventive and corrective maintenance of safety systems and components
 - Testing intended to ensure that operations are within the established operating limits and conditions
 - Inspections initiated by the OO of SSCs to determine whether they are acceptable for continued safe operation



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Maintenance, Periodic
Testing and Inspection
of Research Reactors

Safety Guide
No. NS-G-4.2



NS-G-4.3: Core Management and Fuel Handling for RRs

- Guidance on core management and fuel handling activities that should be performed to optimize reactor core operation and reactor utilization in a manner that ensures the safety of the fuel and the reactor
- Covers topics related to
 - Core design and core operation;
 - Monitoring core safety parameters;
 - Refuelling and receipt, storage, handling and transport of fresh and irradiated fuel

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Core Management and
Fuel Handling for
Research Reactors

Safety Guide
No. NS-G-4.3



NS-G-4.4: Operational Limits and Conditions and Operating Procedures for RRs

- All important aspects of developing, formulating and presenting the OLCs
 - Safety limits;
 - Safety system settings;
 - Limiting conditions for safe operation;
 - Surveillance requirements;
 - Administrative requirements
- Development, content and implementation of operation procedures that should ensure that reactor operations in all modes and operations of experiments are consistent with the OLCs

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Operational Limits
and Conditions and
Operating Procedures
for Research Reactors

Safety Guide
No. NS-G-4.4



NS-G-4.5: The Operating Organization and the Recruitment, Training and Qualification of Personnel for RRs

- Provides guidance on
 - The nature of the operating organization and how to establish the operating organization
 - The recruitment process and required qualifications for reactor personnel
 - The initial training and re-training programmes for reactor personnel
 - The authorization process for individuals whose duties have immediate effects on safety

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The Operating Organization
and the Recruitment,
Training and Qualification
of Personnel for
Research Reactors

Safety Guide
No. NS-G-4.5



NS-G-4.6: Radiation Protection and Radioactive Waste Management in Design and Operation of RRs

- Identifies and provides guidance on important components that should be considered in the design stage to facilitate radiation protection and waste management;
- Provides good practices to be followed in operational radiation protection and radioactive waste management programmes and their optimization.



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Radiation Protection and
Radioactive Waste
Management in the
Design and Operation of
Research Reactors

Safety Guide
No. NS-G-4.6



SSG-10: Ageing Management for RRs

- Provides guidance on
 - Ageing management in different stages of the lifetime
 - Elements for a systematic programme on ageing management for SSCs important to safety
 - Managing obsolescence
- Interfaces of ageing management with other technical areas such as maintenance, periodic safety reviews, equipment qualification, design basis reconstitution, configuration management, continued safe operation and post-service surveillance

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Ageing Management
for Research Reactors

Specific Safety Guide
No. SSG-10



SSG-20: Safety Assessment of RRs and Preparation of the Safety Analysis Report

- Provides guidance on the preparation, review and assessment of the safety analysis report (SAR)
- Provides guidance on the initial licensing process for new RRs, and also on re-licensing and periodic safety reviews of existing RRs.



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Safety Assessment for
Research Reactors and
Preparation of the
Safety Analysis Report

Specific Safety Guide
No. SSG-20



SSG-22: Use of a Graded Approach in the Application of the Safety Requirements for RRs

- Guidance for grading the application of the safety requirements to account for the differences in RR designs, operation and utilization programmes
- Covers using a graded approach throughout the various stages of the lifetime of a RR without compromising safety
- Can be used by use by RBs, OOs and other organizations involved in the design, construction and operation of research reactors

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Use of a Graded
Approach in the
Application of the
Safety Requirements for
Research Reactors

Specific Safety Guide
No. SSG-22



SSG-24: Safety in the Utilization and Modification of RRs

- Provides guidance on the safety categorization of modifications and utilization activities and the associated safety assessments, reviews and approval channels
- Applies to existing and new research reactors and new experiments and utilization activities

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Safety in the Utilization
and Modification of
Research Reactors

