Activities on Safety for the Cross-cutting Issue of Research Reactors in the IAEA

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Abstract

IAEA activities in the field of research reactor safety are included in the programme of the Division of Nuclear Installations Safety and implemented by the Engineering Safety Section through its Research Reactor Safety Unit. Following the objectives of the Division, the results of the IAEA missions and the recommendations from International Advisory Groups, the IAEA has conducted in recent years a certain number of activities aiming to enhance the safety of research reactors. The following activities are discussed in this paper: (a) the new Requirements for the Safety of Research Reactors, main features and differences with previous standards (SS-35-S1 and SS-35-S2) and the grading approach for implementation; (b) new documents being developed (safety guides, safety reports and TECDOCs); (c) activities related to the Incident Reporting System for Research Reactor (IRSRR); (d) the new features implemented for the INSARR missions; (e) the Code of Conduct on the Safety of Research Reactors developed, following the General Conference Resolution GC(45)/RES/10; and (f) the survey on the safety of research reactors conducted in the year 2002 and the results obtained.

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1- INTRODUCTION

Many IAEA activities cut across more than one programmatic area, either due to the structure adopted for the Agency's programme or due to the nature of the issues to be addressed by these activities. Five cross-cutting areas that have been identified are: environment, security and protection against nuclear terrorism, quality assurance, knowledge management and **research reactors**. The issue of management of cross-cutting areas has been discussed in detail at the 2002 Senior Management Conference, in Programme Co-ordination Committee and the Director General's Meeting. It has been decided to assign a responsible staff member for each cross-cutting area, from one of the Departments involved, in order to ensure technical competence and familiarity with the area (Coordinator).

An external evaluation on research reactors recommended the need for an IAEA wide policy and strategy to address in an integrated way the safe operation of research reactors, their optimum utilization, coupled with good management of the facility, the associated fuel cycle and radioactive waste, criticality safety, decommissioning and spent fuel storage and disposal. These aspects are currently included under Major Programmes 1 (Nuclear Science and Technology) and 3 (Nuclear Safety and Protection Against Radiation), as well as in the TC Programme of the IAEA.

The objective of the programme implemented by the Division of Nuclear Installation Safety (NSNI) of the Department of Nuclear Safety and Security of the IAEA is to achieve and maintain a high level of safety of nuclear installations under siting, design, construction or operating worldwide by: establishing standards of safety for the protection of health including standards for research reactors, nuclear power plants and other non-reactor installations; and providing for the application of these standards through, inter alia, support for the Agency's technical co-operation programme, the rendering of services, the promotion of education and training, the fostering of information exchange and the co-ordination of research and development.

The Division of Nuclear Installation Safety is divided into sections under the following topics: Engineering Safety; Operational Safety; and Safety Assessment. The Engineering Safety Section has two units: Design Safety Unit and Research Reactor Safety Unit.

The Research Reactor Safety Unit focuses its activities to address safety issues related to research reactors raised by Member States in the implementation of safety standards and good engineering practices. Emphasis is also given to the development of new safety documents covering areas where there is a lack of guidance.

Relating to Research Reactors, services are offered to Member States in the following areas: safety in the design and operation of research reactors (INSARR - Integrated Nuclear Safety Assessment of Research Reactor - missions); regulatory supervision of research reactors (IRRT **-** International Regulatory Review Team - missions); and experience feedback on safety issues for research reactors (IRSRR -Incident Reporting System for Research Reactors- database).

For many years the IAEA has conducted missions to assess the safety of Member States' research reactors. They have included IAEA staff and other international experts and have varied in size and length from one expert visiting a facility for one day to a team of more than five persons spending up to two weeks on the mission. The results of many safety missions have been collected and analyzed.

In 1998 the chairman of the International Nuclear Safety Advisory Group (INSAG) reported to the IAEA Director General the group concern about the safety of research reactors. INSAG has identified three major safety issues: the increasing age of research reactors; the number of research reactors that are not operating anymore but have not been decommissioned yet; and the number of research reactors in countries that do not have appropriate regulatory authorities.

