



International Atomic Energy Agency

Remediation related activities and tasks related to R&D on off-site activities

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- Remediation. Main concepts, principles and key issues
- Situation in Japan
 - ✓ Affected areas
 - ✓ The remediation process and plans
 - ✓ Main challenges
- IAEA activities
- Summary

Understanding what remediation is about

What is remediation?

Any measures that may be carried out to **reduce the *radiation exposure*** due to existing *contamination* of land areas through actions applied to the *contamination* itself (the *source*) or to the *exposure pathways* to humans.

- ✓ Complete removal of the contamination is not implied

(IAEA Safety Standards No. GSR Part 3)

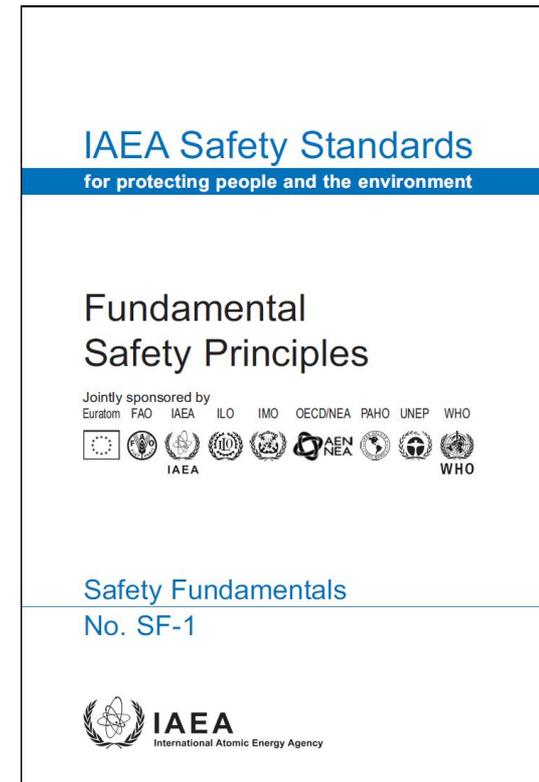
Remediation: Fundamental Safety Principles

(No. SF-1, 2006)

Principle 10:

Protective actions to reduce **existing or unregulated** radiation risks must be **justified** and **optimized**

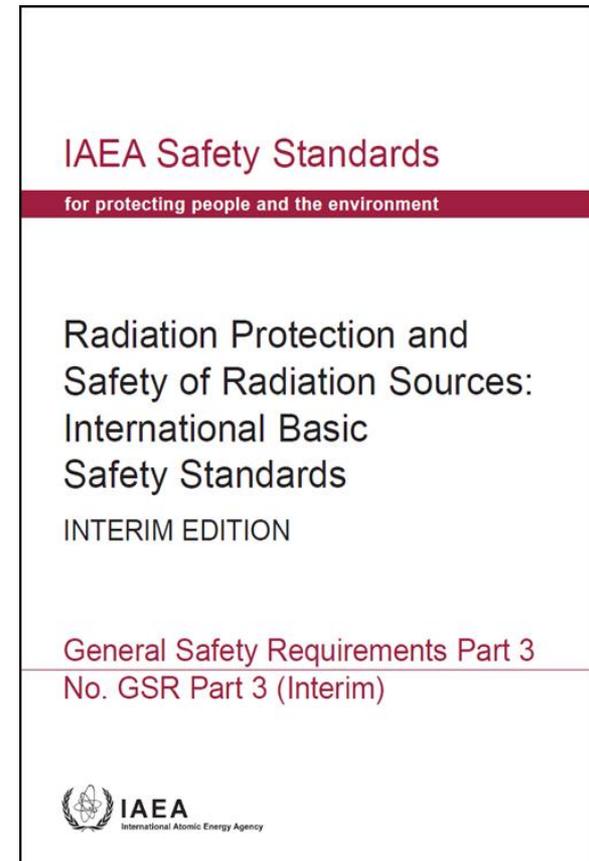
- Radiation risks may arise in situations other than in facilities and activities that are in compliance with regulatory control.
- In such situations, if the radiation risks are relatively high, consideration has to be given
 - ✓ to whether protective actions can reasonably be taken to reduce radiation exposures, and
 - ✓ to remediate adverse conditions



IAEA Safety Requirements for Remediation (2011)

The safety requirements for remediation are now found in the new **IAEA International Basic Safety Standards**

- Integration of Recommendations in ICRP 103 (2007)
- Approval by the IAEA Board of Governors (Sept. 2011)
- Replaces BSS (1996)



