

**Code of Conduct
on the
Safety of Research Reactors**

(As Adopted by the Board of Governors, 8 March 2004)

IAEA, Vienna

PREAMBLE

The IAEA's Member States

Aware that research reactors provide important benefits throughout the world, including research, education, radioisotope production, fuel and materials testing and medical and industrial applications,

Aware of the importance of ensuring that the use of research reactors is safe, well regulated and environmentally sound,

Noting that the International Nuclear Safety Advisory Group (INSAG) has identified the need for action to address safety issues that may arise in research reactors and that subsequently the IAEA General Conference approved a research reactor safety enhancement plan that included the preparation of a Code of Conduct for the Safety of Research Reactors (GC(45)/RES/10),

Desiring to promote an effective nuclear safety culture,

Affirming the importance of international cooperation for the enhancement of nuclear safety,

Affirming the importance of the IAEA's safety standards relevant to research reactors that provide an extensive basis for ensuring their safety,

Noting the finalization of the work by the Open-ended Group of Legal and Technical Experts convened by the Director General to prepare a draft amendment of the Convention on the Physical Protection of Nuclear Material aimed at extending the scope of that convention to cover, inter alia, the physical protection of nuclear material and nuclear facilities, including research reactors, against sabotage,

Keeping in mind that the Convention on Nuclear Safety (1996) establishes the fundamental safety principles for achieving and maintaining a high level of nuclear safety worldwide through the enhancement of national measures and international cooperation for nuclear power reactors, but that it does not apply to research reactors, and

Taking account of the provisions of the Joint Convention on the Safety of Spent Fuel Management and the Safety of Radioactive Waste Management, in particular those provisions that apply to spent fuel and radioactive waste arising from the operation and decommissioning of research reactors,

DECIDE that the following Code of Conduct should serve as guidance to States for, inter alia, the development and harmonization of policies, laws and regulations on the safety of research reactors.

I. SCOPE

1. This Code applies to the safety of research reactors as defined by this Code, at all stages of their lives from siting to decommissioning.
2. This Code does not apply to the physical protection of research reactors.
3. This Code does not apply to research reactors within military or defence programmes.

II. OBJECTIVE

4. The objective of this Code is to achieve and maintain a high level of safety in research reactors worldwide through the enhancement of national measures and international co-operation including, where appropriate, safety related technical co-operation. This objective is achieved by proper operating conditions, the prevention of accidents and, should accidents occur, the mitigation of the radiological consequences, in order to protect workers, members of the public and the environment against radiation hazards.

III. APPLICATION OF THE GUIDANCE IN THE CODE

5. Application of this Code is accomplished through national safety regulations pertaining to all stages in the life of research reactors. In doing so, States are encouraged to make appropriate use of IAEA safety standards relevant to research reactors and those relating to the legal and governmental infrastructure for nuclear, radiation, radioactive waste and transport safety.
6. Noting that there are many different research reactor designs and power levels resulting in a wide range of hazard potential, the State should adopt a graded approach to application of the guidance in this Code commensurate with the hazard potential, while maintaining a strong nuclear safety culture.
7. If the State faces difficulties in application of this Code, it should communicate the difficulties and any assistance it may require to the Agency.

IV. DEFINITIONS

8. For the purposes of this Code:

“associated experimental facilities” means any equipment and apparatus for utilization of the neutrons and other ionising radiation produced by the research reactor that have the potential to affect its safe operation.

“extended shutdown” means the state in which the reactor has been shutdown and for which there are no approved plans and committed resources in place to resume operation or enter decommissioning.

“modification” means a deliberate change in or an addition to the existing reactor configuration, with potential safety implications, intended for the continued operation of the reactor. It may involve safety systems, or safety related items or systems, procedures, documentation or operating conditions.

“operating organization” means the organization which undertakes one or more of the siting, design, construction, commissioning, operation, modification, and decommissioning of a research reactor and is authorized (or is seeking authorization) by the regulatory body.

“regulatory body” means an authority or system of authorities designated by the government of a State as having legal authority for conducting the regulatory process, including issuing authorizations, and thereby regulating nuclear, radiation, radioactive waste and transport safety.

“research reactor” means a nuclear reactor used mainly for the generation and utilization of neutron flux and ionising radiation for research and other purposes, including experimental facilities associated with the reactor and storage, handling and treatment facilities for radioactive materials on the same site that are directly related to safe operation of the research reactor. Facilities commonly known as critical assemblies are included.

“worker” means a person who works in a research reactor and who has recognized rights and duties in relation to occupational radiation protection, including employees of the operating organization, experimenters and other users of the research reactor.