In April 2000, INSAG (now appointed for its fifth term) reported again to the Director General. It stated, "While fully endorsing the concerns expressed by the previous INSAG, it must regretfully recognize that in spite of a prompt reaction by the Secretariat … the problem remains very serious". The April 2000 letter repeated the issues raised in the earlier correspondence and also referred to a low level of safety culture surrounding many research reactors. While noting the efforts of the Secretariat, it stated "the Member States may as yet have realized neither the urgency of the issue nor the dimension of

the problem." INSAG suggested the development of a Protocol to the Convention on Nuclear Safety or some similar legal instrument as a way of establishing a better international safety framework for research reactors. The General Conference GC(44)/RES/14 requested "the Secretariat, within its available resources, to continue work on exploring options to strengthen the international nuclear safety arrangements for civil research reactors, taking due account of input from INSAG and the views of other relevant bodies".

A Working Group (WG) was convened by the IAEA Secretariat as part of its response to the above GC resolution. The WG, consisting of 15 experts from 7 Member States, met in the Agency Headquarters in May 2001 to discuss options for an international arrangement on the safety of research reactors. The WG recommendations were submitted to the Board of Governors, which requested the Secretariat (GOV/2001/28-GC(45)/11-paragraph 18) to develop and implement, in conjunction with Member States, an international research reactor safety enhancement plan. This Board of Governors decision was endorsed by the General Conference GC(45)/RES/10. The plan includes the following elements: conduct a survey on research reactor safety in Member States; 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; and exploration of possible means to strengthen the system for monitoring the safety of research reactors, taking account of the experience of organizations working in other fields.

The activities implemented in the field of research reactor safety, in 2002 by the IAEA Research Reactor Safety Unit, are addressed below.

2- SAFETY STANDARDS FOR RESEARCH REACTORS

Under the terms of its Statute, the Agency is authorized to establish or adopt standards of safety for the protection of health, life and property; and to provide for the application of these standards to its own operations as well as to other operations and, at the request of the parties, to operations under any bilateral or multilateral arrangement, or, at the request of a State, to any of that State's activities in the field of atomic energy [2].

The Safety Standards Series embodies an international consensus on objectives, concepts, principles, logic, methods and facts that is necessary to promote a common approach to ensuring safety in the peaceful applications of nuclear energy. They are categorized, as: (1) *Safety Fundamentals* (silver lettering) give the reason *why* nuclear activities must fulfill certain requirements, they present basic objectives, concepts and principles of safety and protection in activities involving radiation or radioactive materials, and they require approval by the Board of Governors; (2) *Safety Requirements* (red lettering) establish *what* are the requirements to be met to ensure safety and protection, they are govern by the objectives and principles in the Safety Fundamentals, the requirements are expressed as "shall" statements, and they require approval by the Board of Governors; (3) *Safety Guides* (green lettering) recommend *how* safety requirements can be met, they present actions, conditions or procedures for meeting safety requirements, recommendations are expressed as "should" statements, and they require approval by the Publications Committee on behalf of the Director General. The categorization is intended to ensure that users of the safety standards are aware of the status and interrelationship of the various publications.

Besides the safety standards there are safety publications named Safety Reports and Technical Documents (TECDOC), which are descriptive reports on safety and protection in nuclear activities, describing good practices, practical examples and detailed methods of meeting safety requirements. They do not establish requirements or make recommendation and so they do not contain prescriptive "shall" or "should" statements.

Table 1 presents the Safety Documents for research reactors as well as more informational document on topics important to safety (the documents generated directly for research reactors application are typed in italic letter). IAEA website (*http://www-pub.iaea.org/MTCD/publications/publications.asp*).

2.1- Safety Requirements of Research Reactors (DS-272)

From 1997 to 1998 two Consultant Meetings and one Technical Committee Meeting were organized for developing and reviewing the Safety Requirements of Research Reactor (DS-272). Comments from Member States were received and IAEA staff members prepared a final draft version in 2002. Most of the comments were implemented in a final draft version sent to the NUSSC (Nuclear Safety Standard Committee) and is waiting its approval to be sent to the Commission of Safety Standards.

DS-272 revises the two former safety standards of the IAEA Safety Series: No. 35-S1 and 35-S2. Besides updating the material, it places the publication within the new structure and categorization of the IAEA Safety Publications and updates its content to be consistent with the rest of the publications developed within the framework of the IAEA programme on research reactor safety.

