Enhancing Research Reactor Safety- the IAEA's Approach

Ken E. Brockman and L. Walter Deitrich
International Atomic Energy Agency
Wagramerstrasse 5, PO Box 100
A-1400 Vienna, Austria

Introduction

Research reactors have been a key part of nuclear technology throughout its history. They have supported the development of nuclear science, its applications and the education and training of nuclear scientists and engineers. The benefits of research reactors extend to applications of nuclear technology in many other fields. Continued safe operation of research reactors is essential to their future and that of the whole nuclear community.

In recent years, concerns over the need to maintain and enhance safety have led to significant emphasis on strengthening the international research-reactor safety regime. In September, 2001, the 45th General Conference passed resolution GC(45)/RES/10A, which, *inter alia*, endorsed a decision of the Board of Governors to request the Secretariat to develop and implement, in conjunction with Member States, an international Research Reactor Safety Enhancement Plan. A key part of this plan is preparation of a Code of Conduct on the Safety of Research Reactors with a view to establishing the desirable attributes for management of research reactor safety.

Recent Developments

Substantial progress has been made since the Research Reactor Safety Enhancement Plan was approved in 2001.

The Code of Conduct

After an extended drafting and review process, the IAEA's Board of Governors adopted the Code of Conduct on the Safety of Research Reactors at its March 2004 session. The 48th General Conference (2004) endorsed the guidance in the Code, encouraged Member States to apply it to the management of research reactors, and requested the Secretariat to continue to assist Member States in implementation of the Code and associated safety guidance within available resources.

The Code of Conduct is a non-binding international legal instrument that provides guidance for the development and harmonization of national policies, laws and regulations, and sets forth the desirable attributes for the management of research reactor safety. Guidance is provided for the State, the regulatory body and the operating organization. It is intended that States may make a legally non-binding political commitment to apply the Code in their research reactor activities.

The guidance in the Code should be applied through national safety regulations, making appropriate use of IAEA Safety Standards relevant to research reactors and those for legal and governmental infrastructure, nuclear, radiation, waste and transport safety. A graded approach commensurate with the hazard potential of a facility should be used. States are invited to communicate any difficulties faced in applying the Code, and to request assistance, if needed.

The guidance for the State includes provisions for establishing an independent regulatory body having authority to establish regulations, authorize activities, inspect and enforce regulations, while placing the prime responsibility for safety on the operating organization. The State should ensure that the safety of existing research reactors is reviewed and upgraded as necessary, and it should ensure that the operating organization has financing for operation, shutdown and decommissioning. In addition, the State should establish an effective system for emergency response and intervention.

The guidance for the regulatory body gives it the role of establishing regulations and guidance and a process for issuing authorizations. It should inspect and ensure corrective action for deficiencies, take enforcement actions in the event of violations and review and assess safety.

The Code provides general recommendation for the regulatory body and the operating organization based on the principal provisions of the IAEA Safety Standards. The guidance addresses: assessment and verification of safety; financial and human resources; quality assurance; human factors; radiation protection; and emergency preparedness.

It also provides guidance on activities that should be pursued at various stages in the life cycle of a research reactor, including: siting; design, construction and commissioning; operation, maintenance, modification and utilization; extended shutdown; and decommissioning.

Finally, the Code defines the role of the Agency, which includes disseminating the Code and assisting Member States in its application. In addition, the Agency should continue to collect and disseminate information, provide review services, develop safety standards and assist in their application, and assist in all aspects of safety management of research reactors.

In summary, the Code of Conduct on the Safety of Research Reactors is a non-binding document that provides comprehensive guidance on management of research reactor safety, addressing the respective roles of the State, the regulatory body and the operating organization. It should be useful to decision-makers in Member States in ensuring that their research reactors are operated safely.

Effective Application of the Code

At the Third Review Meeting of the Contracting Parties of the Convention on Nuclear Safety in April 2005, an Open-ended Working Group adopted the following resolution:

> "Having taken into consideration the positive impact of the incentive nature and the benefits of the Review Process of the Convention on Nuclear Safety on improving nuclear safety, the Contracting Parties to the Convention on Nuclear Safety request the Director General of the IAEA to convene meetings to which all Member States would be invited. The objective of the meetings should be to discuss how best to assure the effective application of the 'Code of Conduct on the Safety of Research Reactors'."

While the Convention on Nuclear Safety does not apply to research reactors, this resolution reflects the strong interest on the part of the Contracting Parties in enhancing the safety of research reactors through applying the Code of Conduct. In response to this request, an Open-ended Meeting on Effective Application of the Code of Conduct on the Safety of Research Reactors is scheduled for 14-16 December 2005 at IAEA Headquarters in Vienna. Proposed

discussion topics for the meeting include developing a common understanding of the Code and the associated IAEA documents that provide detailed guidance, addressing mechanisms for making a commitment to apply the Code, identifying ways in which Member States might report their progress and exchange ideas and experience, and investigating alternatives for practical applications and Agency assistance.

