Requirements and Provisions for the Release of Material from Regulatory Control

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Research Reactor Decommissioning Demonstration Project (R2D2P)

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- Concepts of exemption, exclusion and clearance
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Background

SAFETY STANDARDS DEVELOPMENT →

- NUCLEAR SAFETY
- RADIATION PROTECTION
- TRANSPORT
- WASTE SAFETY

SAFETY STANDARDS APPLICATION →

- CONVENTIONS
- EXCHANGE OF INFORMATION
- TRAINING AND EDUCATION
- COORDINATED RESEARCH
- TECHNICAL COOPERATION
- PEER REVIEWS

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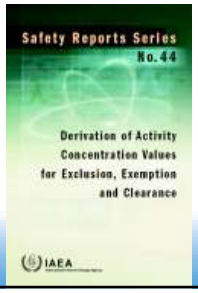
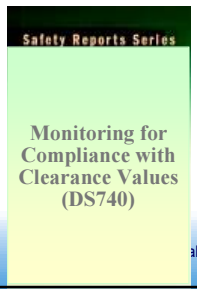
Background (cont)

Safety Standards

Supporting documents





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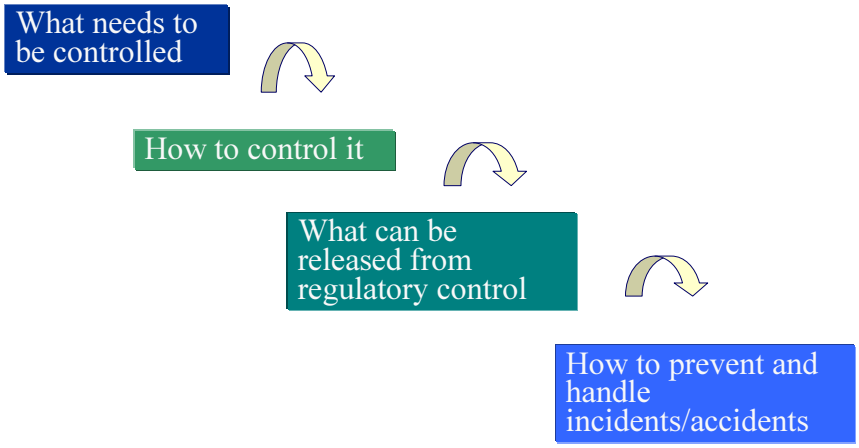
Control of Contaminated Material



Control of Contaminated Material (cont)

- **Material**
  - **Naturally occurring radioactive materials, concentrations vary in nature and human activities can concentrate them deliberately or adventitiously**
  - **Artificial radionuclides are produced**
    - **Deliberately for their use in industry, medicine and other purposes**
    - **As a by product of nuclear fission**

Control of Contaminated Material (cont)

- **High concentrations of radioactive material require safe management**
- **As concentrations become lower - need for control becomes less**
- **At a sufficiently low concentration controls are no longer necessary - for health and safety reasons**
- **Many types of objects and materials and circumstances of generation and use or radioactive material after release**

Control of Contaminated Material (cont)

- **Stylistics approach needed to establish basis for setting lower levels for which controls not required**
- **Sites and buildings need particular consideration**
  - **Bulk quantities**
  - **Fixed location**
  - **Possible re-use for regulated activity**
- **Basic Safety Standards:**
  - *"practice"* is a planned deliberate activity which will introduce a source of radiation, an exposure pathway or an exposed group
  - an *"intervention"* is an existing exposure situation where actions are taken to reduce exposure

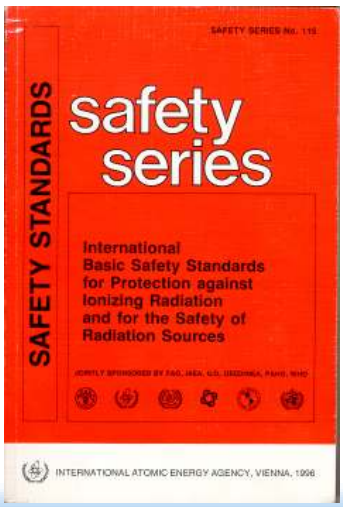
Control of Contaminated Material (cont)