The document covers all the important areas of research reactor safety with particular emphasis on requirements on design and operation. Pursuant requests from end-users, mainly from Member States with small nuclear programmes, to have a single and autonomous publication it also includes basic statements and requirements on regulatory supervision, management and verification of safety including quality assurance and site evaluation. These topics constitute the main differences from the new document to the previous standards. The DS-272 applies to research reactors including critical facilities, but does not apply to subcritical facilities, prototypes, naval reactors, industrial reactors, heat generation reactors, etc.

Research reactors are used for specific and varying purposes, e.g. research, training, radioisotope production, neutron radiography, material tests, etc, resulting in different design features and operational regimes. Design and operating characteristics may vary significantly since experimental devices may impact the performance of reactors. In addition, the need for greater flexibility in their use requires a different approach to achieving or managing safety. Considering the important differences between the different types of research reactors the application of the requirements shall be commensurate to the potential hazard of the reactor using a *graded approach*, ensuring that the design and operation of a research reactor lead to adequate safety of the facility.

2.2- Safety Guides

During 2002 two new safety guides were developed: The Operating Organization and the Recruitment, Training and Qualification of Personnel for Research Reactors Facilities; Operational Radiation Protection for Research Reactors. The first one was sent to the NUSSC and the second one is almost in a final draft version for submittal to the NUSSC.

The objective of the first document is to provide guidance on the selection, training and authorization of research reactor personnel based on the experience gained in Member States. This document also provides examples of initial and re-training programmes and personnel selection criteria, as well as the authorization process for those individuals whose duties have an immediate bearing on safety, for several reactor types from Member States. The document focuses mainly on the training of direct operating personnel but also includes some recommendations regarding other facility personnel such as Reactor Manager and maintenance and radiation protection personnel.

The purpose of the second document is to provide general guidance on radiation protection for research reactor facilities, which is consistent with the recommendations contained in the Basic Safety Standards (SS No.115) and in the new safety requirement document (DS-272). This document includes all the important components, which should be considered for inclusion in an operational radiation protection programme and provides guidance intended to support the optimization of such a programme. It, therefore, can be of value to the management of organizations responsible for the operation of research reactor facilities and to the competent authorities charged with their regulation

Other three safety guides have been finished but are waiting the approval of the DS-272 for consistency check: Commissioning of Research Reactors; Maintenance and Periodic Testing and Inspections of Research Reactors; and Operational Limits and Conditions for Research Reactors.

2.3- Technical Reports and Documents (Safety Report Series and TECDOC Series)

Publications in the (numbered) Safety Reports Series may complement, and be directly related to, Safety Requirements or Safety Guides. They may give practical examples and detailed methods that can be used to ensure the compliance with Safety Requirements or Safety Guides. They may, for example, describe methods for performing certain calculations, illustrate types or form to be used in an auditing process, provide a compilation of data or describe methods for making a specific judgment concerning the fulfillment of safety requirements or recommendations. Safety Reports may describe good practices but they do not establish requirements or present recommendations and therefore they do not generally contain binding 'shall' or 'should' statements.

Owing to the experience and results of IAEA safety related missions to Member States' research reactors there is a perception that additional information is needed to Operating Organizations and to Regulatory Bodies either to implement or to improve the application of the Agency Standards. The Research Reactor Safety Unit has worked in 2002 on the further development of the following documents applicable to research reactors: Source-Term Derivation and Radiological Consequences Analysis for Accidents; Operating Procedures; Safety of New and Existing Facilities in Relation of External Events; Safety Analysis; Safety Related Process and their Implications for OLCs; and Extended Shutdown.

3- INCIDENT REPORTING SYSTEM FOR RESEARCH REACTORS (IRSRR)

The systematic collection and evaluation of operational experience with unusual events is a very useful way to improve operational safety. A proper analysis of unusual events can identify root causes and provide valuable lessons to be learned by, for example, reactor operators or reactor designers [3].

The Incident Reporting System for Research Reactors (IRSRR) collects, maintains and disseminates reports on unusual events that are received from Member States of the IAEA participating in the system (this includes reports on unusual events that occurred before the IRSRR came into effect).

Participation in the IRSRR is voluntary and open to Member States that have a research reactor programme. The IAEA recommends that each Member State appoint a national coordinator (preferably from the regulatory body) and local coordinators (from operating organizations or constructors). Each coordinator should be a professional, knowledgeable with research reactors or should be assisted by such a professional.