Key issues for remediation in the IBSS

- **Defines responsibilities**
 - ✓ Government
 - ✓ Regulatory body
- **Application of radiation protection principles**
 - ✓ Justification & Optimization
- **Responsible organizations**
 - ✓ Establishing and implementing remediation programmes and post-remediation controls
 - ✓ Strategy for radioactive waste management

The Principles for Remediation

- **Justification** → Protection strategy is commensurate with radiological risks and benefits of remedial actions outweigh detriments associated with taken them
- **Optimization** → The form, scale and duration of remedial actions are optimized (*Residual doses should be as low as reasonably achievable, with economic, societal and environmental factors taken into account*)
 - ✓ Priorities for groups with individual residual doses exceeding relevant Reference Levels
 - ✓ Reference Levels: Annual Effective Dose for the representative person: **1-20 mSv/a**

Important to understand

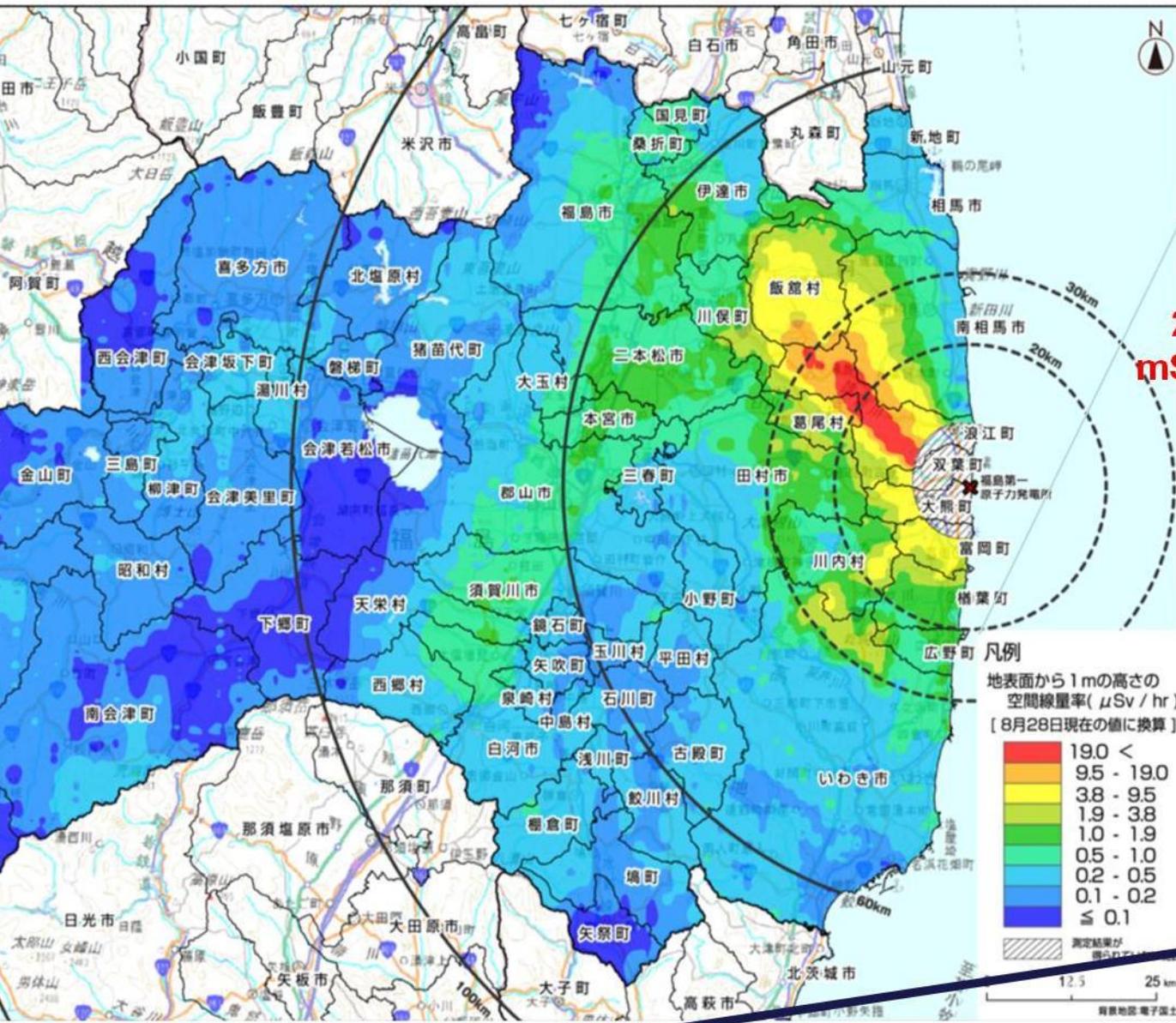
- **According to radiation protection standards**
 - ✓ Remediation does not imply the elimination of all radioactivity (maybe not justified)
 - ✓ Restoration of previous conditions may not be the optimal solution either
- **Important:**
 - The terms *rehabilitation* and *restoration* may imply that the conditions that prevailed before the *contamination* can be achieved again, which is not normally the case. Their use is discouraged by the IAEA.
 - The more informal term *clean-up* is also used. It should be used with the same meaning as *remediation*
 - Important terms: ***Dose, dose reduction, residual dose...***