Research Reactor Safety Standards

The Code of Conduct provides guidance for management of research reactor safety, but it does not provide detailed technical guidance. Technical guidance is provided in the IAEA Safety Standards and other documents. These documents provide a comprehensive and consistent statement of the requirements that must be met to ensure research reactor safety and recommended means of meeting them.

The Board has approved the new Safety Requirements document NS-R-4, *Safety of Research Reactors,* which sets forth the requirements that must be met to assure safety in research reactor design and operation. Nine Safety Guides that support the Safety Requirements are now in various stages of preparation or updating, and are expected to be available in the next 1 to 2 years. The new guides cover: commissioning; maintenance, periodic testing and inspection; operational limits and conditions and operating procedures; the operating organization and the recruitment, training and qualification of personnel; core management and fuel handling; radiation protection and radioactive waste management in design and operation; and application of the graded approach concept. In addition, two existing guides are being reviewed and updated. These cover safety assessment and preparation of the SAR and safety in utilization and modification of research reactors, respectively.

Safety Review Services

The Agency maintains a vigorous program of assistance to Member States in reviewing and assessing the legal and governmental infrastructure of the State, the regulatory structure and functions, and the safety of nuclear installations. This assistance is based on the IAEA Safety Standards. Since 2001, there have been 60 safety missions to research reactors supported by the Technical Cooperation program, extrabudgetary programs and the regular budget. These include 11 pre-INSARR, 9 INSARR[1], 7 follow-up INSARR missions and 33 other safety missions. Of these missions, 36 have been to reactors under Project and Supply Agreement, with respect to which the Agency has special obligations for monitoring safety. The recommendations, suggestions and identification of good practices from these missions are specific to the situation at each individual reactor.

<u>The Approach for the Future</u>

The strategy for the Agency's future programme for improving research reactor safety is based on encouraging Member States to adopt and use the guidance provided in the Code of Conduct and the applicable IAEA Safety Standards and to support them in doing so. This strategy is grounded in Goal B of the Agency's Medium Term Strategy for 2006-2011: "Comprehensive and effective international frameworks for promoting nuclear safety and security." Promoting more effective application of the Code of Conduct and the Safety Standards, facilitating self-assessments and peer reviews based on these documents,

[1] The Integrated Safety Assessment of Research Reactors (INSARR) is the Agency's comprehensive safety review service for research reactors in Member States. It includes a preparatory pre-INSARR meeting to plan the review, the INSARR mission itself and a follow-up INSARR to assess progress on the recommendations.

developing new Standards and updating existing Standards all support Objective B.1: "Continue to strengthen international nuclear safety and security instruments." These elements, plus extending Agency assistance in upgrading safety infrastructures, providing safety review services and in education, training and knowledge management also support Objective B.2: "Achieve global acceptance of international safety standards."

Strategic Elements

The IAEA's approach to enhancing research reactor safety in the future is based on three principal elements:

- Establishing IAEA safety documents as the foundation upon which a global safety regime for research reactors is based;
- Encouraging and assisting Member States in effective application of these safety documents; and
- Fostering global and regional cooperation in research reactor safety.

The status of the Code of Conduct and the associated IAEA documents that provide detailed safety guidance was discussed above. The combination of an internationally endorsed Code of Conduct, the corpus of Safety Standards and safety review services that are based on the standards of excellence reflected in the Agency documents will encourage Member States' acceptance and use of these documents. Training workshops and seminars, and associated training materials for research reactor safety will be developed and made available to all interested Member States. This training will focus on application of the guidance for management of research reactor safety given in the Code of Conduct and on application of the IAEA Safety Standards that provide the detailed technical guidance. Generally, the approach will be to 'train the trainers.' This approach will allow the Agency to develop more efficient training programmes, with material that can be used regardless of individual national differences; more importantly, it will promote independence and self-reliance in the Member States and encourage sharing knowledge and experience.

The discussion of effective application of the Code of Conduct that will take place at the Open-ended Meeting in December 2005 will be key to defining the path forward. The incentive nature and the review process of the Convention on Nuclear Safety have yielded benefits in improved safety of nuclear power plants. It is important that ways be found to realize similar benefits in improved safety of research reactors from application of the Code of Conduct. To realize such a benefit will require commitment on the part of Member States and, in many cases, effective Agency assistance. Use of the Code in concrete applications will help demonstrate the benefits to be gained and focus Agency assistance.