Specific Safety Guide

No. SSG-24

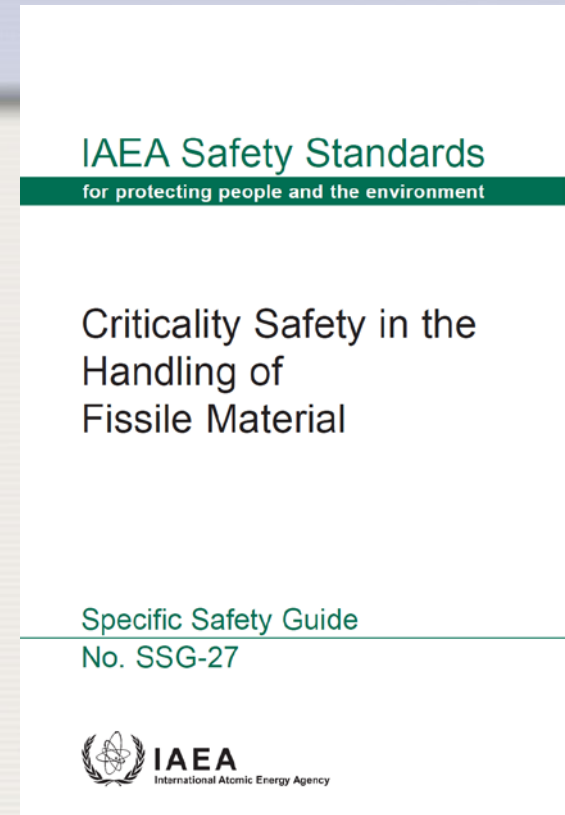


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SSG-27: Criticality Safety in the Handling of Fissile Material

- Guidance on meeting the requirements for ensuring subcriticality when dealing with fissile material and for planning the response to criticality accidents
- Applies to RBs and OOs
- Includes approach and measures for criticality safety, criticality safety assessment, safety for specific practices and planning for emergency response to a criticality accident



SSG-37: Instrumentation and Control Systems and Software Important to Safety for Research Reactors

- Provides recommendations and guidance on instrumentation and control systems important to safety for research reactors, including system architecture, components, operator interfaces and auxiliary equipment
- Applies to design and configuration management for new facilities and modernization of existing facilities

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Instrumentation and
Control Systems and
Software Important to
Safety for
Research Reactors

Specific Safety Guide

No. SSG-37



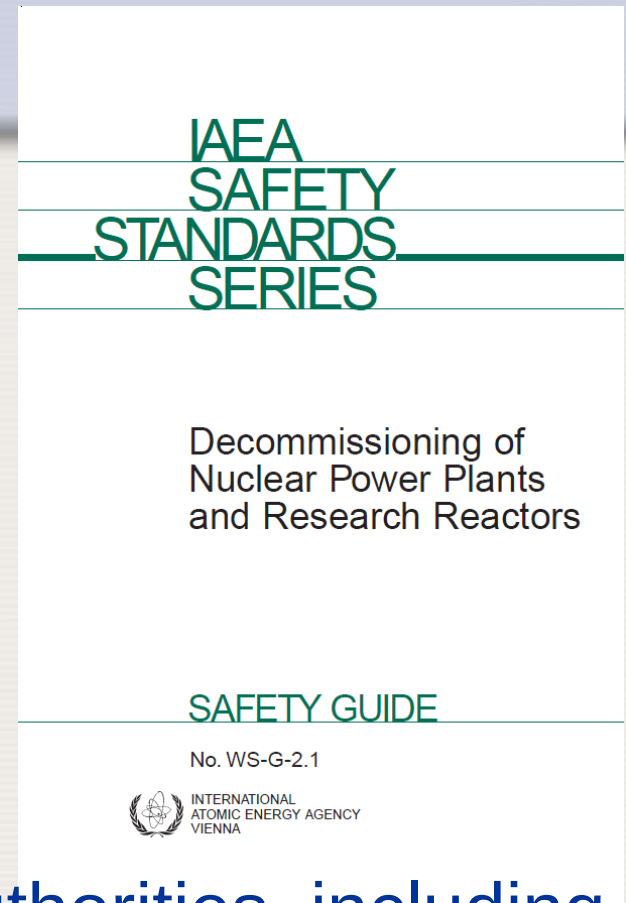
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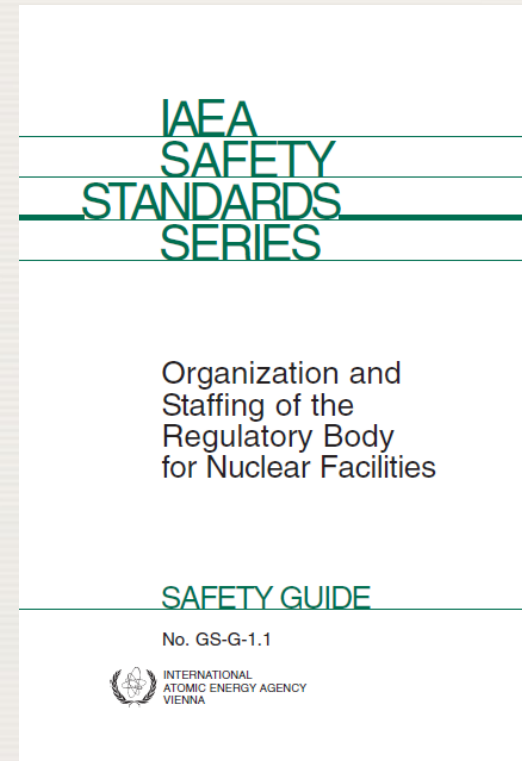
WS-G-2.1: Decommissioning of Nuclear Power Plants and RRs