V. ROLE OF THE STATE

9. The State should establish and maintain a legislative and regulatory framework to govern the safety of research reactors. The framework should place the prime responsibility for the safety of research reactors on the operating organization and should provide for:

- (a) the establishment of applicable national safety requirements and regulations;

- (b) a system of authorization for research reactors and the prohibition of the operation of a research reactor without an authorization;
 - (c) a system of regulatory inspection and assessment of research reactors to ascertain compliance with applicable regulations and the terms of authorizations; and
 - (d) the enforcement of applicable regulations and the terms of authorizations, including suspension, modification or revocation of the authorization.
10. The State should have a regulatory body charged with regulatory control of research reactors based on the national legal structure. The regulatory body should be able to conduct authorization, regulatory review and assessment, inspection and enforcement, and should establish safety principles, criteria, regulations and guides. The regulatory body should be effectively independent from organizations or bodies charged with promotion of nuclear technologies or with operation of research reactors. Before the State authorizes building or importing a research reactor, a functioning regulatory body should be in place. If necessary, assistance in developing the necessary human, technical and regulatory capabilities should be obtained through international cooperation.
 11. The State should provide the regulatory body with the necessary authority and adequate resources to ensure that it can discharge its assigned responsibilities. No other responsibility should be assigned to the regulatory body that may jeopardize or conflict with its responsibility for regulating safety and protecting the environment from radiation hazards.
 12. The State should, if it deems necessary, define how the public and other bodies are involved in the regulatory process.
 13. The State should ensure that the operating organization has a system for financing the safe operation of the research reactor, for maintaining the research reactor in a safe shutdown state for extended periods if this becomes necessary, and for its decommissioning.
 14. The State should establish an effective system of governmental emergency response and intervention capabilities relating to research reactors.
 15. The State should make adequate legal and infrastructural arrangements for decommissioning of research reactors.
 16. The State should take the appropriate steps to ensure that the safety of all operating research reactors and research reactors in extended shutdown is reviewed. When necessary in the context of this Code, the State should ensure that all reasonably practicable improvements are made to upgrade the safety of the research reactors. If such upgrading cannot be achieved, appropriate provisions should be made to shut down and then decommission the research reactors. The timing of the shut-down of the research reactors, if safety allows it, may take into account the contributions of each research reactor's utilization programme to society and the possible alternatives as well as other social, environmental and economic impacts.

17. In circumstances where a research reactor is in extended shutdown and there is no longer any effective operating organization, the State should make arrangements for the safe management of the research reactor.
18. The State should take appropriate steps to ensure that arrangements are put in place to inform neighbouring States in the vicinity of a planned research reactor, insofar as they are likely to be affected by the research reactor, and upon request, provide sufficient information to such States to enable them to evaluate and make their own assessment of the likely safety impact of the research reactor on their own territory for emergency planning and response.

VI. ROLE OF THE REGULATORY BODY

19. The regulatory body should:
 - (a) implement a process of issuing authorizations with regard to all stages in the life of a research reactor;
 - (b) undertake regulatory inspections and assessments of research reactors to ascertain compliance with applicable regulations and authorizations;
 - (c) enforce the applicable regulations and the authorization, including suspension, modification or revocation of the authorization;
 - (d) review and assess submissions on safety from the operating organization both prior to authorization and periodically during the life of the research reactor as appropriate, including in relation to modifications, changes in utilization and experimental activities important to safety; and
 - (e) make available, as appropriate, its regulatory requirements and decisions and their basis, particularly with respect to matters under Paragraph 19(c), above.
20. The regulations and guidance established by the State or the regulatory body according to national arrangements should:
 - (a) require clear arrangements for the management of safety by the operating organization, reflecting safety as the highest priority and encouraging the development of a strong nuclear safety culture in the operating organization;

Assessment and verification of safety

- (b) require the operating organization to prepare and maintain a safety analysis report and to obtain an authorization for siting, construction, commissioning, operation, modifications important to safety, extended shutdown and decommissioning;

- (c) require the operating organization to undertake periodic safety reviews at intervals determined by the regulatory body and to make proposals for upgrading and refurbishment arising from such reviews as necessary;

Financial and human resources

- (d) require the operating organization to demonstrate that it has sufficient financial and human resources to support safe operation of the research reactor;
- (e) require those personnel who operate the research reactor and for experimenters who use associated experimental facilities to be appropriately trained;

Quality assurance

- (f) require the operating organization to put in place effective quality assurance programmes at the different stages of the life of the research reactor;

Human factors

- (g) require the operating organization to take human factors into account throughout the life of the research reactor;

