Steps Involved in a Remediation Process: Implementation of Protection

Task Group 98 Workshop

Radiological Protection in Areas Contaminated by Past Activities

Virtual event – 6 June 2024

Analia Canoba

Charity 1166304 registered with the Charity Commission of England and Wales

ICRP INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

Steps involved in a remediation process

The process consists of **5 main steps**

1. Recognition of the exposure situation
2. Characterization of the exposure situation
3. Planning of remediation
4. Implementation of the remedial action plan
5. Post remediation management

1-Recognition of the exposure situation

- Initial recognition based on the available information of the site
- Identifying ownership of the contaminated area: legal and financial
- Identifying stakeholders involved
- Knowledge of the history of the affected area
- Start communication and engagement early in the process (the values involved of local stakeholders)
- Involvement of different regulatory authorities (Multiple hazards/ each responsibility)
- Shared understanding of the area's main features

2-Characterisation of the exposure situation (1)

Detailed evaluation to determine main exposure pathways and extent of contaminated area: **dose assessments to assess risk to people and the environment**, now and future:

- sampling, measurements (monitoring) and modelling
- environmental characteristics of the site: soil type, hydrogeology, land use and topography
- baseline information on radiation levels to assess contamination caused by the past activity. (NORM sites)
- receptors (affected members of the public and non-human biota).
- dose assessment: realistic scenarios (avoid overly conservative assumptions)
- exposures not certain to occur over the medium and long term (not focusing on highly unlikely scenarios)

2-Characterisation of the exposure situation (2)

- **All hazard approach**: characterisation of radiological and other hazards. (lead, mercury, cadmium, arsenic, asbestos, other.)
- **Site context factors**: economic, resources, social, cultural, technical feasibility, sustainable factors, waste management aspects, surrounding population and habits, stakeholders values (*prevailing circumstances*)
- **Key input to justify** site remediation and a protection strategy
- **Essential** part of the **optimization** process
- **Local communities involvement**: sharing information, understand the risks, building trust and confidence.

3-Planning of remediation (1)

- If implementation of a protection strategy is justified, the remediation planning phase is initiated.
- **Objective of the process: achieving overall well-being**, addressing **all hazards** and considering the **prevailing circumstances**.
- Includes **an evaluation** of the potential **risks** to the **public, workers and the environment** and include risks arising from any on-site and off-site waste management activities
- **Remedial actions** are investigated and considered
- Involves establishing a **reference level** for the residual dose.
- Involves establishing an **"end state"** for the site, appropriate for the societal, economic, and environmental context, in line with the future use.
- End states that require a long time could consider **interim states** to adapt the management to progress towards a final end state .

3-Planning of remediation (2)

- ***Optimisation of protection is an iterative process**: the distribution of individual doses may be moved downwards stepwise to progressively improve the situation until the achieved level of protection can be considered as optimized* (ICRP 103)
- **Coordination** between different **authorities**
- **Stakeholders' inputs** throughout the process:
  - ✓ to share their values and knowledge of the site
  - ✓ to express their concerns about possible decisions/uncertainties.
  - ✓ to understand the implications and benefits of actions
- **Once option is selected,** a site-specific **remedial action plan is defined**: site information, objectives, end state, remedial actions, safety and environmental assessment, monitoring, post-remediation actions, institutional control.

Protecting the public (1)

- Planning involves **establishing** a **reference level (RL).**
- **Factors for setting RL**: characteristics of the exposure, feasibility of controlling the situation, time and cost for remediation, volume of waste generated, impact on the environment, societal disruption through remediation, experience in the management of similar situations.
- The **RL** is determined on a **case-by-case basis.**
- RL selection also includes considering **“exposures not certain to occur”** with the management of uncertainties of exposure scenarios. (Pub 101a).
- *RL: selected in the lower half of 1 to 20 mSv year^{-1} band, with the long-term objective of progressively reducing exposure close to 1 mSv year^{-1}.*
- The **RL** does **not include radon** exposure and **background**.

Protecting the public (2)

- **Endpoint of remediation:** an **optimised dose below the RL**.
- **Optimisation** of protection **is not minimisation of dose** nor the minimisation of a single attribute: the *best under prevailing circumstances*
- The **most appropriate** option **may not be** the one resulting in the **lowest dose.**
- In specific circumstances: RL < 1 mSv year^{-1}.
- Radon: Pub 126, based on optimization principle and a derived RL

  (100–300 Bq m^{-3}).
- Radon: if [Rn-222] > derived RL, further assessment with graded approach
- Public dose assessment: exposures from the site, during remedial work, during waste disposal and post-remediation.
- Health surveillance: stakeholders concerns, dialogue.