- Provides guidance that mainly addresses the radiological hazards resulting from the activities associated with decommissioning, primarily with decommissioning after planned final shutdown
- Provides guidance to national authorities, including RBs and OOs to ensure that the decommissioning process for research reactors is conducted in a safe and environmentally acceptable manner



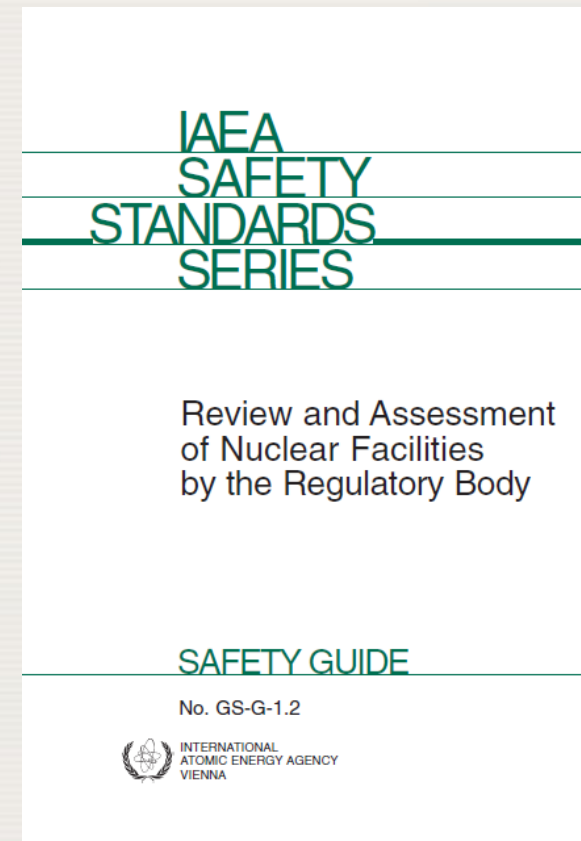
GS-G-1.1: Organization and Staffing of the Regulatory Body for Nuclear Facilities

- Provide recommendations for national authorities on the appropriate management system, organization and staffing for the RB responsible for the regulation of nuclear facilities in order to achieve compliance with the applicable safety requirements
- Regulatory independence and funding
- Organization of the RB
- Staffing of the RB
- Training of regulatory staff