Therefore...

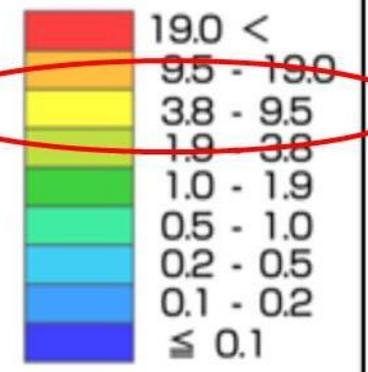
- Remediation is a result of a balance between objective elements (exposure, costs, etc.) and subjective elements (public perception, anxiety, political pressure, etc.)
- Achieving an optimal result is not easy and will depend on the level of public understanding and acceptance of the information given.

The situation in Japan

Monitoring results (Air dose rate)

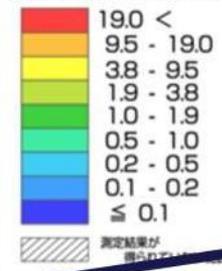


凡例
 地表面から1mの高さの
 空間線量率($\mu\text{Sv} / \text{hr}$)
 [8月28日現在の値に換算]



20
mSv/y

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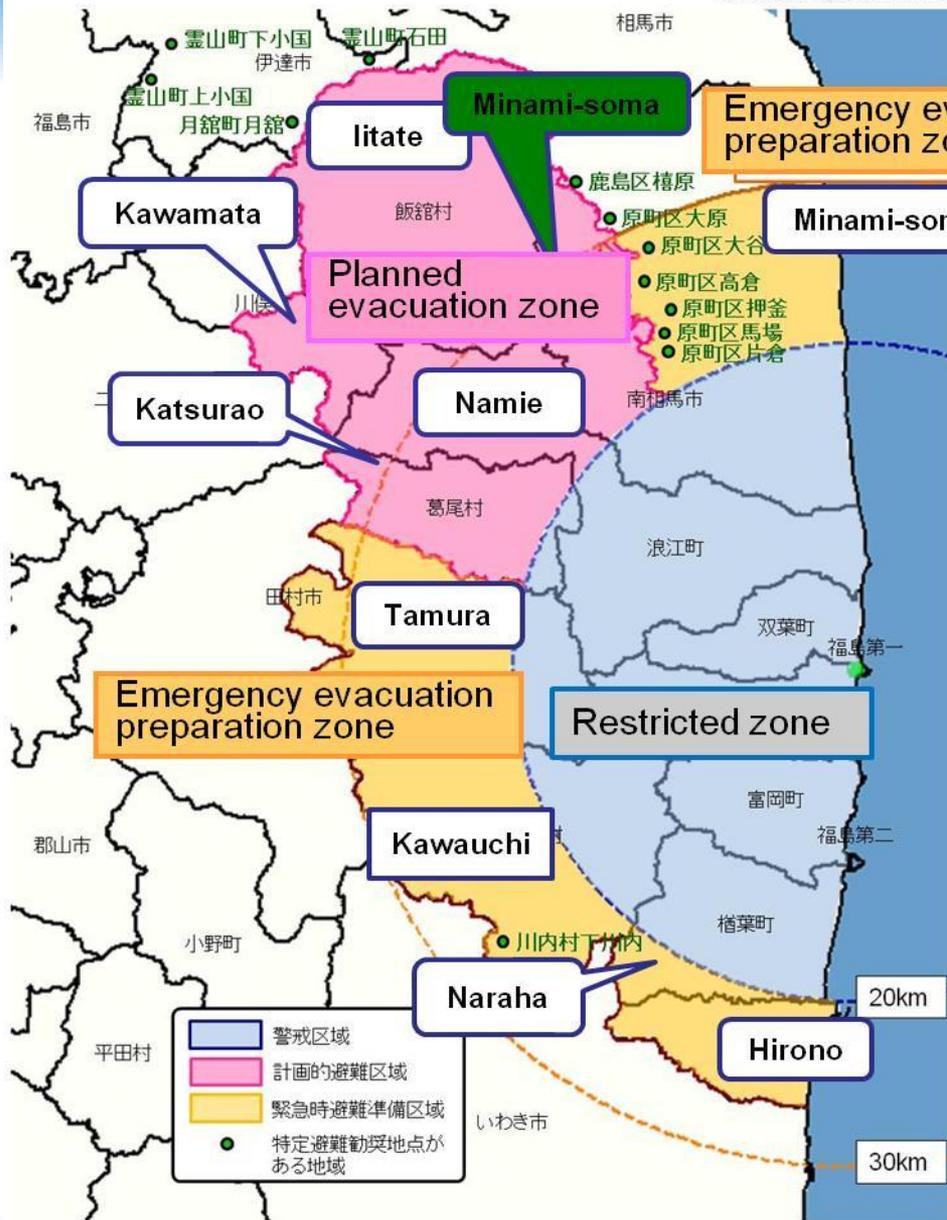


