



# Highlights of Integrated Safety Assessment of Research Reactor (INSARR) missions conducted from 2010 to 2020

Nuclear Safety and Security Programme



Nuclear  
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## Foreword



Research reactors are extremely valuable training, research, and technological tools. Their use fulfils the promise that nuclear science and technology offers for the benefit of society. Research reactors have catalysed new technology

developments in radioisotope production and nuclear medicine, neutron beam research and applications, materials characterization and testing, computer code validation, elemental analyses and capacity building for nuclear science and nuclear power programmes.

For over 60 years, research reactors have been centres of innovation and productivity for nuclear science and technology. The IAEA Research Reactor Database shows that over 800 research reactors have been built to date, and of these 237 continue to operate in 55 IAEA Member States. In addition, 11 research reactors are under construction and 16 more are planned.

In order to ensure their continued application and use, it is paramount to protect the public and the environment against ionizing radiation. One of the many resources that the IAEA provides to assist Member States with research reactors is its Integrated Safety Assessment of Research Reactor (INSARR) mission, an objective, comprehensive peer review service of a research reactor's safety against IAEA's safety standards.

INSARR reviews can provide an initial safety assessment of a reactor project considering design and siting aspects; a safety reassessment of a research reactor in respect to current IAEA safety standards; and an evaluation of ageing management programmes and long-term

## Contents

Overview.....	1
History .....	1
INSARR peer review process.....	2
Review areas .....	2
Findings from INSARR mission .....	3
General conclusions and trends .....	5

operation processes of the research reactor facility as part of its entire life cycle management, especially when deciding to operate the research reactor beyond its original design life.

It is also important to underline that INSARR missions are conducted by an international team of experienced, multidisciplinary experts, with the objective of supporting Member States in ensuring and enhancing the safety of their research reactors. Follow-up missions show considerable safety improvements based on implementation of INSARR recommendations, enabling Member States to attain the goals of their nuclear programme safely.

This brochure provides a brief overview of the IAEA's INSARR service and highlights the results of the INSARR missions from the past decade.

I hope this brochure will provide you with useful information on the support provided by the IAEA to its Member States in an important area of nuclear science and technology.

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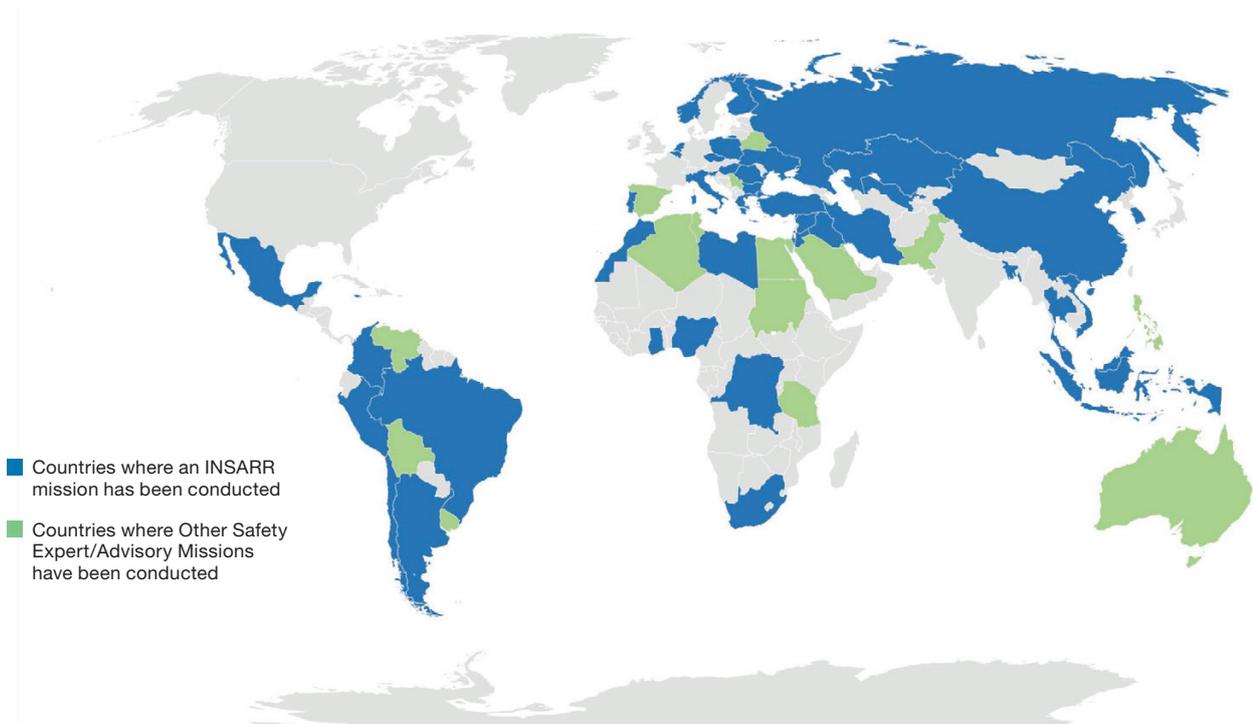
Integrated Safety Assessment of Research Reactor (INSARR) is a peer review of the safety of research reactors based on the IAEA safety standards and is available to all Member States, upon request. The purpose of INSARR is to assist Member States in enhancing safety of their research reactors.