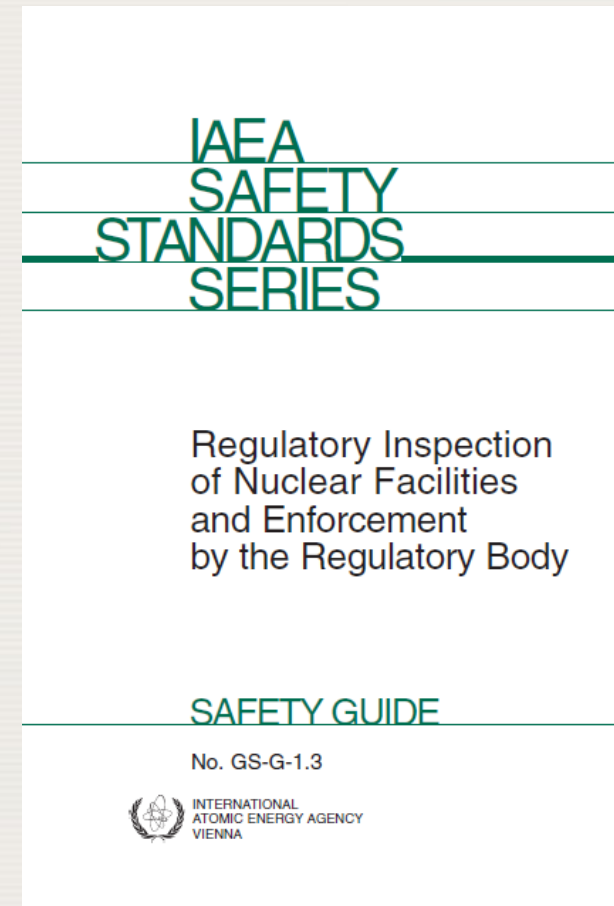
GS-G-1.2: Review and Assessment of Nuclear Facilities by the Regulatory Body

- Provides recommendations for RBs on reviewing and assessing the various safety related submissions to determine whether the facility complies with the applicable safety objectives and requirements, covers
 - nuclear facility at different stages, including siting, design, construction, commissioning, operation and decommissioning or closure
- Review and assessment process
- Performance of R&A
- Monitoring the R&A process



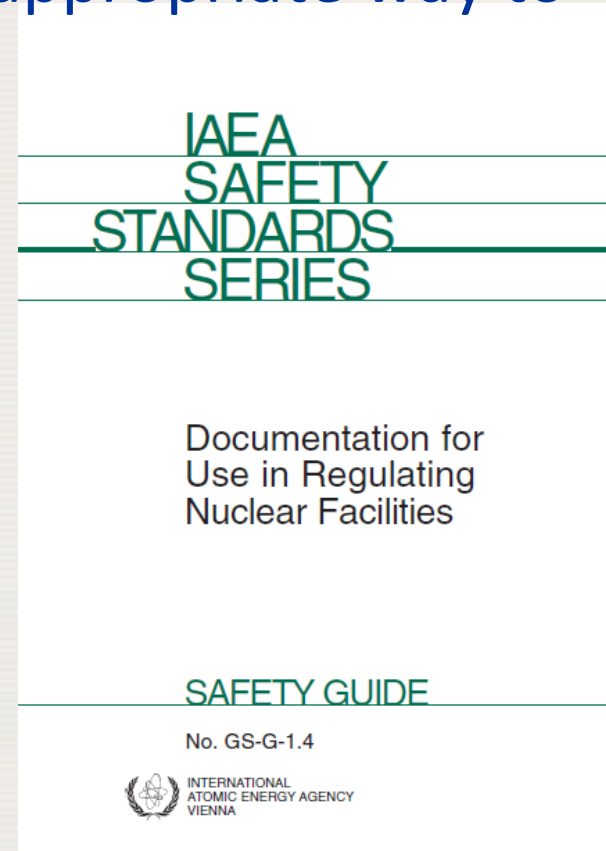
GS-G-1.3: Regulatory Inspection of Nuclear Facilities and Enforcement by the Regulatory Body

- RB should have a high level of confidence that OO has the processes in place to ensure compliance and that they comply with legal requirements, including the safety objectives and requirements
- Provides recommendations on the inspection of nuclear facilities, enforcement and related matters
 - Objectives of inspection and enforcement
 - Management of inspections
 - Performance of regulatory inspections
 - Regulatory enforcement
 - Assessment of activities



GS-G-1.4: Documentation for Use in Regulating Nuclear Facilities

- Recommendations for RBs and OOs on the documentation to be prepared for regulatory processes; and on how to ensure that such documentation is of sufficient quality and provides correct information in an appropriate way to serve its intended purpose
- Overview of documentation
- Regulations and guides
- Documents produced by the OO
- Documents produced for a specific facility by RB



SSG-12: Licensing Process for Nuclear Installations

- Provides Recommendations on developing the basis of a licensing process to be applied by RBs for granting licenses for nuclear installations and their activities, including some aspects of regulatory control
- Provides information on the topics and documents that should be considered in the licensing process throughout the lifetime of the nuclear installation
- General recommendations on and steps of the licensing process



