

Operational Radiation Protection Programme for Research Reactors

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Introduction

- The results of the IAEA Safety Review Missions indicated the need to improve the operational radiation protection programmes, in particular in relation to:
 - *Zoning and working area classification;*
 - *Radiation and contamination monitoring of working areas;*
 - *Operating procedures, including decontamination procedures and techniques.*

Introduction

- The objectives of radiation protection are to:
 - *Ensure the effective control of external and internal doses to the workers and public, and of releases to the environment;*
 - *Ensure conformance with all regulatory requirements;*
 - *Enable further optimization of operational practices.*
- An operational radiation protection programme should be in place to achieve these objectives.

Introduction

- The operational radiation protection programme is subjected to the requirements of the IAEA Safety Standard NS-R-4.
- The basis of the operational radiation protection programme is a set of measures aimed at reducing radiation hazards and radiation doses.

NS-G-4.6: Radiation Protection and Radioactive Waste Management in the Design and Operation of Research Reactors

- NS-G-4.6 identifies important components that should be considered in the design stage to facilitate radiation protection and waste management.
- NS-G-4.6 provides good practices to be followed in operational radiation protection and radioactive waste management programmes and their optimization.



IAEA Safety Standards

for protecting people and the environment

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

Safety Guide

No. NS-G-4.6



Operational Radiation Protection Programme: General

- The operational radiation protection programme should include:
 - *The policy statement of operating organization which includes the radiation protection objectives and commitment to the radiological protection principles, in particular the optimization principle;*
 - *The organization of radiation protection, including the functions, responsibilities, qualifications, and line of communication of the radiation protection personnel. Provisions for adequate training in practices for radiation protection;*
 - *Measures for Controlling compliance with applicable regulations.*

Operational Radiation Protection Programme: General

- The operational radiation protection programme should also include measures for:
 - ✓ Ensuring cooperation between radiation protection staff and the operating staff;
 - ✓ Providing for decontamination of personnel, Structures, Systems, and Components;
 - ✓ Recording inventory of radioactive material;
 - ✓ Providing for the review and update of the programme.

Dose Limitation

- Dose limits set by the IAEA Safety Standard (for workers) GSR Part 3:
 - 50 mSv/y (effective dose) maximum;
 - 20 mSv/y (effective dose) averaged over 5 consecutive years;
 - 20 mSv/y (equivalent dose) to eye lens averaged over 5 consecutive years;
 - 500 mSv/y (equivalent dose) for hands and feet.
- Optimization of measures for radiation protection associated with any particular source or operation in a practice should be subjected to dose constraints.
- Dose constraints are used prospectively for the planning and execution of tasks as well as for design purposes. It is not a limit but rather a ceiling on the values of individual dose that should be considered acceptable in the optimization process.

Dose Control

- **Three types of control:**
 - *Source control: Considerations in design and operation.*
 - *Physical control: Considerations in the design and operation.*
 - *Administrative Control: Defined in local rules, requirements and procedures and form an essential part of the operational radiation protection programme.*

Dose Control: Source Control

- *Material selection:* Should be unlikely to be activated and of high corrosion resistance. Impurities should be investigated.
- *Quality of reactor coolant:* Coolant should be maintained as free from impurities as possible. Maintaining good coolant quality has an advantage of reducing corrosion and minimizing the activation of corrosion products.
- *Beam tubes:* beam tube ports should be well designed, shielded and monitored. Beam tubes that are not in use should be closed and shielded.

Dose Control: Source Control

- *Irradiated fuel:* handled and stored in a way that criticality, and cladding corrosion, melting, and damage are avoided.
- *Minimization of gaseous material:* Reduction of ingress of air near the core, sealing air spaces, purging the spaces with inert gases such as nitrogen or helium, use of filters to prevent build up of radioactive materials in ducts.
- *Minimization of waste:* Segregation of waste, placement of designated locations prior to its storage, treatment, and disposal.

Dose Control: Physical Control

- **Shielding:** Adequate shielding should be provided for all sources or radiation in and around the reactor facility.
- **Ventilation:** To control concentration of Ar^{41} and fission product gases in case of fuel failure. Differential pressure between areas of different potential contamination. Filtration system should be provided for normal and emergency conditions. The efficiency of the ventilation system (integrity, air exchange rate, flow rates, etc.) and efficiency of filters should be routinely checked.
- **Distance:** Use of special operating tools.
- **Time:** this may be the only viable method of dose control in some cases, when the dose rate is high despite shielding and distance protection.

Dose Control: Physical Control

- **Decay:** *Irradiated materials, equipment, and samples should be allowed to decay as long as possible before they are handled. This requires careful planning and scheduling.*
- **Decontamination:** *Contamination monitors, decontamination procedures and facilities should exist for personnel, areas, and equipment; control of items for contamination before transfer outside controlled areas.*
- **Personnel protective equipment:** *Simple laboratory coats, gloves, overshoes, full protective suite with air supply, masks, etc. They should be chosen in accordance with the anticipated hazards.*

Dose Control: Administrative Control

- *Working Area Classification and access control:* Depends on the potential for radiation and contamination hazards. Area classification should be indicated with an appropriate sign and give warning of the hazard. Controlled and Supervised areas should be defined.
- *Workplace monitoring programme:* includes external radiation, surface contamination, and airborne contamination.
- *Approval:* Formal approval is required for undertaking work involving the control of radiation hazards. This includes:
 - Maintenance work permits,
 - Experiment approval;
 - Routine irradiation approvals: non-routine irradiation should be treated as a new experiment;
 - Approval of modification to the facility based on assessment of its radiological implication.

Operational radiation protection procedures

- Procedures should be developed and approved for all activities that have radiological significance, and for all routine activities for radiation protection purposes.
- Radiation protection procedures are to be enforced and followed by the reactor staff, transient personnel and visitors.
- The procedures guarantee that all the activities that could lead to exposure are planned, supervised, and executed in a way that ensure that the radiation protection objectives are met.

Indicative examples on operational radiation protection procedures:

- ✓ Working area classification and procedures for access to different areas;
- ✓ Routine monitoring of external dose to personnel and radiation levels in areas, and monitoring of contamination of personnel, areas, surfaces and objects;
- ✓ Environmental monitoring;
- ✓ Monitoring of operation and maintenance tasks, which include handling of fuel and irradiated samples, maintenance of ventilation system, handling of ventilation filters, maintenance of control rods, working with ion-exchange resins, etc.
- ✓ Calibration and test of radiation protection equipment.

Indicative examples on operational radiation protection procedures:

- ✓ Decontamination procedures for personnel, surfaces and equipment;
- ✓ Use of protective equipment;
- ✓ Detection and recording of radioactive releases;
- ✓ Waste monitoring and management;
- ✓ Use of radioactive sources.

Thank you for your attention!