- 75% Forest
- 10% Agricultural
- 10% Rice
- 5% Urban

* Based on airborne monitoring survey by MEXT (published on Sept. 12, 2011)

1000 km² > 20 mSv/y

1800 km² > 5 mSv/y



● Hot spots

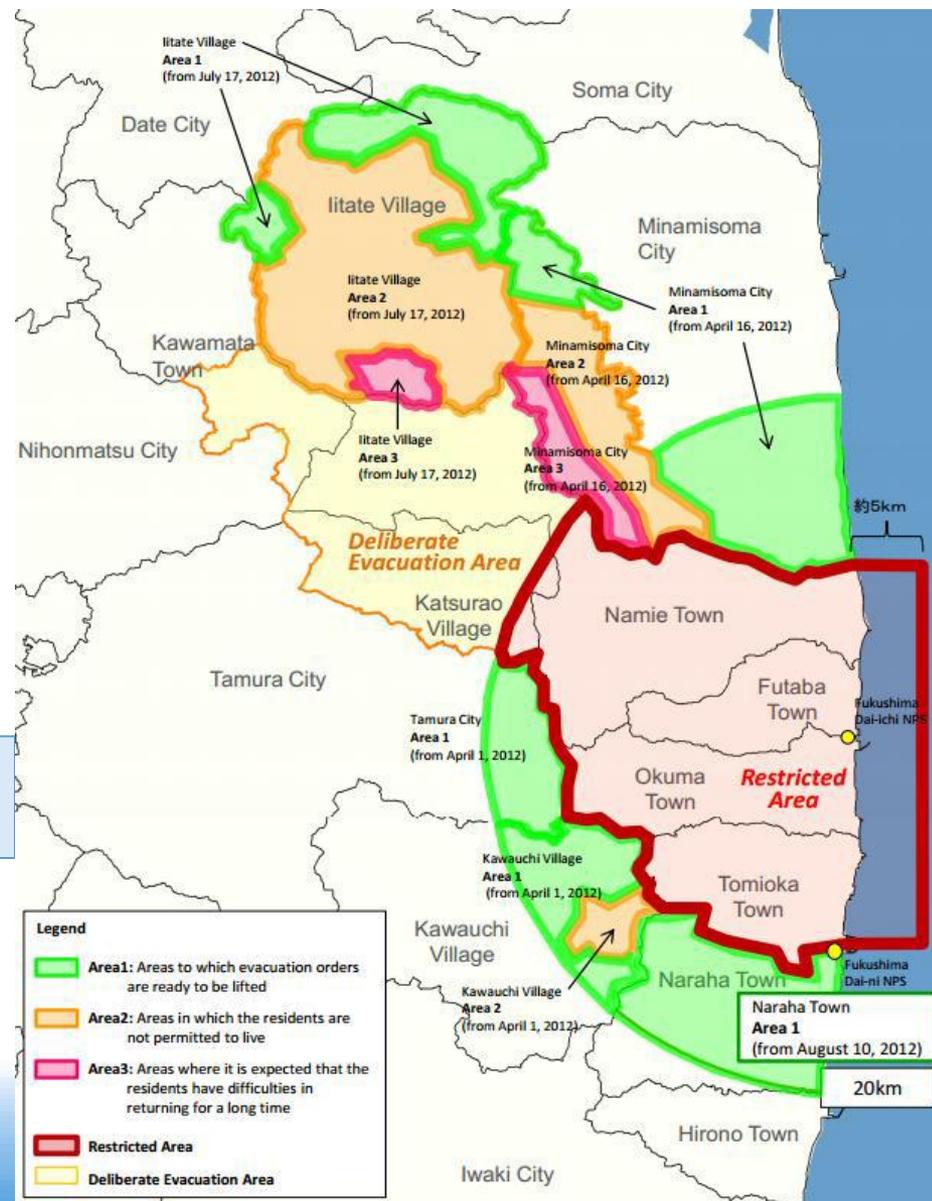