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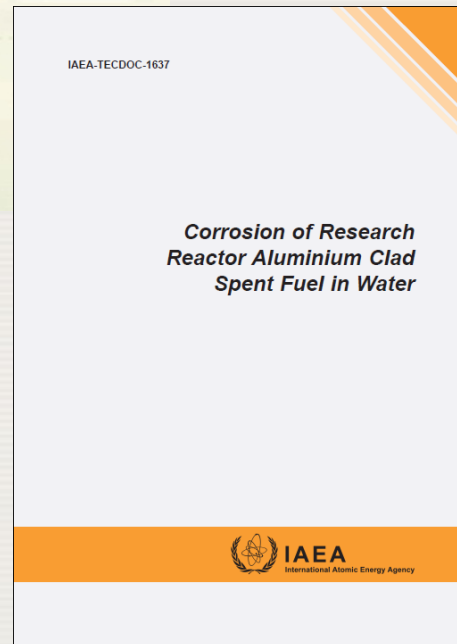
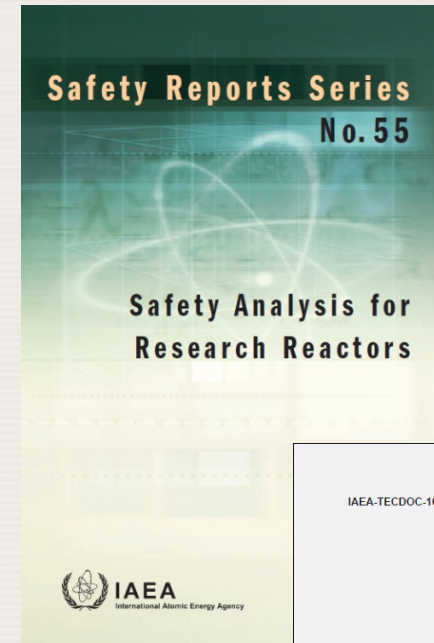
Licensing Process for
Nuclear Installations

Specific Safety Guide
No. SSG-12



Supporting Publications

- Complement the Safety Standards and include Safety Reports and TECDOCs
- Provide technical information, practical examples and detailed methods that can be used to implement the Safety Standards
- Do not establish requirements or recommendations



