Overview of the Results of the Decontamination Model Projects

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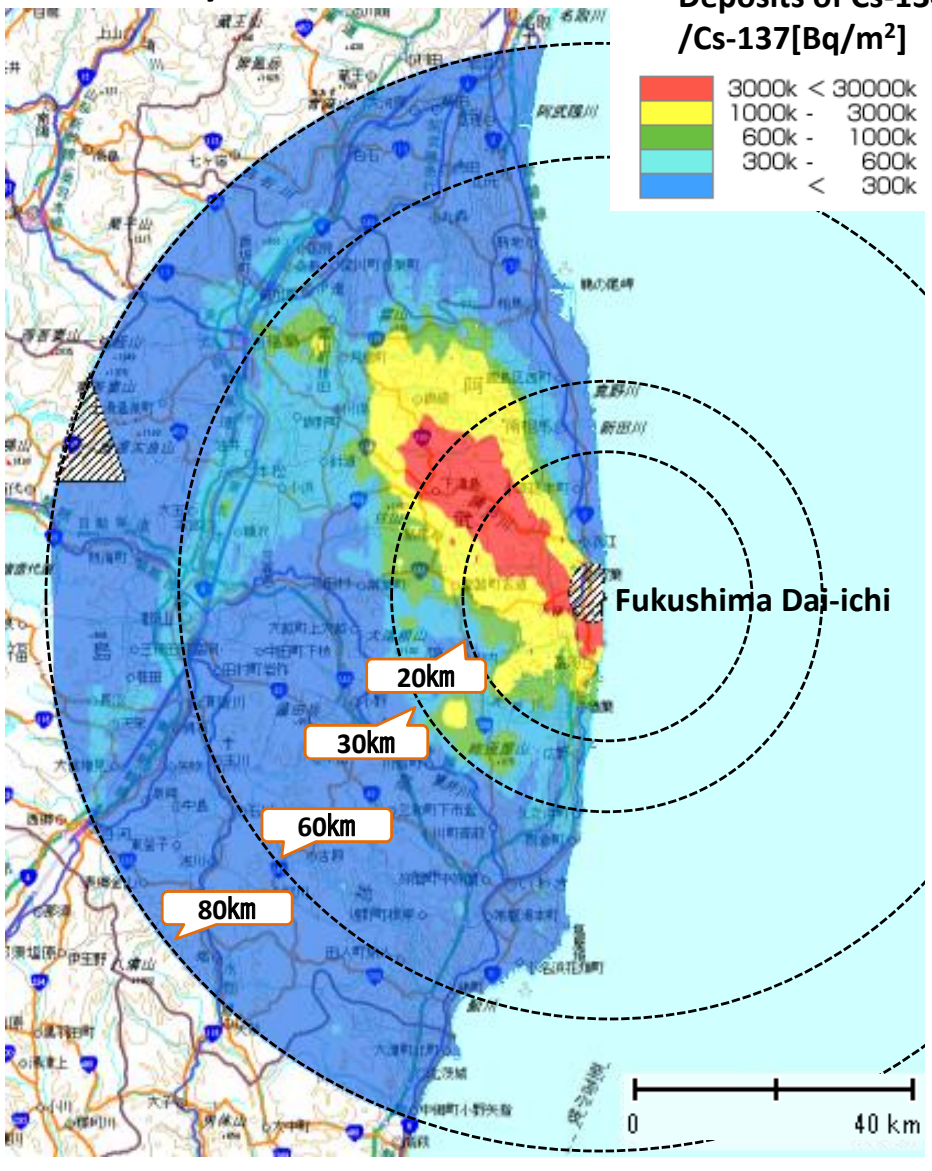
Fukushima regional contamination

- Off-site contamination mainly volatiles: initially concern focused on shorter-lived I isotopes ➔ evacuation and restriction of consumption of some foodstuffs
- After decay of shorter-lived isotopes, now dominated by Cs-134/-137 which is the focus for cleanup actions
- Cs tends to bind strongly to surfaces, especially clays. Doses are generally low and continually reduced by washoff / soil mixing.

Cumulate deposits of Cesium (Cs-134 and Cs-137) estimated by MEXT



Fukushima remediation overview

- A wide range of focused clean-up projects were rapidly initiated by municipalities and local communities for sensitive areas (schools, playgrounds, …)
- 2 small test projects were initiated by JAEA in August: development and testing of technology (ended in March)
- Further technology demonstrations initiated in November in 11 municipalities, including those in the evacuation zone (ended in July)
- Parallel tests of novel decontamination technology (25 proposals funded) have been completed
- Regional decontamination is presently being initiated

Main Challenges for Implementation of Full-scale Decontamination

Which methods are appropriate?