The IRSRR is based on the principle that each participant will provide timely information on its experience with unusual events in research reactors so that the information is available to all other participants. Unusual events with safety significance or of general interest to the research reactor community should be identified by the national or local coordinators and transmitted to the IAEA. In 2002 the system was kept in operation and the access made available through the IAEA web.

Besides receiving, storing and distributing information, the IAEA prepares periodic reports on IRSRR activity and organizes periodic meetings to review and evaluate the material available on unusual events. A collection of received reports was published as " working material" in 1999 and 2000. The last meeting of coordinators was held in November 2001 in Portugal, and the next meeting is scheduled for the 4th quarter of 2003.

Note that while slightly less than half of the countries with research reactors are IRSRR participants (31 of 65) a large majority of the research reactors in the world is represented by the group. Nevertheless, the Agency was encouraged to continue to extend the number of participants to all Member States having research reactors.

4- INSARR MISSIONS

Although the IAEA has been carrying out safety reviews to research reactors since 1972 in order to meet the Member States' increasing requests for assistance to ensure and enhance research reactor safety, the IAEA announced in 1987 the creation of a more formal approach for providing this service.

This approach was named Integrated Safety Assessment of Research Reactors (INSARR) [4]. In 1999 the INSARR methodology was modified to incorporate some of the features of the well-known Operational Safety Review Teams (OSART) service dedicated to power reactors. Following the new methodology, an INSARR Mission is constituted of three stages: Pre-INSARR, Main Mission and Follow-up.

The Pre-INSARR mission has the duration of 2 to 3 days and is performed by one or two IAEA staff members. The purpose of the mission is to discuss and to agree with the Operating Organization the conduct of the Main Mission. The items discussed are normally: the main features of the INSARR Mission; scope of the review indicating the topics to be reviewed; walk-through of the facility; definition of the information to be provided before the Main Mission (advanced information package); overview of the facility design and modifications; overview of the regulatory supervision; overview of the documentation available; and logistic support and financial arrangements, and a work plan for the Operating Organization and for the IAEA to be performed before the Main Mission. The Pre-INSARR mission usually takes place 4 to 12 months before the Main Mission.

The duration of the Main Mission varies from 1 to 2 weeks depending on the reactor complexity and topics to be reviewed. A team leader and a deputy team leader (both Agency staff) and a minimum of three external experts constitute the review team. Observers from organizations receiving an INSARR Mission in the future are invited to participate in the mission depending on the acceptance of the recipient country.

Qualification of the review team is very important and it requires experts that have: at least five years of recent experience in research reactor operation, design or regulatory activities; currently a senior responsible for the specific area of review and at least five years in that area; and skills as an evaluator and good command of English (desirable). The experts are recruited from research reactors personnel, operating organization, regulatory bodies, designers, constructors, or private consultants. The desirable composition of the review team is a maximum of 30% of IAEA staff members, and a minimum of 30% of newcomers. Every expert signs a Confidentiality Agreement before starting to receive information from the host institution.

The main objective of INSARR missions is to conduct a comprehensive operational safety review of the research reactor facility and to verify compliance with the IAEA Safety Standards. However, an important spin-off from INSARR missions has been the mutual transfer of knowledge and experience between mission experts and reactor personnel and the development of self-assessment capabilities among the team members to be applied in their own countries. Certain missions have identified areas where the operating organization had developed a particularly good approach to certain safety topics, to the extent that the IAEA team recognized it as good practice and recommended it for application at other facilities.

The activities associated with a safety review cover a number of specific areas that depend on the objective of the review. However, the main areas to be examined during a safety review can be divided into four categories.

(a) *General:* nuclear regulations; regulatory supervision and licensing process; operating organization; reactor management and personnel training; quality assurance programme (QA); and emergency planning.
(b) *Nuclear Operational Safety*: safety analysis; safety analysis report (SAR); operational limits and conditions (OLC); operating procedures; maintenance and periodic testing; experiments and modifications; and conduct of operations including records and reports.
(c) *Radiation Protection*: radiation protection programme; waste management; airborne and liquid effluents; and radiological impact.
(d) *Special Issues* - which may consider unique topics such as: siting; design; construction; commissioning, major modifications; decommissioning; reactor ageing; and safety culture.

Topics such as design or safety culture are included in the area of special issues. In general, topics in this area require substantial effort and time from the reviewer. Therefore, these topics are not usually covered by typical INSARR missions, which focus on the topics in areas (a), (b) and (c).