The third part of the IAEA's approach, fostering global and regional cooperation in research reactor safety is especially important in this connection. Regional or inter-regional cooperation among Member States can be an effective means of dealing with issues facing the research reactor community. Cooperation in addressing safety issues, building strong safety cultures, overcoming a scarcity of resources and disseminating operational experience will all be strongly encouraged by the Agency. Methods by which regional facility plans can be

developed and implemented must be identified. Such regional plans will have direct safety implications since they will maximize the availability of financial resources, help maintain the professionalism and qualification of operating personnel and allow for the development of more effective regulatory bodies. Extension of concepts developed on a regional basis to a global research reactor forum involving the worldwide research reactor community is a longer-term vision.

Sharing Experience

Sharing of experience must become a universally accepted practice if the research reactor community is to become a 'learning community' that can be expected to raise its own standards. Reporting incidents and operational events, following-up to assure that events are properly analysed and that the lessons learned are reported and disseminated throughout the nuclear community are essential to improving safety. The principal mechanisms for sharing of experience are periodic regional and international meetings, networks organized for information exchange and databases of mission results.

Global and regional networks, such as the Asian Nuclear Safety Network, and incident reporting systems, such as the Incident Reporting System for Research Reactors (IRSRR) provide vehicles for Member States to effectively and efficiently share safety insights and knowledge. The IRSRR is now in place and operating, with 47 Member States participating (as of August 2005). Regional meetings to promote the establishment of national systems for reporting, analysing and disseminating lessons learned will continue, as will the biennial meetings of national IRSRR coordinators.

The INSARR database will be updated and expanded to improve the sharing of information and experiences gained during these review missions. Statistical studies, designed to identify generic issues and trends and to communicate best practices will be conducted on a periodic basis and made part of the database. This information will be made available to the entire nuclear community.

Regional Cooperation

Regional meetings to exchange information on the safe operation of research reactors, facilitate discussions concerning solutions to safety issues and disseminate operational experience can be an effective way to develop cooperation in efforts to enhance safety. The Latin America and Caribbean Regional Workshop on Research Reactors, held in Lima, Peru, in August 2005, provides a test of this concept. While the scope of the meeting went beyond safety, its safety-related objectives included: exchange of information on safe utilization of research reactors; facilitating solutions of safety issues, including regulatory aspects; promoting regional cooperation on research reactor activities; and providing for application of the Code of Conduct. In advance of the workshop, participants were asked to submit a facility report following a format provided by the Agency covering management and verification of safety, utilization planning, management of aging, radiation protection, emergency planning, training and qualification, quality assurance, safety culture, decommissioning planning and fuel management. There are 17 research reactors in 7 countries in the region. Each one submitted a report. Presentations at the Workshop based on the reports led to fruitful discussions.

While at the Workshop, participants considered implementation of the Code of Conduct. From these exercises, it was concluded that areas for improvement include: the regulatory framework; training of regulators; management of safety, including inspections, verification, training of safety committees, quality assurance, and radiological protection; training and qualification of operators; emergency preparedness; criteria and planning for spent fuel and waste management and for decommissioning.

Creation of a regional group on research reactors was of great interest to the Workshop participants, starting as a network for exchanging information and for supporting future regional cooperation and activities.

The Workshop was successful in gathering regulators and operators from all of the reactors in the region. The joint discussions helped to harmonize evaluations, especially those related to the Code of Conduct, functioning of safety committees and safety analysis. The approach should be a model for future meetings of this nature.

Building a sustainable system for regional cooperation is an important goal. In this connection, TRTR and IGORR have an opportunity to serve as models for sustainable organizations. Modern electronic communications and Web-based networks can greatly aid in sharing of information.

Summary and Conclusions

Substantial progress has been made since the Research Reactor Safety Enhancement Plan approved in 2001. The Code of Conduct on the Safety of Research Reactors and the Safety Requirements NS-R-4, *Safety of Research Reactors,* provide a strong foundation on which to build the global safety regime. Completion of the corpus of Safety Standards over the next two years will strengthen this foundation.

The upcoming Open-ended Meeting on Effective Application of the Code of Conduct on the Safety of Research Reactors will provide an opportunity for Member States to discuss ways in which more widespread application of the Code can be achieved and the potential enhancement of research reactor safety based on the Code and the underlying Standards can be realized. The outcome of this meeting will be key to defining the path forward.

Global and regional cooperation is a key part of the Agency's approach to enhanced safety. Sharing of experience is essential to becoming a learning community and raising the standards of safety. Regional meetings, such as the meeting held in Lima for the Latin American and Caribbean countries, are an effective means to build regional cooperation. Similarly, regional networks using electronic media are proving to be effective, and this approach is encouraged. Existing organizations, such as TRTR and IGORR, can fill a valuable role in providing the mechanism for cooperation within their own scope and in acting as a model for other regional groupings that may emerge.