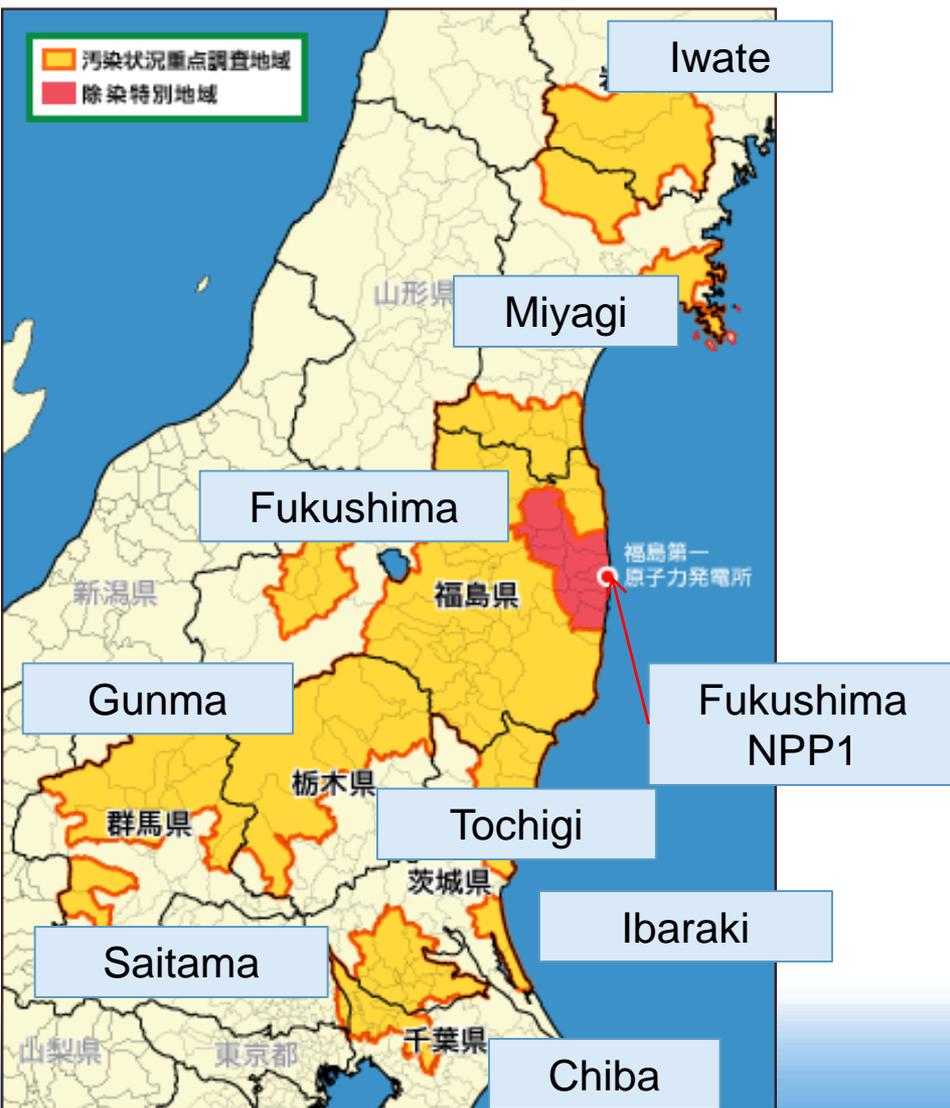
Zones	Population (thousands)
Restricted zone	78
Planned evacuation zone	10
Emergency evacuation preparation zone (Lifted on September 30.)	58
Total	150