It is conducted in accordance with the methodology established by the IAEA Service Series No 25: Guidelines for the Review of Research Reactor Safety. In preparation for INSARR, recipient organizations are recommended to perform self-assessment of research reactor safety in accordance with the methodology provided by the IAEA Service Series No 35: Guidelines for Self-Assessment of Research Reactor Safety.

## About INSARR

- INSARR review procedures were formalized and documented in 1997;
- As of December 2020, there have been 90 INSARR missions conducted in 44 countries;
- In addition, up to 10 safety expert missions are conducted per year, based on the INSARR methodology.

**INSARR and Safety Expert/Advisory Missions by Geographic Area**



The map does not imply the expression of any opinion whatsoever on the part of the IAEA concerning the legal status of any country, territory, city or area or of its authorities, or concerning the delimitation of its frontiers or boundaries.

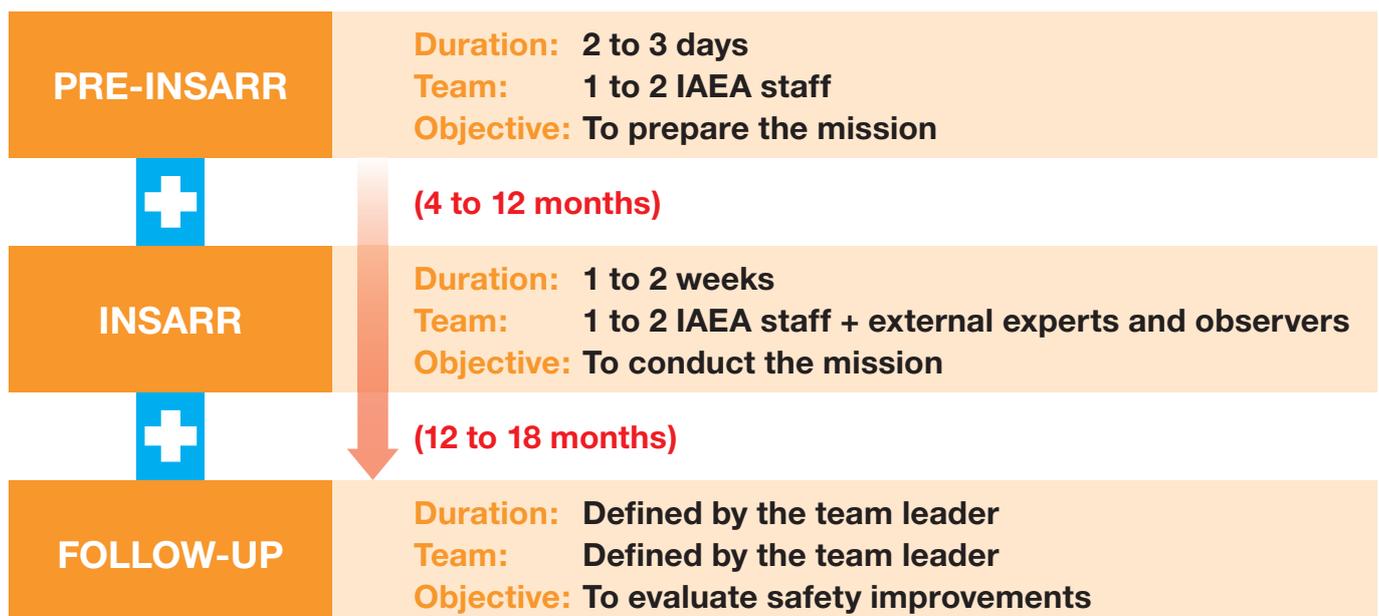
A three-stage approach is applied for INSARR:

- (1) Pre-INSARR mission: aims to familiarize the host facility with the INSARR review methodology, and to obtain preliminary information about the facility. During this mission, discussions take place and an agreement is reached with the host on the date, scope and provisional agenda of the main mission, as well as on the documentation to be provided to the IAEA.
- (2) Main INSARR mission: includes a review of the research reactor safety documents, observation of the facility conditions and operating practices, discussions and sharing information and good practices with members of the reactor operating organizations. The mission results in recommendations\* for strengthening the safety of the facility.
- (3) Follow-up INSARR mission: assesses the implementation of the recommendations of the main INSARR mission and evaluates safety improvements. Feedback on the effectiveness of the INSARR mission is also collected.