The mission team gathers information in the review areas through: review of written material; interview with personnel; direct observation of performance; and discussion of evaluations within team members. Issues identified by the reviewer must be: supported by facts; based on an objective

comparison with generally accepted good international nuclear safety practices; agreed by the mission team; and agreed by the counterpart. The implication of each issue to safety should be indicated.

The mission team designates issues for which it addresses either a recommendation or a suggestion. Good practices are also indicated. The definition for each one is as follows:

(a) *Recommendation*: team advice on how to improve the operational safety. It is based on standards and proven, good international practices and addresses the root causes rather than the symptoms of the identified concern. It very often illustrates a proven method of striving for excellence that reaches beyond minimum requirements.
(b) *Suggestion*: an additional team proposal in conjunction with a recommendation. It may indirectly contribute to improvements in operational safety but is primarily intended to make a good performance more effective.
(c) *Good Practice*: a proven performance, activity or use of equipment, which the team considers to be markedly superior to that observed elsewhere. It should have application to other facilities.

Daily meetings between mission team and counterparts are held during the mission, where all issues are presented and discussed. At the exit meeting the draft report of the mission is given to the counterpart and discussed. The official report is produced in Vienna by the team leader (IAEA) and sent to the host country government with copies to the host institution.

The Follow-up Mission takes place 12 to 18 months after the Main Mission. The duration and the necessary expert team is defined by the IAEA technical officer who conducted the Main Mission. The scope of the Follow-up Mission is: evaluation of the safety improvements based on the recommendations provided at the final report; feedback from counterparts on the INSARR service and the means to improve it; preparation of a Follow-up Report.

In 2002 a total of 2 Pre, 4 Main, and 1 Follow-up INSARR missions were performed. The main areas with issues were: legal and regulatory supervision; operating organization and reactor management; training and qualification; safety analysis; OLC; QA; conduct of operation; maintenance and periodic testing; seismic safety, and emergency preparedness.

5- CODE OF CONDUCT ON THE SAFETY OF RESEARCH REACTORS

Strengthening the international nuclear safety arrangements for research reactors from a legal point of view can be achieved in a number of ways. At one end of the spectrum, States may wish to adopt a binding international legal instrument on the subject, for example in the form of a convention (like the Convention on Nuclear Safety related to land-based nuclear power plants which does not include research reactors). At the other end of the spectrum there are non-binding international instruments such as a code of conduct or resolution to cover the subject matter. The non-binding instrument as the code of conduct was chosen.

According to the GC(45)/RES/10 request, the IAEA Secretariat arranged for the preparation of the Code of Conduct on the Safety of Research Reactor. Member States were invited to designate representative(s) for an Open-Ended Working Group of Legal and Technical Experts to develop the Code of Conduct on the safety of Research Reactor. Two meetings were held in the IAEA Headquarters: the first in May 2002 and the second in December 2002, at which the Code of Conduct was developed.

The basic structure of the Code of Conduct is given by: scope, objective, implementation, role of the State, role of the Regulatory Body, role of the Operating Organization, and role of the IAEA.

The Code of Conduct outlines the attributes of safety to be implemented in the site evaluation, design, construction, operation, utilization, modification, and decommissioning of a research reactor. Its three major sections identify the roles of the State, the Regulatory Body and the Operator. While the majority of the Code is drawn from requirements of the IAEA safety standard series, it focuses on current problematic issues such as reactors in extended shutdown or in need of improved ageing management. [5]

6- SURVEY ON THE SAFETY OF RESEARCH REACTORS

Through resolution GC(45)/RES/10, the General Conference requested the Secretariat to conduct a survey on research reactor safety in Member States. The objectives of the survey are: to better characterise the status of safety at specific research reactors; to heighten Member States awareness and attention to potential safety issues; and to identify opportunities to apply existing modified or new Agency services and programmes to research reactor safety concerns.

A questionnaire comprising 15 questions covering topics on regulatory supervision, operational safety, radioactive waste management and emergency planning, was prepared and distributed to all the countries with research reactors independent of their status (planned, under construction, operational, shutdown or decommissioned).