Existing Exposure Situation

Government strategy for remediation

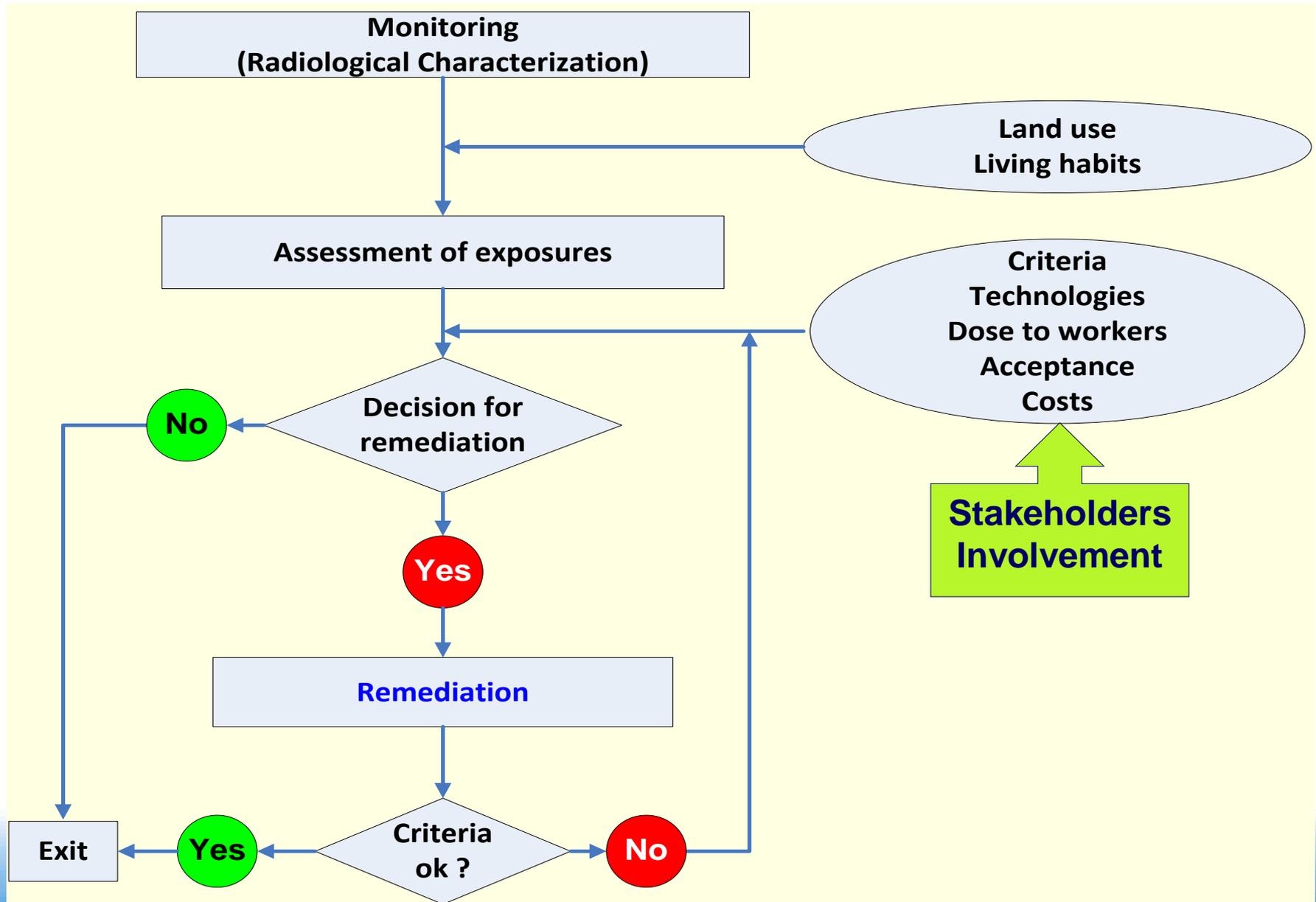
- Reduce size of the areas where annual dose is above 20 mSv/y (graded approach)
- Reduce exposure in the areas where it is currently between less than 20 mSv/y to 1 mSv/y or less
 - ✓ General public → Reduce estimated annual exposure by 50% in 2 years (by Aug 2013)
 - ✓ Children → Reduce estimated annual exposure of children by 60% in 2 years (by Aug 2013) by thorough remediation of their living environment
- Areas with exposure below 1 mSv/y, concentrate activities in hot spots

Classification of affected areas



The remediation process

Remediation – An iterative process



Remedial actions

- **External exposure**

- ✓ Activity removal
 - Roofs, walls, streets, gardens, soil
- ✓ Soil mixing

- **Internal exposure**

- ✓ Agricultural measures (ploughing, fertilizer, modification of practices)
- ✓ Change of living habits
- ✓ Prevention of dust (if applicable)

- **Feasibility, side effects and costs**

Examples of Remedial Actions

Buildings



Asphalt



Concrete



Soil – Top Soil Removal



Trees and Forest



**As a result of the
decontamination activities...**

Implications of Remediation Activities

- Almost all remedial actions, especially those involving decontamination, will **generate wastes** that need to be properly managed.
- Estimated volume of contaminated material in Fukushima Prefecture from clean-up lies in the range of 5 to 20 million m³ (being the largest amount agricultural soils totalling 17.4 million m³).
- The tsunami also dumped 2.9 million tons of debris in Fukushima Prefecture.