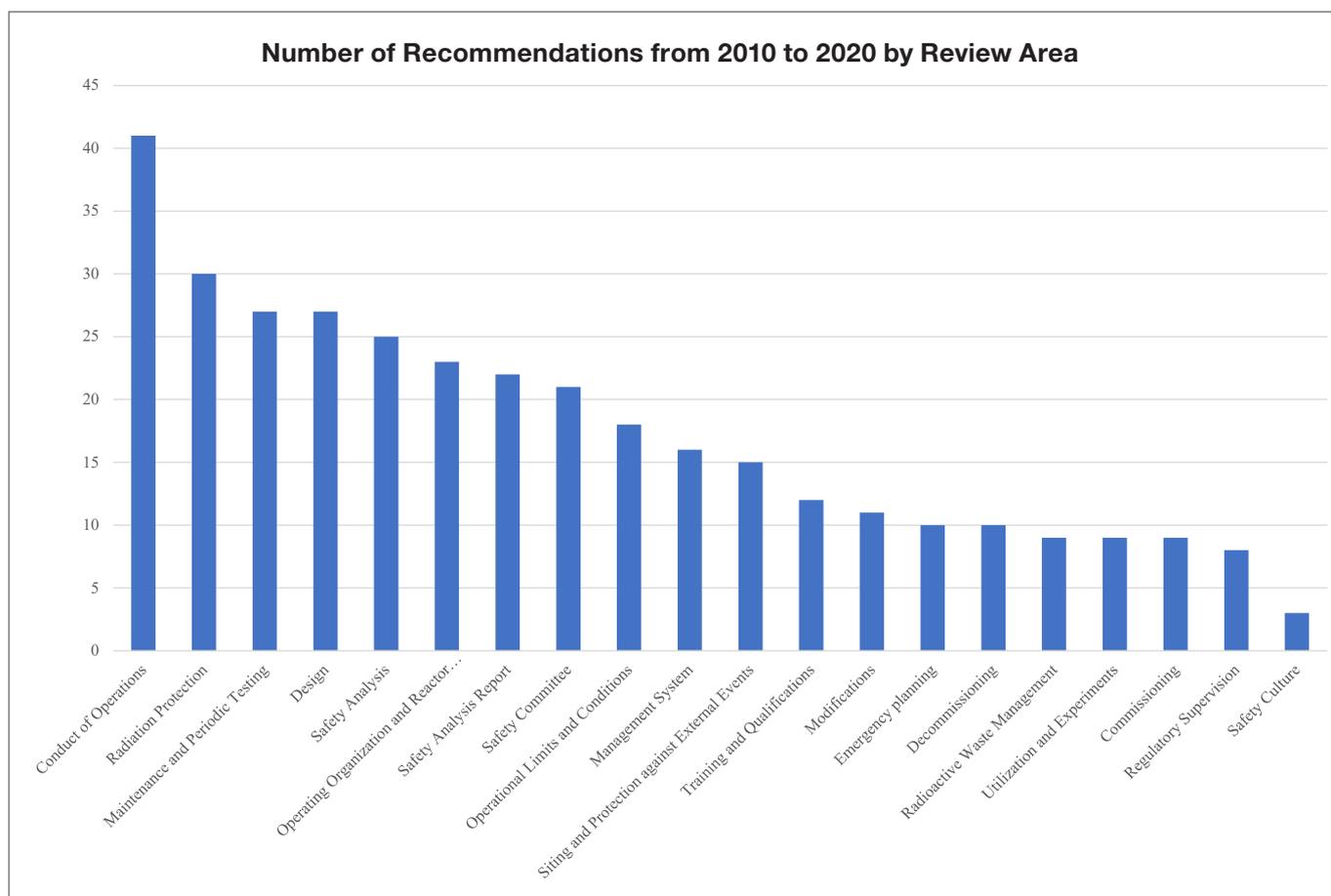


## Review areas

INSARR covers all technical and organizational areas that are important to research reactor safety. These areas include reactor management and safety committees, management system, training, safety analysis, operational limits and conditions, conduct of operations, maintenance and inspection programme, safety of utilization and experiments, modifications, operational radiation protection, and emergency planning. Specific areas are also covered by INSARR such as regulatory supervision, design, siting and protection against external hazards, construction, commissioning, and preparation for decommissioning.