Protecting the environment

- **Integrated approach**: ensure both protection of people and the environment.
- Pubs 108 and 124: RAPs and DCRLs as tools for non-human species.
- Environmental risk: adverse impacts on ecological receptors, including habitat disruption or damage to natural resources (aquifers, soils, forest)
- Flora and fauna populations and ecosystem components protection.
- **Graded approach**
  - Generic assessment
  - Specific assessment
  - Further detailed site specific risk assessment
- **Options assessment:** not only dose rates vs DCRLs, other factors beyond the estimated dose rate.
- Increasing interest of ecosystem services monitoring in other areas for EP.

Protection of workers (1)

- **Remediation worker:** In most circumstances be considered and managed as **occupationally exposed workers** with dose limit and dose constraints.
- **Workers called for their specific skills**:
  - working around ionising radiation is not part of the routine job (**episodical**). Their exposure **protected as members of the public**.
  - in **special circumstances flexibility** in the implementation of **specific requirements** for radiation protection could be provided, **commensurate with the level of exposure** and adapted to the **circumstances**.
- **Management framework**: case specific, **all hazards approach** with **balance use** of tools to **achieve protection**
- For **people working in workplaces located in contaminated areas**: considered as **members of the public**

Protection of workers (2)

- Remediation plan includes a **radiation protection programme** for safety and health worker protection:
  - identification of exposure scenarios (remedial actions and waste disposal);
  - dose assesment;
  - personal protective equipment;
  - adequate information and training,
  - specialized training if needed
  - integrating radiological protection with procedures for controlling other hazards.
- Radiological protection **requirements** should be **graded** according to the risks and included in an **all occupational hazard approach**.

Selecting remedial actions

- Objective: an **overall balance of risks and benefits** for the protection of **people and the environment**, **now and in the future**.
- ***Sustainable remediation***: actions that reflect an **understanding of the overall impact** of remediation activities. Assessments of **safety** and **environmental** benefits and impacts, as well as **social** and **economic** benefits and drawbacks, in the **short term and the long term.**
- Technique selection: the selected reference level, national policy, availability of proven technologies; technical capacity, stakeholders' views, resources, soil types, groundwater location, effects on environment, local culture and traditions, waste management, timeframe, land use, etc.
- Remediation techniques applied may aim at removing or reducing the concentration of radionuclides, disrupting exposure pathways, or reducing radionuclide bioavailability.
- **Restrictive management options** may impact on the quality of life of inhabitants and damage the local economy. (**sustainable aspects addressed**)
- **Local people & authorities** work together: identification of **self-help protective actions**.

Management of residues and waste (1)

- Remediation generates residual material, containing radioactive and non-radioactive contaminants: tailings, mineralised rock, resins, soils, liquids, sediments, surface-contaminated objects, metal, concrete, etc
- Waste management: considered alongside the selection of the protection strategy and remedial actions, in accordance with national policy and strategy for protection.
- **Selection of reference level** may strongly **influence the amount of waste generated during remediation**
- The **generation of radioactive waste** during remediation should be **reduced to the extent practicable**, specially when no disposal route is available
- Although management of waste generation is an important factor in the remediation process, the **overall objective is to optimise radiation protection as a whole.**

Management of residues and waste (2)