What are the points to consider when preparing plans and ordering decontamination equipment/services?

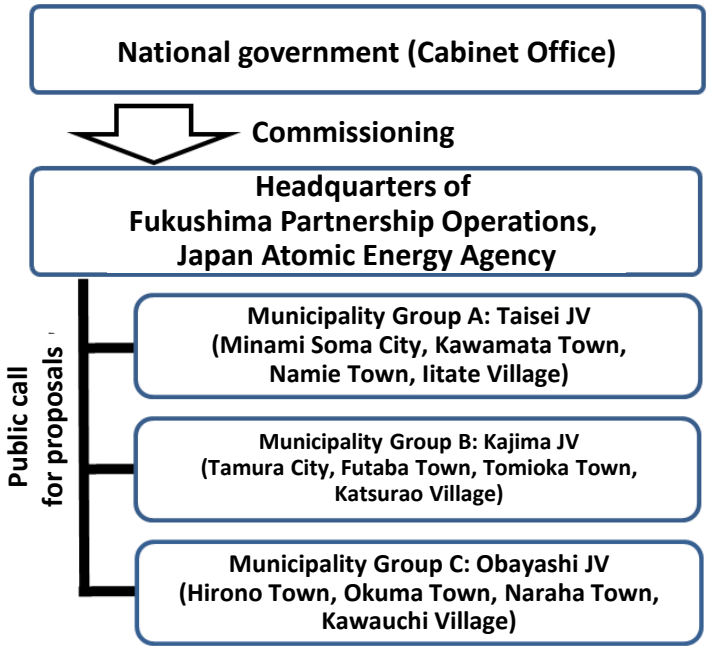

What are the points to check when supervising decontamination work? What know-how should be used for decontamination work?



Is it possible to apply new technology?

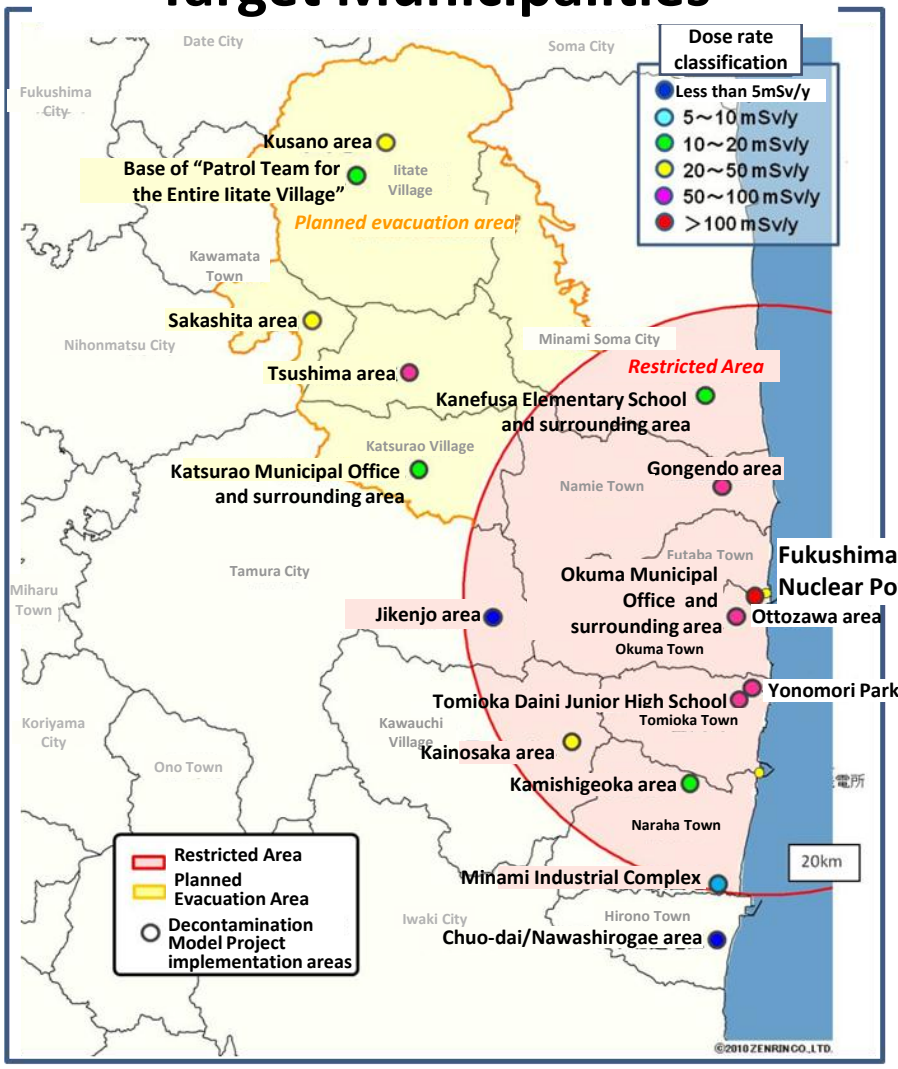
- There was little organised quantitative information based on actual data (cleanup effectiveness, costs, volumes of wastes generated, etc.) that could be used when selecting between various alternatives for decontamination, waste transport and storage methods
- There was little documented guidance on decontamination for local governments, local residents and private sector companies on how to order decontamination equipment/services
- Possibilities of development and upgrading of new decontamination technologies had not been examined