\* Recommendations are the review team's advice for improving safety based on IAEA safety standards and recognized good practice.



**Figure 1.** Mission recommendations by review area.

The scope of an INSARR mission is tailored to the need of the recipient research reactor and is defined during the pre-INSARR mission.

INSARR Missions can be tailored to assist Member States in ensuring the safety of major modifications of research reactors, such as the conversion of reactor fuel from highly enriched uranium (HEU) to low enriched uranium (LEU), and for assessing refurbishment projects, including upgrades of reactor power and utilization programmes and the modernization of instrumentation and control systems.

INSARR is strongly linked to other IAEA peer reviews such as Site and External Events Design (SEED), Independent Safety Culture Assessment (ISCA), and Safety Aspects of Long-Term Operations - Research Reactors (SALTO-RR). These missions are also available to all Member States upon request.

## Findings from INSARR missions

From 2010 to 2020, 29 INSARR missions were conducted in 19 countries, resulting in 497 recommendations. The distribution of these recommendations by review area is provided in Fig. 1.

The findings from these INSARR missions show the need of research reactor organizations to pay increased attention to the importance of leadership and management for safety. This includes the establishment of an effective integrated management system covering all stages in the lifetime of the facility and all activities of safety importance. These findings also reflect the need for increased attention to:

- Enhancing the effectiveness of reactor safety committees, specifically by clarifying the advisory role of the committee, expanding scope of review to cover all areas important to safety, and ensuring independence from reactor management;

- Improving the quality of safety documentation to conform with the actual status of the facility, including justification and safety assessments of modifications, new experiments and utilization of the facility;
- Enhancing the operational safety programmes and procedures, in particular ageing management, procedures for operators' responses to abnormal situations, arrangements to ensure power supply to safety classified items, and independence of the operational radiation protection programme;
- Implementing safety upgrades identified from safety reassessments performed in light of the lessons learned from the 2011 Fukushima Daiichi nuclear power plant accident;
- Ensuring adequate consideration of eventual decommissioning in operation and utilization of the facility, including updating of the preliminary decommissioning plan.

Follow-up INSARR missions showed that considerable safety improvements were achieved in the areas mentioned above based on implementation, or significant progress in the implementation, of about 90% of the INSARR recommendations.

The findings from INSARR missions also indicate continued safety enhancements in several areas, including:

- Completeness and effectiveness of training and qualification programmes of reactor operating personnel;



(Photo: IAEA)

- Effective use of operational and maintenance procedures;
- Consideration of ageing of reactor's structures, systems and components and minimization of radioactive waste generation in design and operation of new experimental devices and modification projects;
- Adequate and improved planning and implementation of maintenance and in-service inspection programme;
- Progressing in establishing an effective ageing management programme;
- Improvement of radiological classification and work-place monitoring programme;
- Initiation and implementation of periodic safety reviews.

In addition to the areas of improvements mentioned above, Member States reported on effective use of the findings from INSARR missions, for example:

- Developing and improving the regulatory inspection programme of their research reactors;
- Implementing activities on developing and sustaining a strong culture for safety, including self-assessment surveys, and leadership training;
- Ensuring the safety of modifications of major safety significance such as conversion from use of HEU to LEU fuel;
- Establishing and/or improving licensing processes for modifications of major safety significance;
- Supporting implementation of periodic safety review in view of renewal of reactor operation license;
- Ensuring the effectiveness of commissioning programmes for new research reactors;
- Planning and implementing safety upgrades, including through the IAEA technical cooperation programme.

# General conclusions and trends



(Photo: IAEA)

The findings from INSARR missions conducted during the past ten years have led to the following conclusions regarding the safety of research reactors:

- Progress in safety improvements in many research reactor organizations in several areas, including regulatory supervision, safety analysis and safety documents, training of personnel, maintenance, ageing management, and safety of modification and refurbishment projects.
- Increased interest by research reactor organizations to enhance management systems, the effectiveness of safety committees, improve the quality of safety documentation, and to effectively consider ultimate decommissioning in the operation and utilization of the facilities.
- Increased interest of research reactor organizations on development and implementation of programmes and activities on leadership and management for safety, including safety culture.
- Increased interest of research reactor organizations to establish processes on periodic safety reviews, based on the IAEA safety standards, for identification and implementation of reasonable and practicable safety improvements.