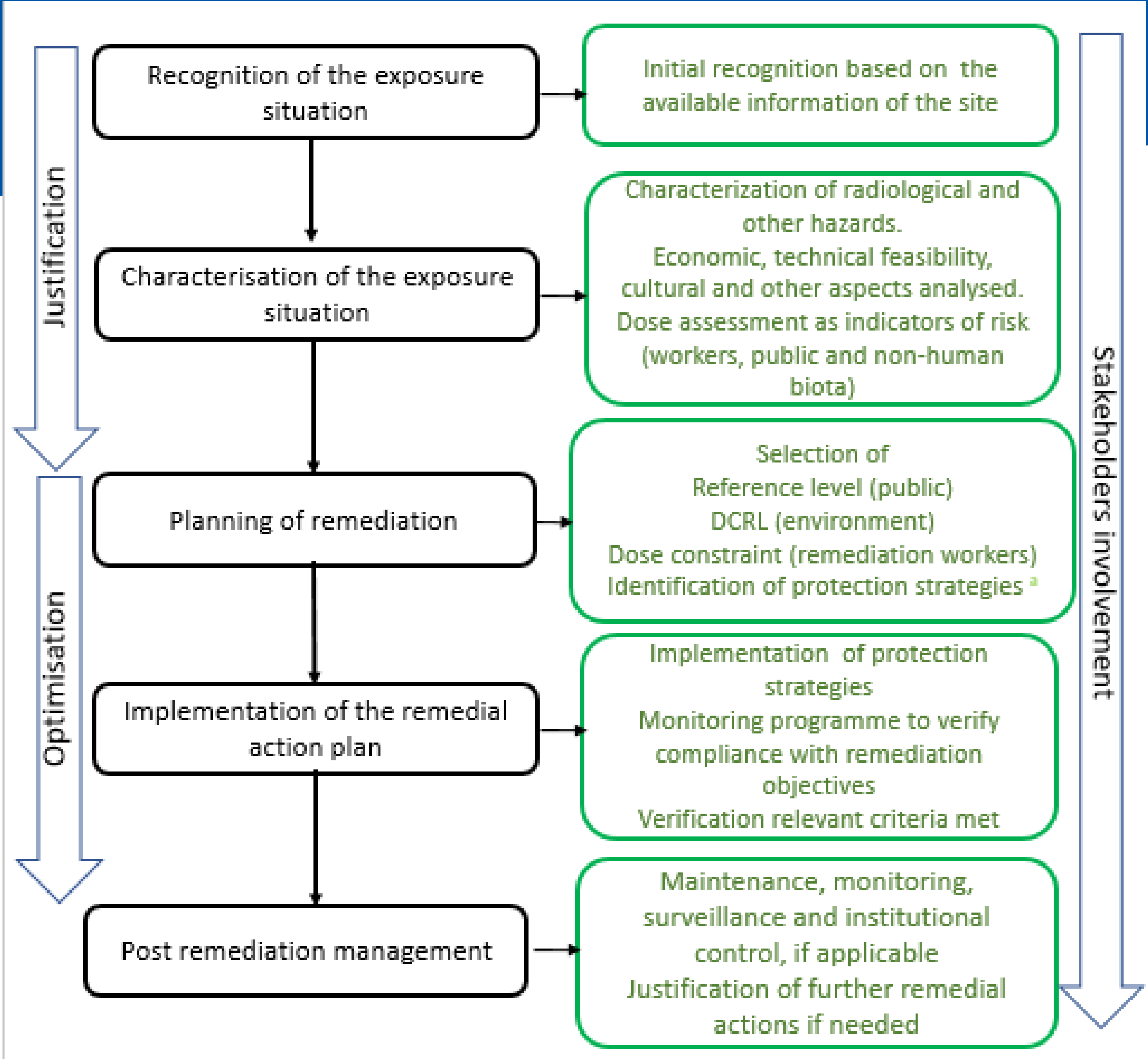
- Not all the residual material meets the definition of radioactive waste.
- Residual materials are designated as radioactive waste when these materials cannot be recycled, reused or cleared from further control.
- **A sustainable approach** for management of residues/ waste should be applied, implementing reuse, recovery, and recycling into other useful products, from a linear to a circular economy.
- Some wastes could be treated as industrial or hazardous wastes.
- Radioactive waste management: follow national policy, strategy, and legal and regulatory framework.
- If wastes are transferred to other areas, a dialogue with the stakeholders of this area is needed, as part of the consultation.

4- Implementation of the remediation action plan

- Once the remediation plan has been decided and approved implementation is initiated.
- **Activities** in accordance with **remediation plan requirements** and **working procedures.**
- Radioactive and non-radioactive **waste management:** in compliance with **legal and regulatory requirements**.
- Implementing source, environmental and remediation workers **monitoring programmes** to **ensure compliance with remediation objectives**.
- **Involvement** of **relevant stakeholders** in the monitoring programmes
- If unexpected levels of exposure are detected, corrective actions applied
- If remediation cannot be implemented as planned, the remediation plan should be reviewed and updated, including the objectives of protection,

5-Post remediation management

- After completion of remediation, perform **monitoring** to confirm remediation has been **successful.**
- **Monitoring :** for sites with institutional control and without restriction
- **Monitoring programmes results** should be **recorded**, maintained, **documented** and **made available** (Data traceability)
- **Stakeholders** should be **fully informed and involved**
- **Further actions** could be **justified** (e.g. remediation was less effective than planned or availability of new technological developments).
- A **long-term monitoring programme:** next generations achieve a shared understanding of the practical process done.
- Important to have procedures to assure **that the site is not forgotten**, even after active control is ended.


Justification
Optimisation
Recognition of the exposure situation
Initial recognition based on the available information of the site
Characterisation of the exposure situation
Characterization of radiological and other hazards.
Economic, technical feasibility, cultural and other aspects analysed.
Dose assessment as indicators of risk (workers, public and non-human biota)
Planning of remediation
Selection of
Reference level (public)
DCRL (environment)
Dose constraint (remediation workers)
Identification of protection strategies [a]
Implementation of the remedial action plan
Implementation of protection strategies
Monitoring programme to verify compliance with remediation objectives
Verification relevant criteria met
Post remediation management
Maintenance, monitoring, surveillance and institutional control, if applicable
Justification of further remedial actions if needed
Stakeholders involvement

www.icrp.org