General strategy for safe management of waste

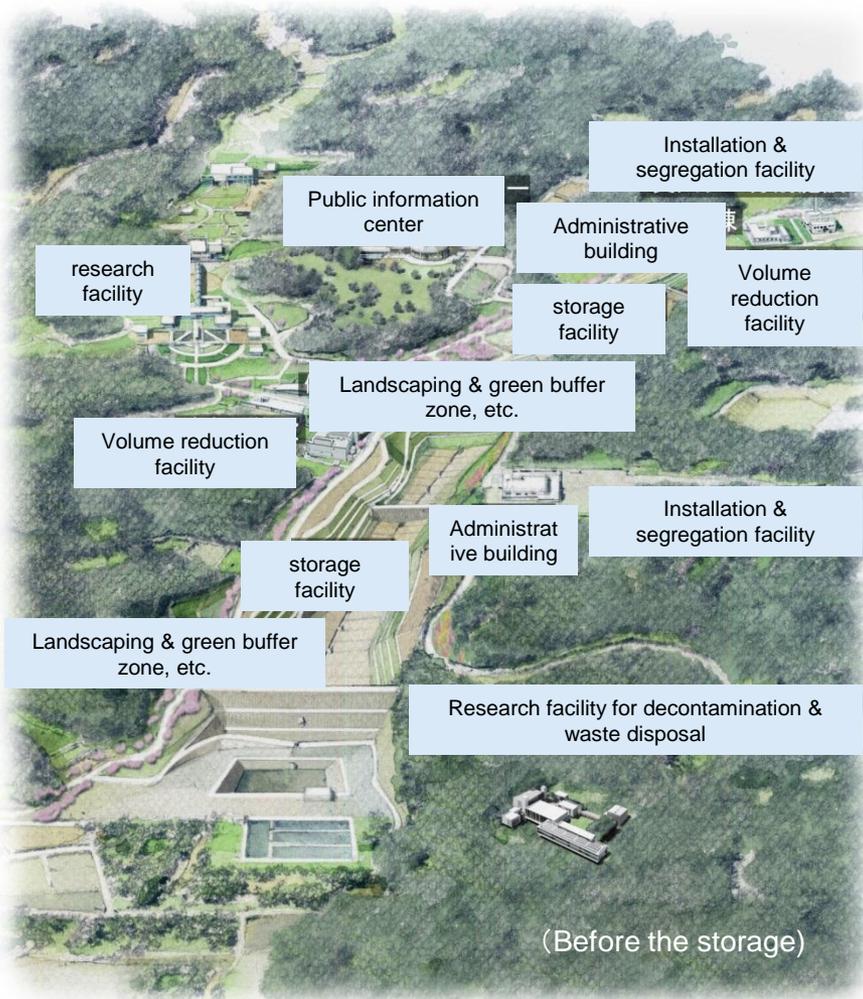
Application of a graded approach

- ✓ Measures have to be commensurate with the associated risk
- ✓ Adaptation of regulatory requirements and licensing process

- Clearance (including conditional clearance)
- Segregation
- Characterization
- Conditioning
 - ✓ Concentration
 - ✓ Containment
- Storage pending disposal
- Disposal

Interdependencies between all steps must be considered

Overview of the Interim Storage Concept



❖ This picture illustrates envisaged facilities and structures at this moment, and is subject to change in the future.

Mission on remediation

Main conclusions: Important progress

- Main basis of the remediation programme
 - ✓ Legal, economic and technological resources to develop an efficient remediation programme
 - ✓ RP basis in line with ICRP recommendations and IAEA standards
 - ✓ Priority to children. More than 400 schools already remediated by volunteers
- Demonstration projects & Fukushima Decontamination Promotion Team

Schoolyard



Side of the road



Mission on remediation

Main conclusions: Advice for enhancing Remediation Prog.