In May 2002, 102 answers were received by the Agency and a preliminary evaluation was made. One of the main conclusions was that the number of questionnaires received was insufficient and a reminder letter should be sent to the Member States that did not respond. This reminder letter was sent out on July 2002 and the total the number of responses increased to 233. [6]

Of the 67 Member States possessing or planning to possess a research reactor, 13 did not provide any answer to the survey, 26 provided information on some of their research reactors and the remaining 28 provided information on all the research reactors in the country. 233 research reactors provided information: 2 planned, 3 under construction, 143 operational, 48 shutdown, 37 decommissioned.

Much of the concern for RR safety has been based on the number of reactors that are shutdown and not decommissioned. The safety assessment survey was designed in large part to better characterize the state of those reactors. The responses to the surveys indicate that a number of facilities that are categorized in the database as shutdown are in fact decommissioned or in the process of decommissioning.

Surveys should continue to be collected to verify that the 61% that did not respond do not have a larger fraction of facilities with safety concerns. Concerning this topic, the General Conference (GC(46)/RES/9 - September 2002) urged those Member States with RRs which have not yet responded to the Secretariat's questionnaire on the safety status of their RRs to do so as soon as possible.

7- CONCLUDING REMARKS

Research reactor safety is gaining in importance within the general scope of nuclear installation safety worldwide. The IAEA develops activities and offers various programmes to assist Member States in enhancing the safety of research reactors. This paper outlined some of these activities and services performed in 2002. As a remark for 2003 it is expected that the Board of Governors will forward the Code of Conduct to the General Conference for consideration. Also an improvement on the survey of research reactor safety is foreseen.

8- REFERENCES

[1] INTERNATIONAL ATOMIC ENERGY AGENCY, Safety of Research Reactors, International Conference on Topical Issues in Nuclear Safety, 3-6 September 2001, Vienna, Austria
[2] INTERNATIONAL ATOMIC ENERGY AGENCY, Preparation and Review of Safety Related IAEA Publications, Version 2.2, October 1998
[3] Guide on the Incident Reporting System for Research Reactors, January 2000
[4] INTERNATIONAL ATOMIC ENERGY AGENCY, Guidelines for the Review of Research Reactor Safety, December 1997
[5] Code of Conduct on the Safety of Research Reactors – GOV/2003/7 Annex 1- 6 February 2003.
[6] Report on the Research Reactor Safety Assessment Survey Results – Draft – February 2002.

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Table 1 – IAEA Documents on Research Reactor Safety (as December 2002)

SAFETY FUNDAMENTALS

- THE SAFETY OF NUCLEAR INSTALLATIONS, SS No.110
- RADIATION PROTECTION AND THE SAFETY OF RADIATION SOURCES, SS No.120

SAFETY REQUIREMENTS

- LEGAL AND GOVERNAMENTAL INFRASTRUCTURE, GS-R-1
- PREPAREDNESS AND RESPONSE FOR A NUCLEAR OR RADIOLOGICAL EMERGENCY, GS-R-2
- INTERNATIONAL BASIC SAFETY STANDARDS FOR PROTECTION AGAINST IONIZING RADIATION AND FOR THE SAFETY OF RADIATION SOURCES, SS No.115
- QA FOR SAFETY IN NPP AND OTHER NUCLEAR INSTALLATIONS, SS No.50 C/SG-Q
- PREDISPOSAL MANAGEMENT OF RADIOACTIVE WASTE INCLUDING DECOMISSIONING, WS-R-2
- *CODE ON THE SAFETY OF NUCLEAR RESEARCH REACTORS: DESIGN, SS No.35-S1*
- *CODE ON THE SAFETY OF NUCLEAR RESEARCH REACT: OPERATION, SS No.35-S2*
- *SAFETY REQUIREMENTS FOR RESEARCH REACTORS, DS 272,* **for approval (supersede SS 35-S1 and SS 35-S2)**
- SITE EVALUATION FOR NUCLEAR FACILITIES, DS 305, **for approval**