Implementation Scheme for the Decontamination Model Projects



- **Public call for proposals: Proposals for complete cleanup: including planning, decontamination and evaluation stages were submitted by Joint Ventures (JVs). The 3 JVs shown above were selected after an examination* by JAEA.**
- **Implementation scheme: Each JV implemented its proposed technological activities and JAEA managed, supervised and evaluated the overall program.**
- **Target municipalities: Eleven municipalities in evacuated areas**
- **Sizes of the decontamination target areas: approx. 20ha per target municipality**
- **Total manpower effort for the model projects (excluding employees of JAEA): approx. 87,000 person-days**

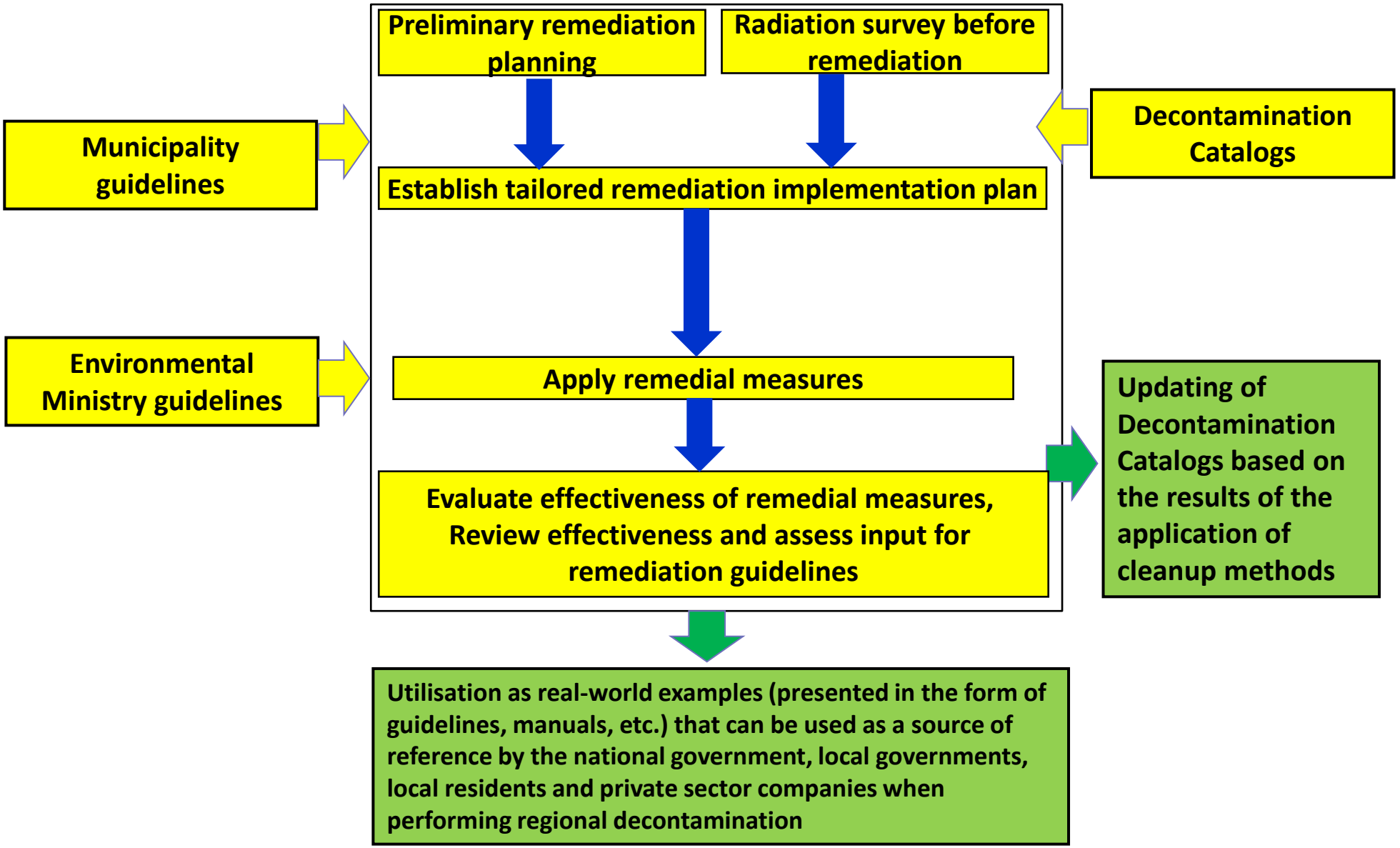
Target Municipalities