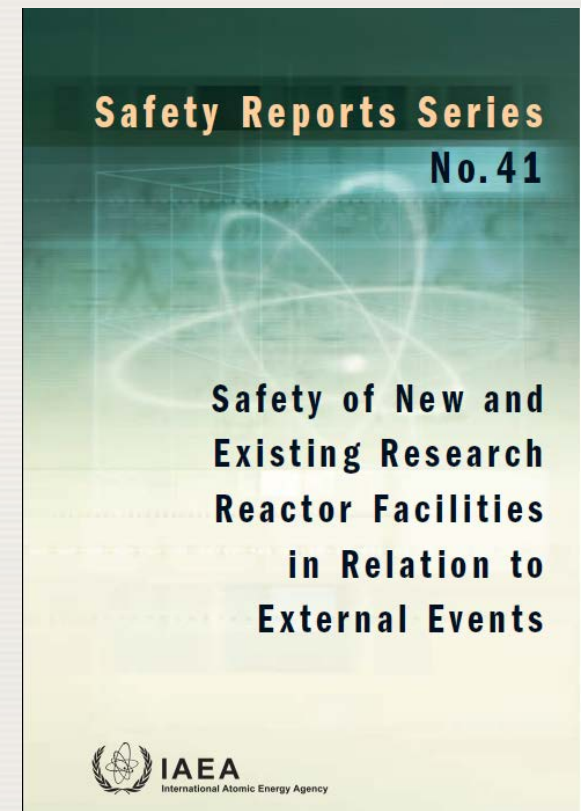
Supporting Publications

Safety Reports



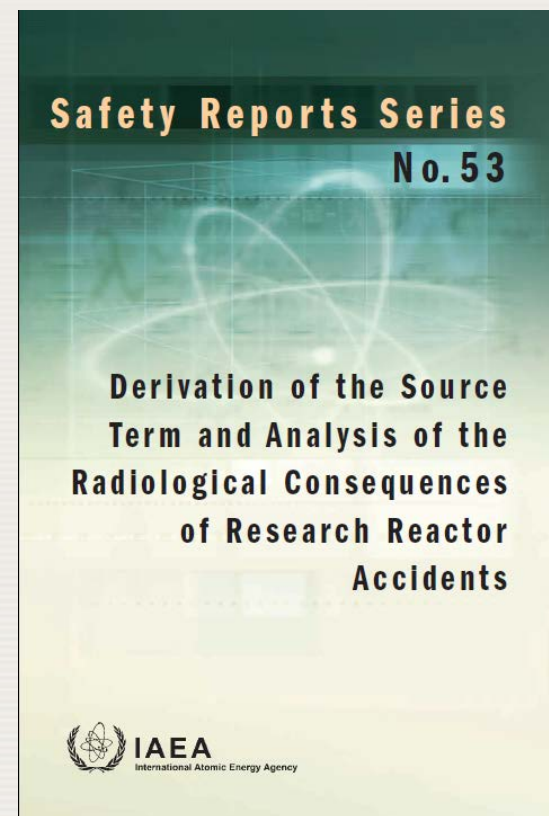
Safety Report Series No. 41

- Provides guidance for conducting a safety evaluation of new and existing research reactors in relation to the hazards posed by external events, consistent with the general safety requirements in SSR-3
- Provides a coherent framework for the application of a graded approach to design safety
- Covers natural phenomena and industrial and transportation accidents



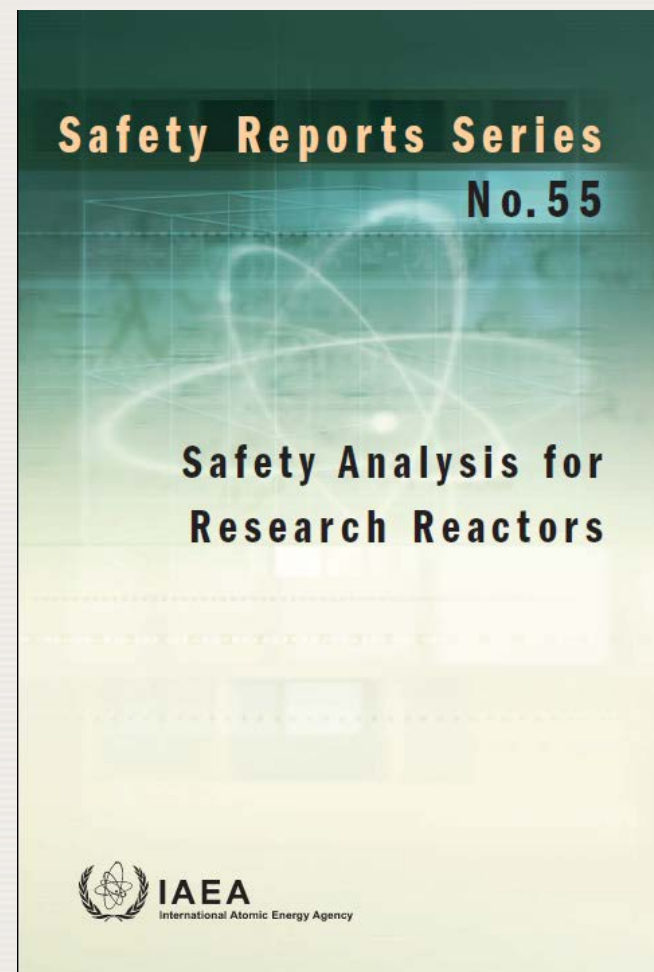
Safety Report Series No. 53

- Provides a set of suggested methods and practices for deriving the source term and analysing the radiological consequences of research reactor accidents;
- Covers selection of initiating events and the analysis of the core damage mechanisms and progression, radionuclide inventory releases, and radiological consequences inside the reactor building, outside the reactor building and off site;
- Presents practical examples applied to existing research reactors.



