CENTRE D'ÉTUDE SUR L'ÉVALUATION DE LA PROTECTION DANS LE DOMAINE NUCLÉAIRE

Sustainable recovery after nuclear accidents

Aligning remediation and waste management with UN SDGs

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- Proposed framework for analysis
- Analysis of remediation and associated waste management
- Discussion


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2 ZERO HUNGER
3 GOOD HEALTH AND WELL-BEING
4 QUALITY EDUCATION
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12 RESPONSIBLE CONSUMPTION AND PRODUCTION
13 CLIMATE ACTION
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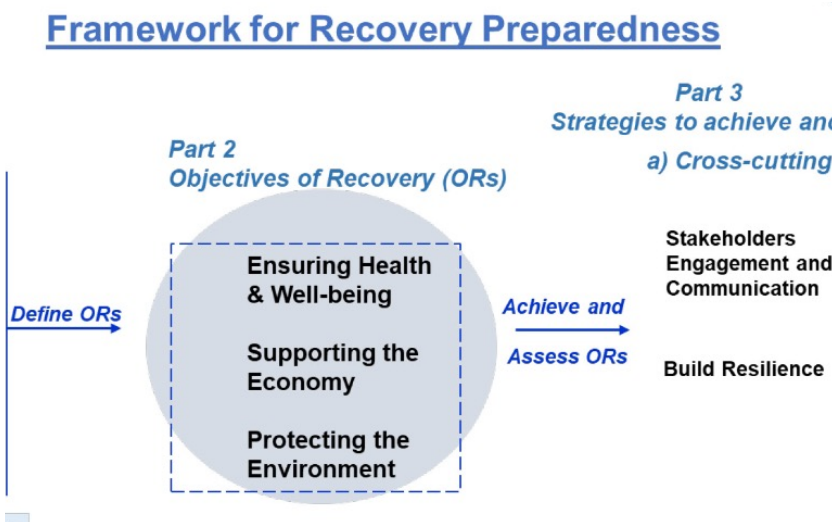
- Post-accidental recovery involves sustainability challenges beyond RP: environmental protection, socio-economic resilience, public trust (core dimensions of UN SDGs).
- Sustainable recovery requires a holistic approach aligned with UN SDGs (CRPPH 2022)*



- RP principles (ICRP) already support SDGs (e.g. intergenerational equity, environmental protection) (ICRP 2024)**.

Proposed framework for the analysis of sustainable recovery

- The objective is to test usefulness of guiding recovery strategies with sustainable development pillars, with radiation protection and ethics as transversal dimensions

- This is a **work-in-progress**

Dimensions considered:

- Socio-economic: economic recovery, social cohesion
- Environmental: land restoration, ecosystem health
- Societal: health, public trust, well-being

Transversal issues

- Radiation Protection
- Ethical values: justice, solidarity, transparency, participation, accountability, long term vigilance

Layout

- Analysis of remediation and associated waste management
  - Decontamination
  - Classification of wastes
  - Temporary storage
  - Volume reduction by incineration
  - Recycling and reuse
  - Storage and disposal

- Discussion

Decontamination

Japan: objective to reduce additional annual dose to 1 mSv or less on the long term (SDA & ICSA)

- Examples for farmland: interchanging topsoil and subsoil, ploughing with zeolite & K

Sustainable development challenges

- Socio-Economic: high costs, large waste volumes
- Environmental: risks of erosion, fertility loss, ecosystem disruption
- Societal: stress, uncertainty, distrust in uneven efforts

Transversal issues

- Radiation Protection: limiting exposure
- Ethical challenges : solidarity efforts for managing contamination

Off-site Environmental Remediation in Fukushima Continuing.
Photo: IAEA 2013

Classification of wastes

- **Japan:** ≠ between debris, specified waste, and decontamination waste (+soil) which is managed separately by MOEJ

Sustainable development challenges

- Socio-Economic: over-classification → high costs (storage, transport, disposal)
- Environmental: under-classification → contamination risks
- Societal: complex system → enforcement difficulty; communication on the special classification

Transversal issues

- Radiation Protection: justifying exposure scenarios, storage, disposal, recycling thresholds
- Ethical issues: the system needs to be accountable and transparent for stakeholders.