Futaba Town has advised us that they would not join the Decontamination Model Project as a target area.

* An examination conducted by a committee appointed by JAEA

Activities within the Decontamination Model Projects

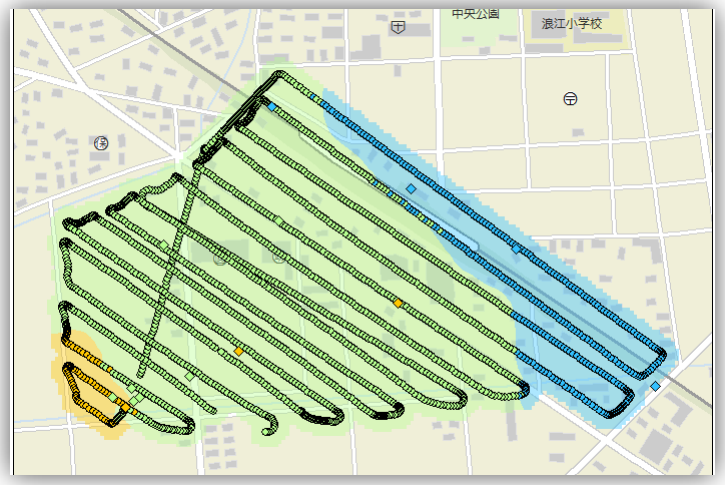


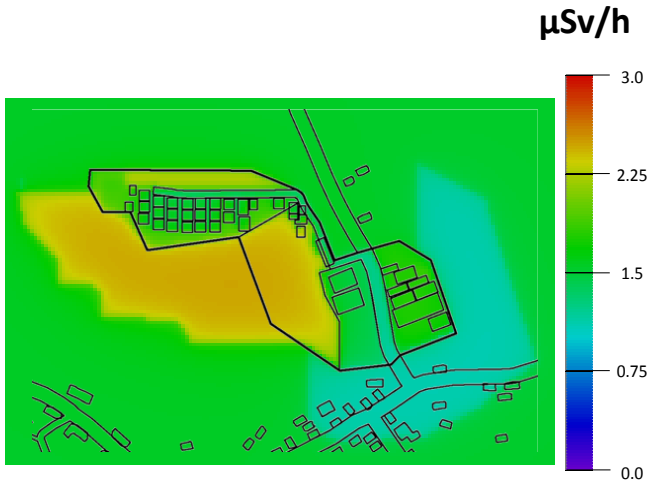
Site characterisation

- Measurement approaches involved modification of existing technology and development of new methods
- When linked to appropriate data loggers, these provided rapid and user-friendly maps of radionuclide distributions

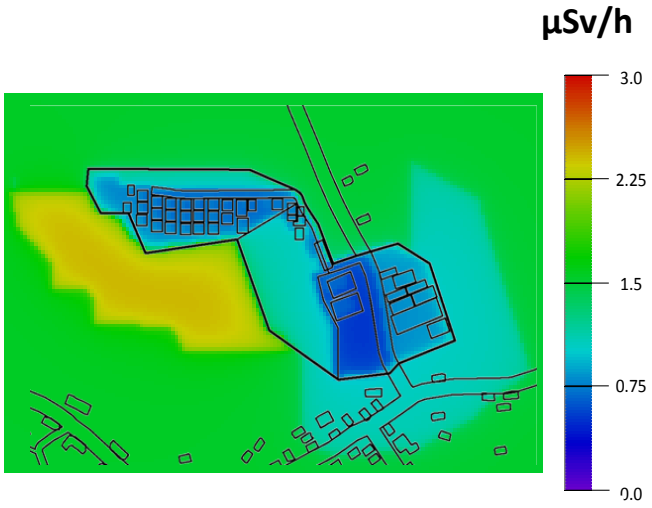
Data interpretation & synthesis

- Maps were particularly useful to guide remediation planning
- Depth profiles allowed assessment of benefits of different soil remediation approaches
- Options could be assessed using a model to predict effective dose reduction