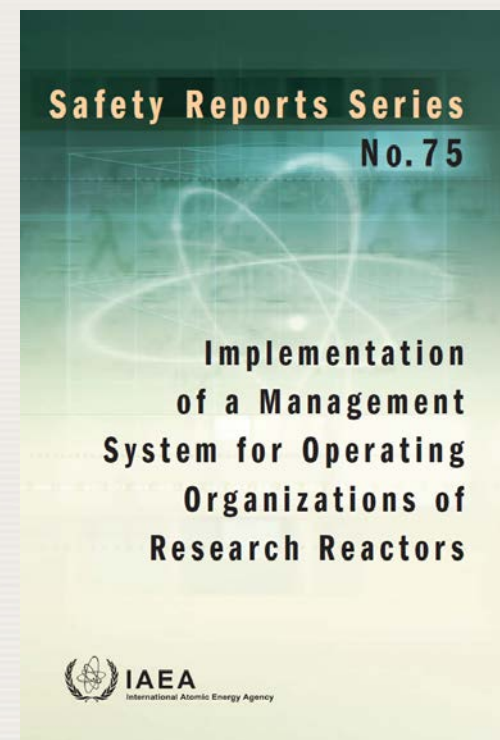
Safety Report Series No. 55

- Provides a set of suggested methods and practices, both conceptual and formal, for performing all steps of safety analyses;
- Discusses deterministic and probabilistic analysis methods for research reactor design and licensing;
- Useful for operating organizations, regulatory bodies and other organizations involved in the safety of research reactors.



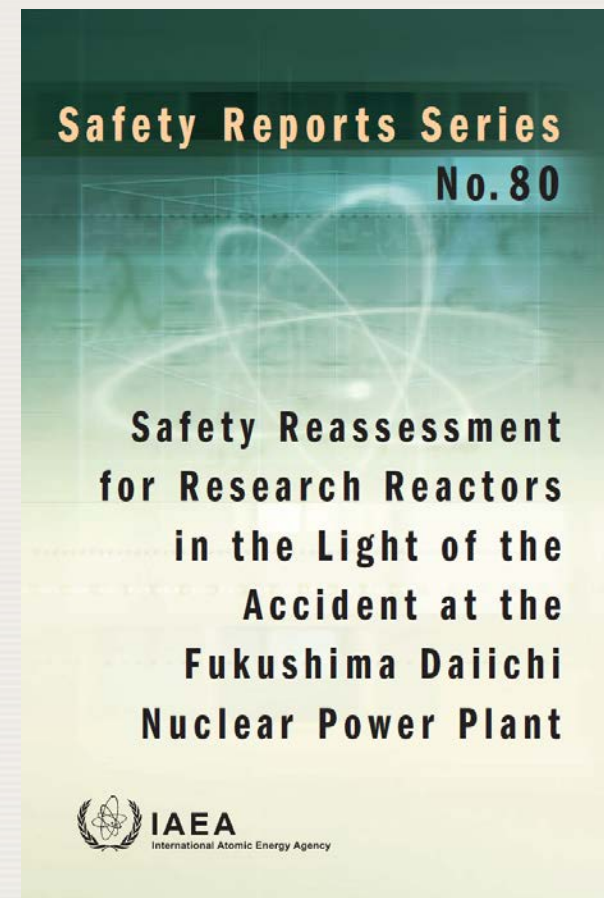
Safety Report Series No. 75

- Provides practical information and examples for the implementation of a management system for OOs of RRs
- Discusses prerequisites at the senior management level and examples of processes related to management responsibilities;
- Gives examples of processes for resource management, process implementation and the process for continual improvement.
- Examples are generic in nature and need to be adapted to the OO depending on its size, organization and utilization, as appropriate.



Safety Report Series No. 80

- Provides suggestions and methods for performing safety reassessment for RRs based on current international good practices and taking into consideration the feedback from the Fukushima Daiichi accident
- Discusses the use of the IAEA safety standards in performing the safety reassessment
- Intended for use by OOs, RBs, design organizations and other authorities involved in the safety of RRs