- **Normal operation of an authorised practice**
  - Mining and mineral processing facilities
  - Fuel cycle facilities (NPP, etc.)
  - Enrichment facilities
  - Operation, maintenance
  - **Decommissioning of facilities**
  - Use of ionizing sources
- **Contamination as a result of incidents or accidents**
  - Operational/decommissioning radiological incidents or accidents
  - Handling and long-term management of disused sealed sources
  - Management of orphan sources

Control of Contaminated Material (cont)

- **Define the scope of regulatory control**
  - Exclusion
  - Exemption
  - Clearance
- **Methods to control**
  - At the licensee site (on-site handling)
  - Off-site transport
  - Transboundary movement
- **Definition of release of material from regulatory control - criteria and conditions**

Concepts of Exclusion, Exemption, and Clearance



Concepts of Exclusion, Exemption, and Clearance (cont)

- **Exclusion** - *any exposure whose magnitude or likelihood is essentially unamenable to regulatory control and is deemed to be excluded from the standards (legal framework)"*
  - **e.g. K^{40} in the body, cosmic radiation at the surface of the earth, unmodified concentrations of naturally occurring radionuclides**
  - **fallout from previous atmospheric weapons testing**

Concepts of Exclusion, Exemption, and Clearance (cont)

- **Exemption** - *Practices and sources within a practice may be, a priori, exempted from the requirements of the standard (not from legal framework) if exposures or risks will be sufficiently small*
  - Quantitative criteria specified (for reference limited amounts of material)
  - Practice must be justified (will introduce more overall benefit than detriment)

What Does This Mean?

- **Individual dose must be sufficiently low as not to warrant regulatory concern – the dose is trivial**
- **Radiation protection must be optimized, taking the cost of regulatory control into account – cost/benefit analysis**

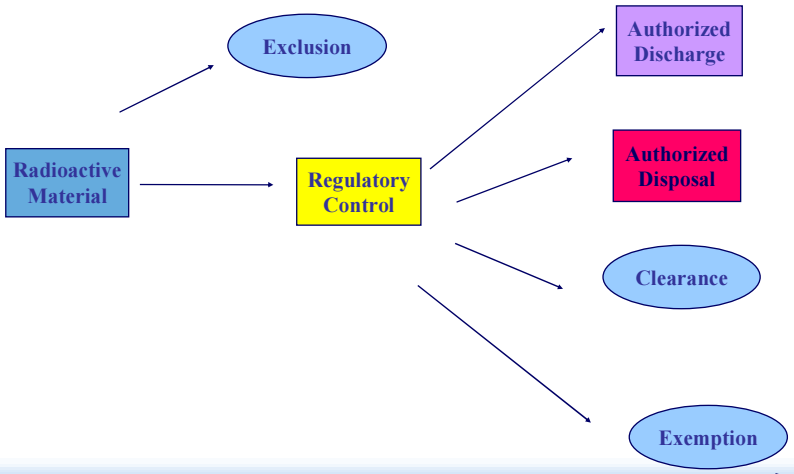
Trivial Dose

- **Choose a risk level and a corresponding dose which have no significant effect as regards to individuals**
- **Use the exposure to natural background, to the extent that it is normal and unavoidable, as a relevant reference level**
- **Relates to a level of individual dose of some tens of microSieverts in a year**
- **Because an individual may be exposed to radiation from several exempted practices, it must be ensured that the total dose does not exceed the trivial level**
- **Therefore, the IAEA recommends 10 µSv in a year**

Concepts of Exclusion, Exemption, and Clearance (cont)

- **Clearance** - *Removal of radioactive materials or objects from within authorised practices without any further control by the regulatory authority*
  - Clearance levels shall not be higher than (reference) exemption levels
  - Bases is the same as for exemption except have different scenarios
  - Clearance of bulk amounts of material require particular regulatory consideration

Concepts of Exclusion, Exemption, and Clearance (cont)



Application of the Concepts of Exclusion, Exemption, and Clearance

Application of the Concepts of Exclusion, Exemption, and Clearance (cont)

- **Guidance to regulators and operators**
- **Bulk material - over the order of a 1 tonne**
- **Approaches used:**
  - Levels are established for exclusion of naturally occurring radionuclides from regulatory control
  - Basis linked to radiation levels in natural environment
  - Amenability to control
  - Levels proposed from data on levels of naturally occurring radionuclides reported by UNSCEAR
  - Based on median natural content in soil (not counting radon)