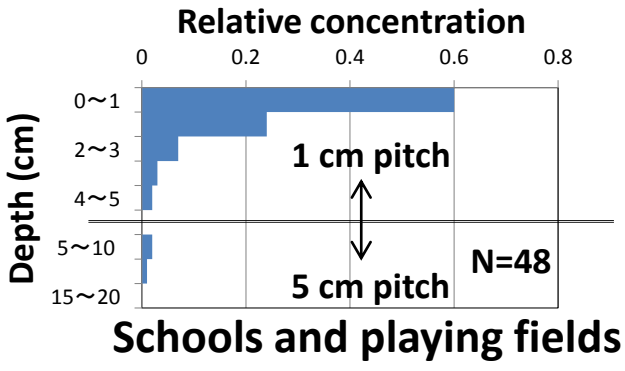




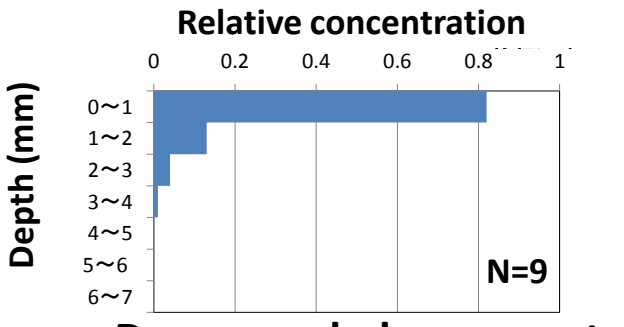
Dose rate before clean-up based on monitoring results



Dose rate after clean-up based on a model prediction



Schools and playing fields



Dense-graded pavements

Clean-up technology

- Although the majority of the effort involved manual washing and contaminated material removal using conventional technology, methods that might improve decontamination while decreasing volumes of waste were tested
- Radiation dose of clean-up workers was strictly controlled and always remained low (within the specified upper dose limit)

