DISCLAIMER

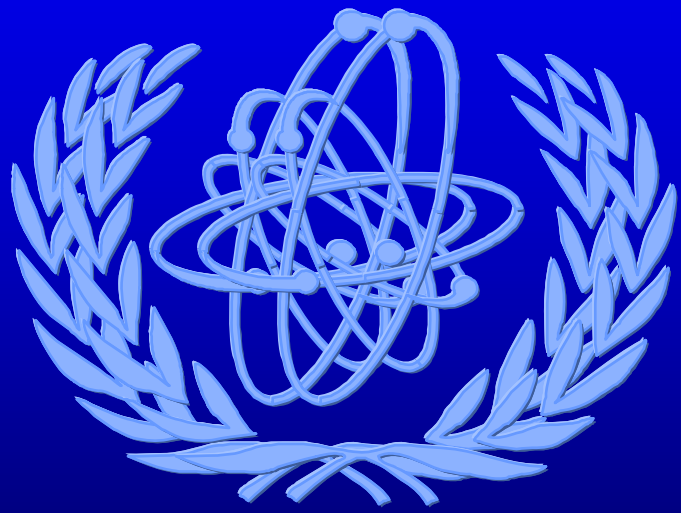
The information contained in this document cannot be changed or modified in any way and should serve only the purpose of promoting exchange of experience, knowledge dissemination and training in nuclear safety.

The information presented does not necessarily reflect the views of the IAEA or the governments of IAEA Member States and as such is not an official record.

The IAEA makes no warranties, either express or implied, concerning the accuracy, completeness, reliability, or suitability of the information. Neither does it warrant that use of the information is free of any claims of copyright infringement.

The use of particular designations of countries or territories does not imply any judgment by the IAEA as to the legal status of such countries or territories, of their authorities and institutions or of the delimitation of their boundaries. The mention of names of specific companies or products (whether or not indicated as registered) does not imply any intention to infringe proprietary rights, nor should it be construed as an endorsement or recommendation on the part of the IAEA

Establishing Emergency Response Capability



Emergency Preparedness and Response Aspects for Research Reactors

Lecture

Introduction

- **Many research reactor facilities operate without having emergency plan or/and without adequate cooperation with off-site organisations**

- **This lecture will concentrate on emergency preparedness and response aspects that are specific for research reactor facilities**

Content

- Radiation protection at research reactor facilities
- Research reactor emergency planning needs
- Threat assessment for research reactors
- Needs analysis and response strategy
- Summary

Radiation Protection at Research Reactor Facility

- **Aim**
- **Scope**
- **Operation**

Aim

- **Conditions under which radiation exposure of personnel can occur:**
  - **Radiation source is under control and exposure can be limited**
  - **Control over radiation source is lost and exposure can be only limited by remedial action**

Scope

- Protection of reactor personnel against radiation exposure
- Instrumentation and equipment for personnel monitoring
- On-site radiological monitoring and surveys
- Off-site radiological monitoring
- Decontamination of personnel, equipment and structure
- Detecting and recording activity releases

Operation

- Programme
- Organisation
- Training

Radiation Protection Systems

- Stationary dose rate meters
- Stationary dose rate monitors
- Monitors of radioactive substances in the atmosphere
- Laboratory stationary equipment for contamination identification

Radiation Protection Systems (1)

- Stationary equipment for monitoring effluents
- Portable, operational devices for measuring surface contamination
- Portable, operational facilities for measuring doses and doe rates
- Facilities for measuring doses and contamination of personnel

Research Reactor Emergency Planning Needs

- **EP needs depend primarily on:**
  - **Size and type of facility**
  - **Availability of on-site resources**

- **First, you must do:**
  - **Threat/risk assessment**
  - **Needs analysis**

Research Reactor Planning Needs

- **Threat assessment:**
  - **What kind of emergencies are possible?**
  - **What are potential consequences ?**

Threat Assessment

- **Conventional hazards**
  - **Fire**
  - **Explosion**
  - **Chemical threats**

Threat Assessment

- **Radiological hazards**
  - **Criticality**
  - **Shielding events**
  - **Overexposure of workers**
  - **Fuel damage and release in reactor building**
  - **Fuel damage and release to environment**
  - **Spills**
  - **Lost radioactive sources**