SAFETY GUIDES

- *SAFETY ASSESSMENT OF RR AND PREPARATION OF THE SAR, SS No.35-G1*
- *SAFETY IN THE UTILIZATION & MODIFICATION OF RR, SS No.35-G2*
- DECOMMISSIONING OF NUCLEAR POWER PLANTS AND RESEARCH REACTORS, WS-G-2.1
- DESIGN OF SPENT FUEL STORAGE FACILITIES, SS No.116
- OPERATION OF SPENT FUEL STORAGE FACILITIES, SS No.117
- ASSESSMENT OF OCCUPATIONAL EXPOSURE DUE TO EXTERNAL SOURCES OF RADIATION, RS-G-1.3
- ASSESSMENT OF OCUPATIONAL EXPOSURE DUE TO INTAKES OF RADIONUCLIDES, RS-G-1.2
- REGULATORY CONTROL OF RADIOACTIVE DISCHARGES TO THE ENVIRONMENT, WS-G-2.3
- *COMMISSIONING OF RESEARCH REACTORS, DS 259,* ***for approval***
- *MAINTENANCE AND PERIODIC TESTING AND INSPECTIONS OF RR, DS 260,* **for approval**
- *OPERATIONAL LIMITS AND CONDITIONS FOR RESEARCH REACTORS, DS 261*, **for approval**
- *THE OPERATING ORGANIZATION AND THE RECRUITMENT, TRAINING AND QUALIFICATION OF PERSONNEL FOR RESEARCH REACTORS FACILITIES, DS 325,* **for approval**
- *OPERATIONAL RADIATION PROTECTION FOR RESEARCH REACTORS,* **in preparation**

TECHNICAL REPORTS (Safety Report Series)

- SAFETY ASSESSMENT FOR SPENT FUEL STORAGE FACILITIES, SS No.118
- DEVELOPING SAFETY CULTURE IN NUCLEAR ACTIVITIES, Safety Report No.11
- CALIBRATION OF RADIOLOGICAL PROTECTION MONITORING INSTRUMENTS, Safety Report No.16
- INDIRECT METHODS FOR ASSESSING INTAKES OF RADIONUCLIDES CAUSING OCCUPATIONAL EXPOSURE, Safety Report No.18
- TRAINING IN RADIATION PROTECTION, Safety Report No.20
- *SOURCE TERM DERIVATION AND RADIOLOGICAL CONSEQUENCES ANALYSIS FOR RESEARCH REACTOR ACCIDENTS,* **in preparation**
- *OPERATING PROCEDURES FOR RESEARCH REACTORS,* **in preparation**
- *SAFETY OF CORE MANAGEMENT AND FUEL HANDLING FOR RESEARCH REACTORS,* **in preparation**
- *INSTRUMENTATION & CONTROL,* **in preparation**
- *SAFETY OF NEW AND EXISTING RR FACILITIES IN RELATION OF EXTERNAL EVENTS,* **in preparation**
- *SAFETY ANALYSIS FOR RESEARCH REACTORS,* **in preparation**
- *SAFETY RELATED PROCESSES AND THEIR IMPLICATIONS FOR OLCs,* **in preparation**

TECHNICAL DOCUMENTS (TECDOC Series) and others

- SITING, TECDOC-403
- EARTHQUAKE RESISTANCE, TECDOC-348
- *GUIDELINES FOR THE REVIEW OF RESEARH REACTOR SAFETY, Services Series No.1*
- AGEING MANAGEMENT, TECDOC-792
- EMERGENCY RESPONSE PREPAREDNESS FOR NUCLEAR OR RADIOLOGICAL ACCIDENTS, TECDOC-953
- COMPARISON BETWEEN IAEA 50-C/SG AND ISO 9001:1994, TECDOC-1182
- *CORE CONVERSION, TECDOC-233, TECDOC-643*
- *MTR FUEL, TECDOC-467*
- *GENERIC COMPONENT RELIABILITY DATA FOR RESEARCH REACTOR, TECDOC-930*
- RELIABILITY DATA, TECDOC-636
- PSA, TECDOC-400, TECDOC-517
- *APPLICATION OF NON-DESTRUCTIVE TESTING AND IN-SERVICE INPECTION TO RR, TECDOC-1263*
- *INSARR MISSION RESULTS, working material*

- *EXPERIENCE W/ ACCIDENTS 1999, working material*
- *EXPERIENCE W/ ACCIDENTS 2000, working material*
- *EXTENDED SHUTDOWN*, **in preparation**
- *PLANNING AND MANAGEMENT FOR THE DECOMMISSIONING OF RESEARCH REACTORS AND OTHER SMALL NUCLEAR FACILITIES -TRS No. 351*
- *DECOMMISSIONING TECHNIQUES FOR RESEARCH REACTORS*, TRS No. 373
- *DECOMMISSIONING TECHNIQUES FOR RESEARCH REACTORS- CRP REPORT, TECDOC-1273*