Radiation protection

- (h) require that radiation doses to workers and the public, including doses from releases to the environment, be within prescribed national dose limits and be as low as reasonably achievable, social and economic factors being taken into account;
- (i) provide guidance, as international consensus develops, on the protection of the environment from the harmful effects of ionising radiation;

Emergency preparedness

- (j) establish criteria for intervention in emergencies, and require that adequate emergency plans be in place;

Siting

- (k) establish criteria for the siting for research reactors;

Design, construction and commissioning

- (l) require that the design provide for defence in depth and diversity and redundancy in safety systems, so that if failures were to occur, they would be detected and compensated for or corrected by appropriate means;

- (m) require that construction be carried out in accordance with applicable codes, standards, specifications and criteria;
- (n) require that a commissioning program be carried out by the operating organization to ensure that the reactor meets design requirements;

Operation, maintenance, modification and utilization

- (o) require the operating organization to establish operational limits and conditions for the research reactor, with the regulatory body to assess and approve the limits and conditions and changes to them;
- (p) require the operating organization to report the occurrence of events significant to safety in accordance with criteria established by the regulatory body;
- (q) require the operating organization to classify modifications according to their safety significance, establish suitable internal review procedures, and keep up to date records of modifications and changes to the research reactor, including temporary modifications arising from experiments;
- (r) require access for the regulatory body to the research reactor for the purposes of inspection to verify compliance with regulatory requirements, such inspections to be followed with reports provided to the operating organization for assessment and response;
- (s) establish requirements for management of radioactive waste arising from the research reactor;

Extended shutdown

- (t) where necessary in national circumstances, establish criteria for the safety of research reactors in extended shutdown; and

Decommissioning

- (u) establish criteria for the release from regulatory control of decommissioned research reactors.

VII. ROLE OF THE OPERATING ORGANIZATION

21. The operating organization should establish its own policies in accordance with State requirements that give safety matters the highest priority, that promote a strong nuclear safety culture and are implemented within a management structure having clearly defined divisions of responsibility and lines of communication.

VII.A GENERAL RECOMMENDATIONS

Assessment and verification of safety

22. The operating organization should:
- (a) carry out a comprehensive and systematic safety assessment and prepare a safety analysis report before the construction and commissioning of a research reactor, and carry out safety reviews at appropriate intervals throughout its life, including in relation to modifications, changes in utilization and significant experimental activities and the management of ageing. The safety assessments and periodic safety reviews should include all technical, operational, personnel and administrative aspects of safety related operations. The assessments and reviews should be well documented, subsequently updated in light of operating experience and significant new safety information and reviewed under the authority of the regulatory body; and
 - (b) verify by analysis, surveillance, testing and inspection that the physical state and the operation of a research reactor continues to be in accordance with its design, safety analysis, applicable national safety requirements, and operational limits and conditions for the lifetime of the research reactor.

Financial and human resources

23. The operating organization should ensure that there is an overall effective system for the financing of the safe operation of the research reactor, including for any extended shutdown state, and for decommissioning.
24. The operating organization should make available sufficient numbers of staff qualified through appropriate education and training (initial and ongoing) for all safety related activities throughout the life of the research reactor. Appropriate training should be provided for experimenters that will use associated experimental facilities.

Quality assurance

25. The operating organization should establish and implement effective quality assurance programmes with a view to providing confidence that specified requirements for all activities important to nuclear safety are satisfied throughout the life of the research reactor. Experimenters using associated experimental facilities should be required to work within the relevant quality assurance programme and with safety arrangements established by the operating organization.

Human factors

26. The operating organization should take into account the capabilities and limitations of human performance throughout the life of the research reactor for operational states and in accident conditions, also taking into account human factors relating to experiments.

Radiation protection

27. The operating organization should in all operational states keep the radiation exposure from the research reactor to the workers and members of the public as low as reasonably achievable, social and economic factors being taken into account, and should ensure that no individual incurs a radiation dose which exceeds prescribed national dose limits.
28. The operating organization should also respond to any guidance that is provided by the regulatory body in relation to the protection of the environment from the harmful effects of ionizing radiation.

Emergency preparedness

29. The operating organization should establish, and maintain by training and exercises, appropriate emergency plans in accordance with established criteria of the regulatory body, and in co-operation with other appropriate bodies, to provide an effective response to emergencies.

VII.B SAFETY OF RESEARCH REACTORS

Siting

30. The operating organization should establish, implement and maintain appropriate procedures for:
 - (a) evaluating all relevant site-related factors likely to affect the safety of the research reactor over its projected lifetime;
 - (b) evaluating the potential safety impact of a planned research reactor on the public and the environment; and
 - (c) re-evaluating the two preceding issues at appropriate times so as to ensure the continued safety acceptability of the research reactor.