Research Reactor Classification

- **Regarding the threats RR can be grouped into four classes:**
  - **Zero power RR – up to 1 kW**
  - **Small RR – 1 kW to 1 MW**
  - **RR - neutron sources – 1 MW to 10 MW**
  - **High flux RR – over 10 MW**

Zero Power RR – up to 1 kW

- **Potential emergencies**
  - **Criticality**
- **Security events**
  - **Nuclear material theft**
- **Possible health effects**
  - **On-site: severe deterministic effects (death)**
  - **Off-site: no consequences**

Small Reactors – 1 kW to 1 MW

- **Potential emergencies**
  - **Over power**
  - **Loss of coolant**
  - **Fuel failure and fission product release**
  - **Loss of AC and DC power sources**
  - **High primary coolant I-131 concentration**
  - **Loss or degraded control of safety systems**
  - **Fire**
  - **Civil engineering destruction**

Small Reactors – 1 kW to 1 MW (1)

- **Security events:**
  - **Nuclear material theft**
  - **Terrorist destruction**

- **Possible health effects**
  - **On-site: severe deterministic effects (death)**
  - **Off-site: no consequences likely**

RR - Neutron Sources – 1 to 10 MW

- **Potential emergencies**
  - **Over power**
  - **Operator/user over exposure**
  - **Fission product release**
  - **Fire**

- **Security events:**
  - **intruder or terrorist attack**
  - **nuclear material theft**

RR - Neutron Sources – 1 to 10 MW (1)

- **Possible health effects:**
  - **on-site: operator/user over exposure**
  - **off-site: foodstuff/ground contamination**

- **Public protective actions:**
  - **iodine administration**
  - **sheltering**
  - **foodstuff control**

High Flux RR – over 10 MW

- **Potential emergencies**
  - **Failure to scram**
  - **Fuel melting and fission product release**
  - **Primary system leak, loss of coolant**
  - **Partial core damage**
  - **Effluent release**
  - **High ambient dose rates beyond the site boundary**

High Flux RR – over 10 MW (1)

- **Non-nuclear and security accidents**
  - **water flood and civil engineering terrorist destruction**
  - **nuclear material theft and sabotage**

- **Possible health effects**
  - **On-site: personnel over exposure, radioactive iodine intake by personnel**
  - **Off-site: foodstuff/ground contamination, radioactive iodine intake by public**

High Flux RR – over 10 MW (2)

- **Public protective actions:**
  - **iodine administration**
  - **sheltering**
  - **foodstuff control**

Man Made Action Threat

- What class of adversary is to be considered?
- What is the range of the adversary's tactics?
- What are the adversary's capabilities?

Research Reactor Preparedness

- Is there an accident classification system based on facility conditions?
- Is classification system well understood by staff and outside services?
- Is there a 24 hour contact point for the facility?
- Can facility emergency response organization be activated 24 hours a day?

Research Reactor Preparedness (1)

- Are there arrangements with off-site emergency services?
- Do these off-site services have appropriate training to respond to emergency at facility?
- How is radiation protection and dose monitoring provided to off-site services?

Needs analysis

- What is the response strategy?
- What resources do I need?
- What resources do I already have?

Response Strategy

C L A I M !

- **Classify**
- **Life saving**
- **Assess and protect**
- **Inform**
- **Manage**

Classify

- Promptly detect accident situation
- Very quickly rank it in terms of severity
- Trigger automatic actions associated with classification level

Life-saving

- **Evacuate people from the high hazard area**
- **Provide immediate medical first aid**

Assess and Protect

- Survey and monitor
- Determine need for protective actions
- Implement protective actions
  - Sheltering or evacuation
  - Stable iodine
  - Access control
  - Food ban in immediate vicinity

Inform

- **Inform the public on protective actions needed**
- **Inform the media**

Manage

- Coordinate facility response with outside services and off-site authorities
- Monitor unfolding of events and actions
- Communicate
- Follow up

Summary

- State what has been learned
- Define ways to apply this lecture

Where to Get More Information

- Publication No. 60, Annals of the ICRP 21 1-3
- IAEA Safety Series No. 115
- US NUREG-0849
- US NRC Regulatory Guide 2.6, HF 201-4
- US ANSI/ANS-15.16-1982