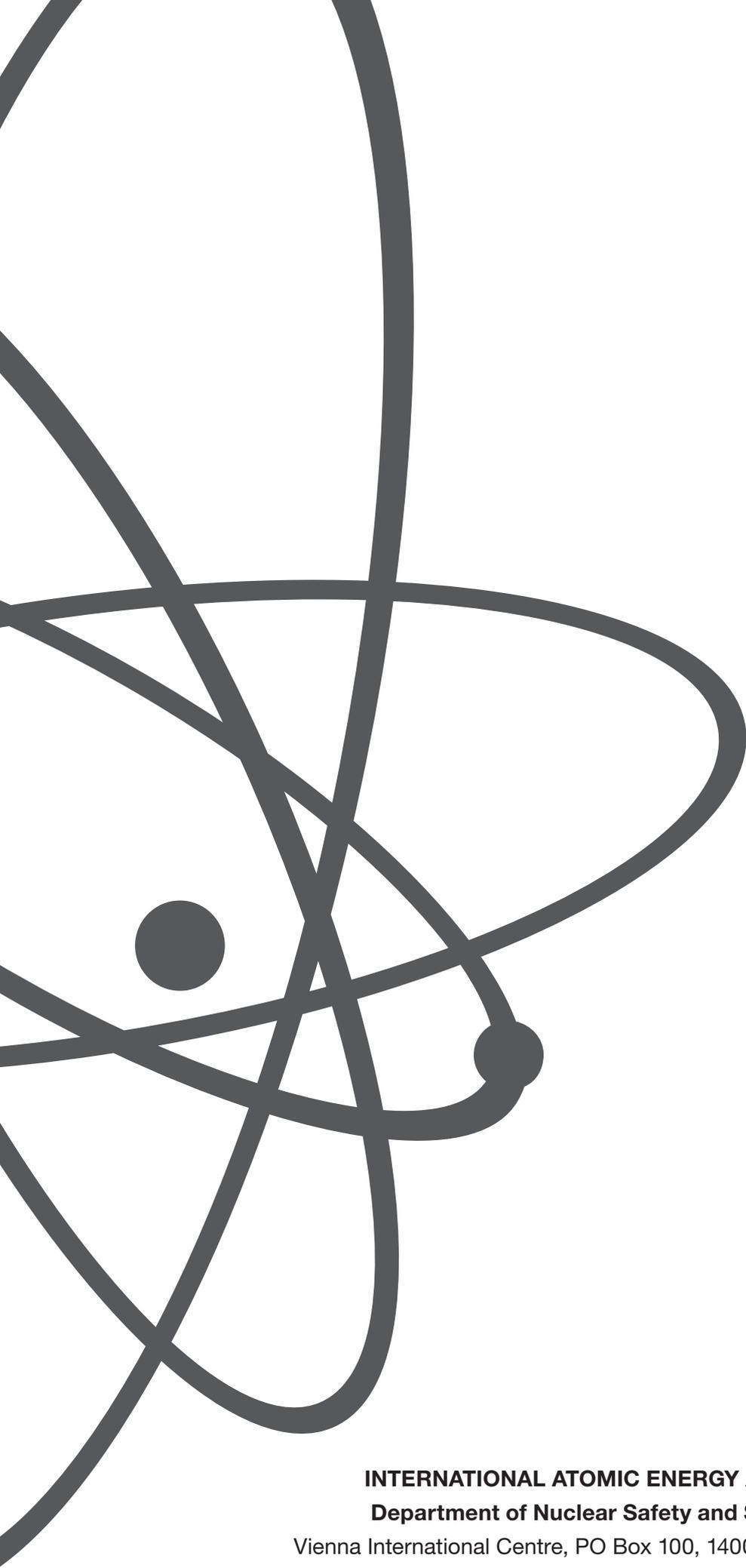
The assessment of effectiveness and efficiency of INSARR missions reveal the following observations:

- Effective preparation by the host organization is key for a successful mission. This involves a comprehensive self-assessment in accordance with IAEA Guidelines. The self-assessment capabilities of organizations received INSARR missions have been continuously improving.
- Commitment by recipient organizations to implement the mission recommendations is vital to enhancing safety.

Recognizing the need to further improve the efficiency and effectiveness of the INSARR missions and thereby maximize the benefits to Member States, IAEA recently revised the mission guidelines and methodology, and the process for preparation of mission reports, including development timeliness and dissemination of results.

Further improvements are planned through inclusion of a review area on the interface between safety and security as well as training of potential INSARR review team members.





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