Application of the Concepts of Exclusion, Exemption, and Clearance (cont)

- **Activity concentration values (Bq/g)**
- Radionuclides of natural origin
  - K-40 (10 Bq/g)
  - All other radionuclides of natural origin (1 Bq/g)
  - U-238, U-235, Th-232- parent of decay chain

Exemption for Bulk Quantities of Material

- Levels for considering exemption of artificial radionuclides
- Doses to individuals anticipated 10 μSv and unlikely to exceed 1 mSv
- Collective dose associated with exemption of bulk quantities not to exceed 1 man.Sv in a year
- Exemption for bulk quantities of material can be used for clearance
- Levels tabulated for individual radionuclides

Values for Selected Radionuclides

Radionuclide	Bq/g
H-3	100
C-14	1
Mn-54	0.1
Fe-59	1
Co-60	0.1
Ni-59	100
Sr-90	1
Tc-99	1
I-131	10
Cs-137	0.1
Eu-154	0.1
Pu-238	0.1
Am-241	0.1

Mixture of Radionuclides

- **Natural origin**
  - concentration of each radionuclide should be less than the relevant value of the activity concentration
- **Artificial origin**

$$\sum_{i=1}^{n} \frac{C_i}{(\text{activity concentration})_i} \leq 1$$

- **Natural and artificial origin**
  - Both conditions presented in paras 4.6 and 4.7 should be satisfied.

Application of the Concepts of Exclusion, Exemption, and Clearance (cont)

- **<u>Application of levels:</u>**
  - Decisions needed how the values will be incorporated into national regulations
  - Decisions needed on how the values will be used to control clearance of materials
  - These will depend on the legal framework and national regulatory practices

Application of the Concepts of Exclusion, Exemption, and Clearance (cont)

- **Graded approach**
  - Commensurate with the characteristics of the practice or source
  - Commensurate with the magnitude and likelihood of the exposures and
  - Conforming to any requirements specified by the Regulatory Body
  - When values are exceeded by several times (e.g. up to ten times)

Application of the Concepts of Exclusion, Exemption, and Clearance (cont)

- **Trade**
  - Mechanisms must avoid re-entry of materials into the system
  - International trade in materials and objects with radioactivity levels below derived levels should not be restricted
  - Authorities should ensure compliance at source of origin of object or material
  - Monitoring at borders and important locations such as metal recyclers should be established

Monitoring for Compliance with Clearance Criteria

- Safety Report on Monitoring for Compliance with Clearance Values (DS740) - in preparation
- Selection of a monitoring strategy
  - Scope of work (material)
  - Clearance criteria (e.g. generic, site-specific, averaging)
  - Material characteristics
  - Management approach
  - Decision of optimum strategy
  - Stakeholders involvement

Monitoring for Compliance with Clearance Criteria (cont)

- Implementation of monitoring strategy
  - Selection of monitoring techniques and instruments
    - Background
    - Dealing with mixture of RNs (Fingerprint)
    - Converting clearance criteria to field levels (units)
    - Measurement sensitivities
    - Use of multiple monitoring techniques
    - Uncertainties
    - Physical sorting techniques

Monitoring for Compliance with Clearance Criteria (cont)

- **Measurement:**
  - Surface contamination
  - Bulk material
- **Collection and analysis of samples**
  - Sampling methods
  - Representative samples
- **Quality management**
  - Documentation
  - Responsibilities and supervision, etc.

Monitoring for Compliance with Clearance Criteria (cont)

- **Summary clearance report**
  - Executive summary
  - Background
  - Material description
  - Clearance objectives
  - Clearance criteria
  - Clearance strategy and techniques
  - Results
  - Lessons learned
  - References
  - Contributors to the report
- **Follow-up actions**
- **Communication of results**




Summary

- **Clearance of material**
  - Decommissioning process
  - Safety and trade
  - Activity concetration values and not surface values
- **Food and drinking water**
  - Use Codex Alimentarius for general consumption and for milk and infant foods
  - Use WHO guidelines for drinking water

Summary

- **Monitoring for compliance with release levels of contamination**

- **Agency assistance:**
  - **Development of safety reports on derivation and monitoring for compliance with clearance levels**
  - **Technical support to MSs in establishing their regulatory framework**