Design, construction and commissioning

31. The operating organization should ensure that:
 - (a) the design and construction of the research reactor provides for several reliable levels and methods of protection (defence in depth) against the release of radioactive materials, with a view to preventing the occurrence of accidents and to mitigating their radiological consequences should they occur;
 - (b) the design of the research reactor allows for reliable, stable and easily manageable operation, with specific consideration of human factors and the man-machine interface;

- (c) the construction of the research reactor is in accordance with the approved design (and any approved modifications to the design);
- (d) the technologies incorporated in the design and construction of the research reactor are proven by experience, testing or analysis; and
- (e) the commissioning programme demonstrates that the design objectives and performance criteria of the research reactor structures, systems and components important to safety have been achieved.

Operation, maintenance, modification and utilization

32. The operating organization should:

- (a) establish and revise as necessary operational limits and conditions derived from the safety analysis, tests, commissioning programme and operational experience to identify the limiting conditions for safe operation;
- (b) conduct operation, utilization, modification, maintenance, inspection and testing activities important to the safety of the research reactor in accordance with approved procedures and regulations;
- (c) establish procedures for responding to anticipated operational occurrences and to accidents;
- (d) make available the necessary engineering and technical support in all safety-related fields throughout the lifetime of the research reactor, including through international cooperation;
- (e) report events significant to safety to the regulatory body, analyse the events and act upon the findings to improve safety in a timely manner;
- (f) subject modifications to the research reactor over its lifetime to the design, construction and commissioning provisions described in this Code;
- (g) assess appropriately modifications proposed to perform experiments;
- (h) establish a safety review committee, as part of the operating organization, but reporting independently from the reactor management, to advise it on safety matters;
- (i) subject each utilization project having safety significance, including any modification of the research reactor, new construction or experimental device, to an appropriate level of safety assessment and approval; and
- (j) keep the generation of radioactive waste resulting from the operation and utilization of the research reactor to the minimum practicable for the process concerned, both in activity and in volume, and ensure that there are effective arrangements for the safe management of such waste at the site of the research reactor.

- (k) maintain documentation in a secure and organized manner throughout the life of the research reactor to assist in its safe operation and ultimate decommissioning. The documentation should include updated technical information and drawings of the facility and experimental devices, and records of operation and events.

VII.C EXTENDED SHUTDOWN

33. If unusual and compelling circumstances make it necessary for a research reactor to enter into or to continue in a state of extended shutdown, the operating organization should, as appropriate, prepare and implement a technical preservation programme to maintain the safety of the reactor and the reactor fuel, to be approved by the regulatory body. The programme should include:
- (a) arrangements for ensuring that the reactor core remains subcritical, noting that if appropriate arrangements exist for storing the fuel safely, it is preferable to unload the core;
 - (b) procedures and measures to disconnect, dismantle and preserve the systems that are to be taken out of operation or temporarily dismantled;
 - (c) modifications of the safety analysis report and the operational limits and conditions;
 - (d) arrangements for dealing with the fuel and radioactive waste in the research reactor;
 - (e) regular surveillance and periodic inspection, testing and maintenance activities to ensure that the safety performance of structures, systems and components does not degrade;
 - (f) revised emergency planning arrangements; and
 - (g) staffing requirements to undertake the tasks necessary to keep the research reactor in a safe condition and to maintain knowledge about the research reactor.

VII.D DECOMMISSIONING

34. The operating organization should ensure that siting, design, construction, operation, maintenance, and utilization of the research reactor are carried out keeping in view the ultimate decommissioning of the installation.
35. The operating organization should prepare a comprehensive decommissioning plan and assessment of environmental impact for review and approval by the regulatory body prior to commencing decommissioning activities. The elements of the plan should include:
- (a) the broad decommissioning option to be pursued and the justification for choosing that option;

- (b) the decontamination and dismantling techniques to be applied so as to minimise waste generation and airborne contamination;
- (c) arrangements for dealing with the fuel and radioactive waste arising from the research reactor;
- (d) arrangements for radiation protection during the decommissioning process; and
- (e) a description of the volumes, activities and types of waste to be generated in the decommissioning and the means proposed to manage these wastes safely.

VIII. ROLE OF THE IAEA

36. The IAEA Secretariat should:

- (a) disseminate this Code and related information widely;
- (b) assist States, upon their own request, in application of this Code;
- (c) continue to collect and disseminate information relating to the safety of research reactors, provide safety review services, develop and establish relevant technical standards and provide for the application of these standards at the request of any State by advising and assisting on all aspects of the safe management of research reactors.