Temporary storage

- Japan: temporary storage sites with monitoring (groundwater, atmospheric, air dose rates) + Interim Storage Facility (ISF)

Sustainable development challenges

- Socio-Economic : long-term burden on host communities
- Environmental: monitoring and reducing land use impacts
- Societal : stress from proximity to residential areas

Transversal issues

- Radiation Protection: integrating decommissioning in design
- Ethical challenges: participatory governance, fairness of burden in already-affected areas

Temporary storage facilities for radioactive decontamination waste in Iitate village. Source : Evrard et al. 2019 (Creative Commons)

Storage of removed soil in the Interim Storage Facility. Source : MOEJ

Volume reduction strategies: concentration by incineration

Japan: preferred option to drastically reduce volume of waste

- 12 temporary incinerators built and managed by MOEJ (3 remaining)

Sustainable development challenges

- Socio-Economic: long-term burden on host municipalities
- Environmental: energy-intensive process, risk of secondary pollutants, mandatory exhaust monitoring
- Societal: need for transparent monitoring & operations

Transversal issues

- Radiation Protection: exhaust monitoring for public, workers, environment protection
- Ethical challenges: participatory governance by involving local stakeholders.

Temporary Incineration Facility in Okuma Town. Source : MOEJ

Recycling and reuse

- **Japan:** recycling of disaster debris in civil engineering, recycling of decontamination soil in specific projects (< 10 µSv/year in use).

Sustainable development challenges

- Socio-Economic: uncertain long-term acceptance in recycling areas
- Environmental: uncertain impacts from large-scale reuse
- Societal: balancing public acceptance, equity, and governance

Transversal issues

- Radiation Protection:
  - Control of reuse & shielding, prevent contamination spread
  - Need for clear, transparent exposure scenarios for levels
- Ethical challenges:
  - Necessary public participation in the decision process.
  - Risk of uneven burden-sharing if reuse projects are concentrated in specific communities.

Reuse of decontamination at Prime Minster's Office. Source : MOEJ

Reuse of decontamination at Prime Minster's Office. Source : MOEJ

Storage and disposal

- Japan: designated waste stored at ISF is planned for final disposal outside Fukushima. (example of using an existing landfill)

Sustainable development challenges

- Socio-Economic: high costs
- Environmental: long term monitoring
- Societal: stress may persist due long term burden

Transversal issues

- Radiation Protection: long term monitoring
- Ethical challenges: intergenerational equity

Supervised landfill for remediation wastes in Tomioka

Discussion (1)

- Long term recovery and associated waste management are strongly linked to the development of affected territories
- Using SD helps considering this recovery management beyond the scope of radiation protection

Environmental pillar

- Goals : restore contaminated land and ecosystems, minimize ecological footprint of temporary facilities (e.g., storage, incineration), prevent secondary pollution (soil, water, air).

Economic pillar

- Goals: support economic recovery in affected regions, optimize costs of waste management and remediation, create temporary economic activity through facility operations.

Social Pillar

- Goals: promote social cohesion and return to normal life, rebuild public trust in decision-making processes, protect physical and mental health of affected populations.

Discussion (2)

Transversal issues

- Ethical values (cross cutting), main concerns related to:
  - Intergenerational justice: avoid passing risks to future generations & addressing disposal of remediation wastes
  - Transparency: to ensure access to information and justification of decisions, also for participatory processes
  - Responsibility: considering long-term consequences of such actions.

- Main radiation protection challenges
  - Limiting exposure to humans and the environment by design, and monitoring
  - Justifying acceptable exposure levels in recycling, storage and disposal strategies.
  - Justifying decontamination targets, presenting clear and transparent exposure scenarios

Topics to be further investigated

- Mechanisms to help stakeholder participation and public trust
- Aligning waste management with circular economy principles
- Balancing technical feasibility and social acceptability

Thank you for your attention !