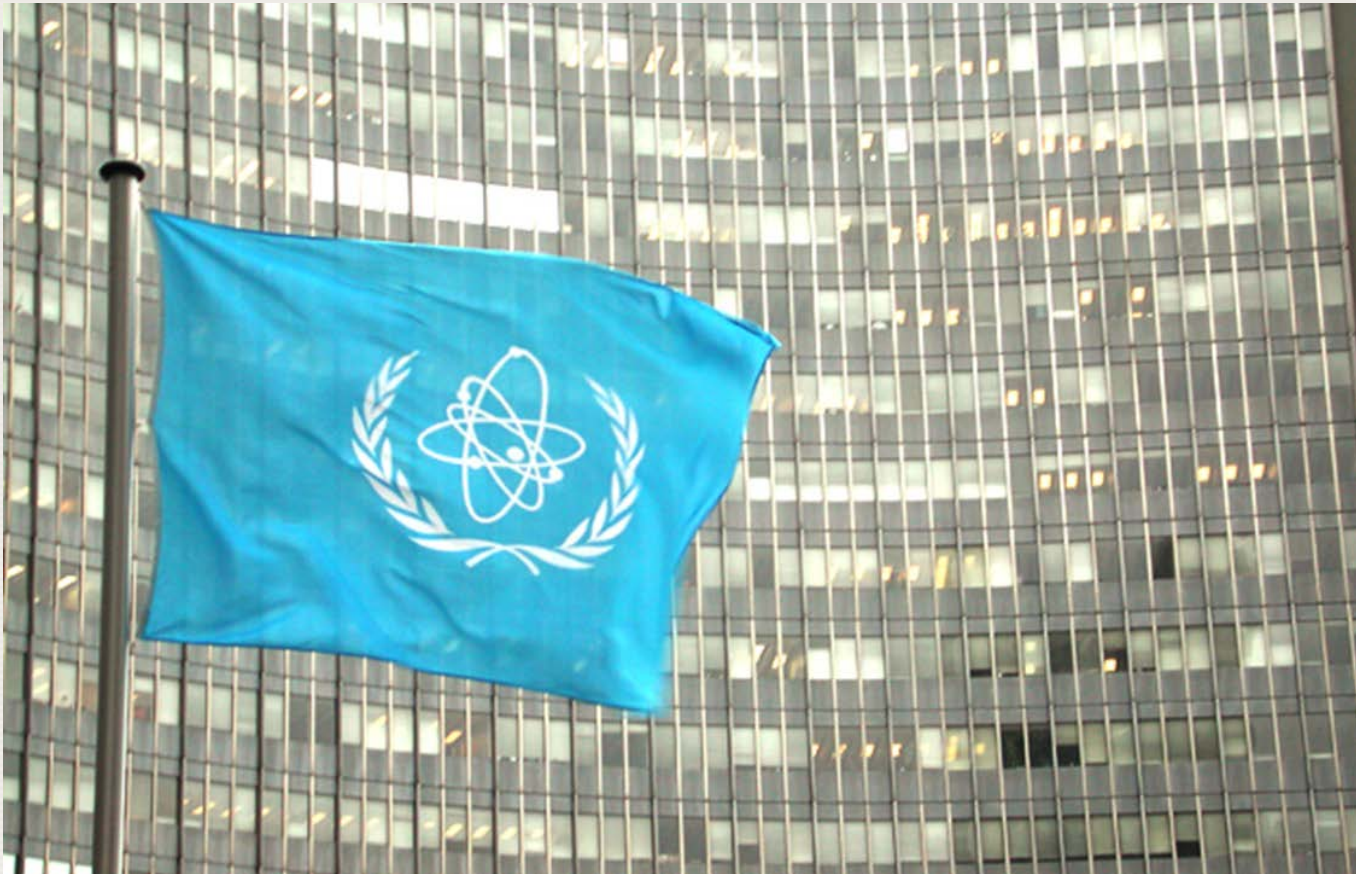


IAEA Safety Standards and Supporting Publications for RRs Available Online

- IAEA Safety Standards homepage:
<http://www-ns.iaea.org/standards/default.asp?s=11&l=90>
 - IAEA Safety Standards for RRs:
<http://www-ns.iaea.org/standards/documents/default.asp?s=11&l=90&sub=20&vw=9#sf>
 - IAEA Safety Report Series:
<http://www-pub.iaea.org/books/IAEABooks/Series/73/Safety-Reports-Series>
- IAEA TECDOCs:
<http://www-pub.iaea.org/books/IAEABooks/Series/34/Technical-Documents>

Concluding Remarks

- Application of the IAEA safety standards will help to achieve the highest level of safety for RRs.
- The IAEA safety standards for RRs and other IAEA safety standards should be applied for regulatory programmes in a specific manner taking into account the facilities that will be regulated and using a graded approach.
- Regulatory requirements should be clear and specific to facilitate compliance by the OO and inspection and enforcement by RB



Thank you for your attention.