➤ Room for optimization

- Avoid over-conservatism. Use more realistic criteria.
 - ✓ Agricultural areas (transfer factors)
 - ✓ Forest (safety assessments before investing efforts and time)
- Focus information to public on “**dose reduction**” to avoid population only concerned with “contamination”

➤ Waste management

- Lack of real sites for storage and disposal. Lack of public acceptance
- Lack of optimisation in waste classification and over-conservative “clearance-levels” for very-low contaminated materials



Challenges

Challenges for Japan (1/2)

- Enhance practical application of optimization.
Stakeholder involvement
- Manage the wastes generated during remediation
 - ✓ Siting and Construction of Interim Storage Facility (s)
 - ✓ Siting and Construction of the final disposal facility

Challenges for Japan (2/2)

- Seek for more efficient/effective technologies for decontamination from the perspective of cost, time, etc. through demonstration project and R&D (incl. soil / waste minimization and volume reduction)
- Promote public communication for securing temporary storage sites, interim storage facilities, and final disposal facility
- Research on the behaviour and environmental fate of Caesium, including the development of environmental transfer models

Challenges for the International Community

- Have Policy and Strategies established for remediation of contaminated areas
- Coordinate remediation plans with emergency response plans
- Development of strategies for stakeholder involvement and communication in the remediation of contaminated areas
- Improve methods for remediation decision making process

What the IAEA is doing?

Nuclear Safety Action Plan

1. Safety assessments in the light of the accident at Fukushima Daiichi NPP
2. IAEA peer reviews
3. Emergency preparedness and response
4. National regulatory bodies
5. Operating organizations
6. IAEA Safety Standards
7. International legal framework
8. Member States planning to embark on a nuclear power programme
9. Capacity building
10. Protection of people and the environment from ionizing radiation
11. Communication and information dissemination
12. Research and development.



Nuclear Safety Action Plan

NSAP activities on off-site remediation, decommissioning and RAW management are as follows:

- Preparation of report on the experience and lessons learned worldwide in clean-up and decommissioning of nuclear facilities in the aftermath of accidents (on-going);
- Organization of International Experts' Meeting on decommissioning and remediation after a nuclear accident (28 January – 1 February 2013);
- Support of MSs in developing their competence in the selection and use of technologies for characterization and remediation of sites affected by nuclear and radiological accidents (on-going);
- To collect experience on approaches, techniques, tools and equipment to deal with **clean-up, decontamination** and decommissioning after an accident (planned for 2013);
- To initiate a project on clean-up and decommissioning of nuclear facilities in the light of the lessons learned from Fukushima (by 2013-2014);
- To collect experience and lessons learned on management of accidental waste (2013+).

Nuclear Safety Action Plan

NSAP activities on off-site remediation (cont.):

- To review the current strategies for monitoring the environment, food and people to facilitate dose assessment and decision-making on countermeasures and remediation (on-going);
- To develop remediation strategies in urban and rural areas for a wide range of environmental conditions (by December 2013);
- To encourage MSs to share information on existing monitoring networks and programmes and experience with management of contaminated land from previous accidents and past practices;
- To produce a technical report on recommendations for establishing monitoring networks and programmes for the management of contaminated land from previous accidents and past practices (by December 2013).



Modelling and Data for Radiological Impact Assessment (MODARIA)

- Launched in Vienna from 19-22 November
- 10 active working groups
- Main topics
 - Remediation strategies and decision aiding techniques
 - ✓ Agricultural and urban areas
 - ✓ NORM and nuclear legacy sites
 - Transfer data for assessment of radiological impacts
 - Uncertainty associated with radiological impact assessments
 - Biosphere modelling for radioactive waste disposal facilities
 - Exposure models for accidental tritium releases
 - Exposures and effects to flora and fauna
 - Dispersion of radionuclides in the marine environment

International Experts' Meeting on decommissioning and remediation after a nuclear accident

The objective of the IEM is to assist MS to prepare for and to be able to manage the consequences resulting from a nuclear accident.

Meeting will focus on the technical, societal, environmental and economic issues to be considered for decommissioning and remediation activities after a nuclear accident.

Target groups of participants are decision makers, regulators, operators, contractors and TSOs responsible for these issues.

International Experts' Meeting on
**Decommissioning and Remediation
after a Nuclear Accident**



IAEA Action Plan on Nuclear Safety

IAEA Headquarters

28 January – 1 February 2013

Vienna, Austria

Summary

- Remediation is to **reduce radiation exposure** in existing exposure situations. Relevant IAEA Safety Standards
- Remediation actions to be **justified** and **optimized**
- Reference levels for optimization processes
- Situation in Japan
 - ✓ Contaminated Areas
 - ✓ Remediation programme. Room for better optimization
 - ✓ Need for real facilities for interim storage and for disposal of radioactive wastes
- Nuclear Safety Action Plan
 - ✓ To promote further development of nuclear safety
 - ✓ Specific issues related to Radiation Protection and to Remediation



Thank you!