Scheduling of Decontamination

Forest decontamination

Farmland decontamination

Decontamination of playing fields and large buildings

Decontamination of residential houses

Decontamination of roads

Clean-up of Trees and Forest

removing and replacing hotspot soil

clipping

clipping

removing humus layer

water jet

Clean-up of Farmland

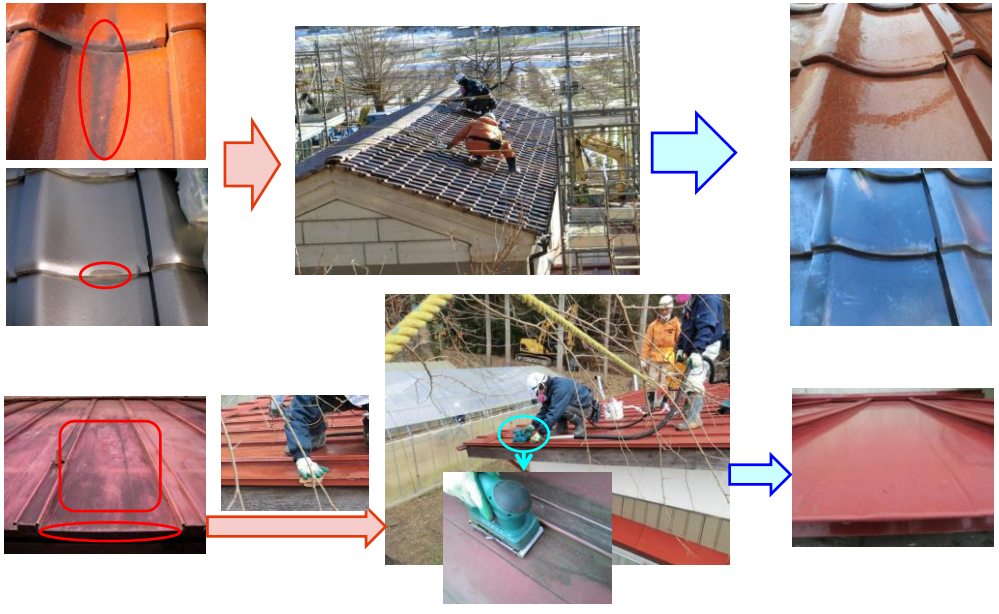
- ploughing

- turf stripping

- topsoil removal

Clean-up of Buildings

Pressure washing roofs



Wiping and grinding roofs

Cleaning gutters

Removing drainage hotspots

Stripping roof surfaces

Clean-up of Paving and Surfaces

high pressure water

road cleaner

surface stripping

blasting

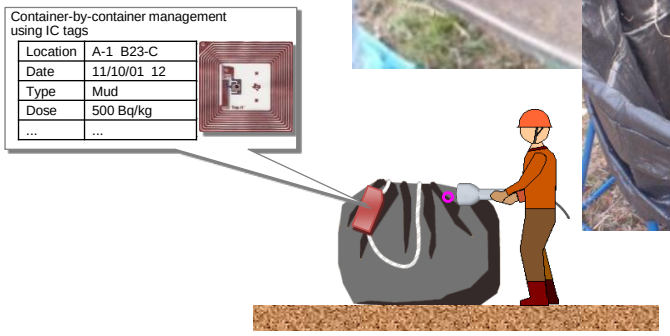
Iron shot blasting

Ice blasting

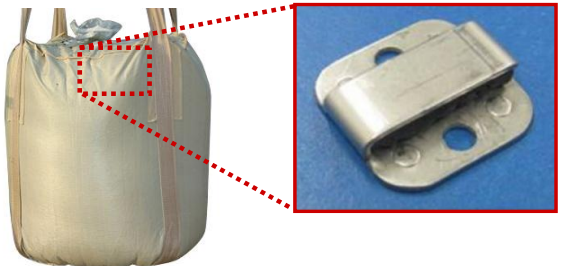
Waste handling

- Waste was reduced in volume to the maximum extent possible – e.g. grinding / chipping of foliage, concentration of radioactivity from contaminated water, separation of waste by activity level,…
- In most cases, labelled heavy-duty flexible containers were used for solid waste transportation and storage

Measurement of surface dose rates of decontamination waste in the shielding zone



An example of IC tag



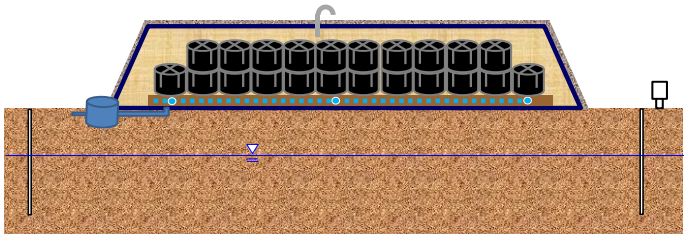
An example of metal tag

An example of paper tag

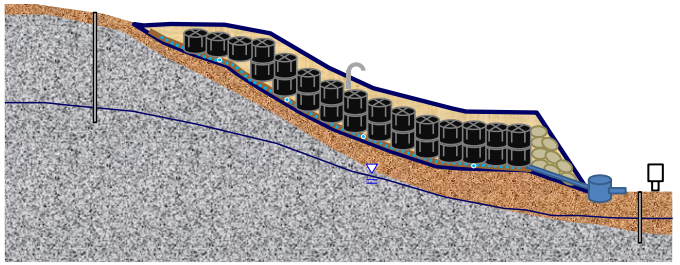
Management of decontamination waste information (tags)

Waste Management

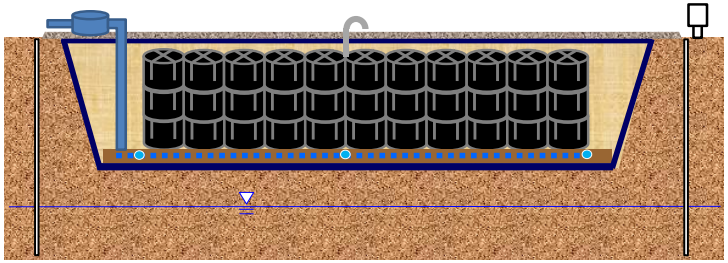
- Locations for temporary storage sites were selected taking into consideration topography, land use status, available areas of land, local government requests, etc., following checks that safety can be ensured
- A range of different approaches were used for temporary storage of waste on the surface or in shallow pits



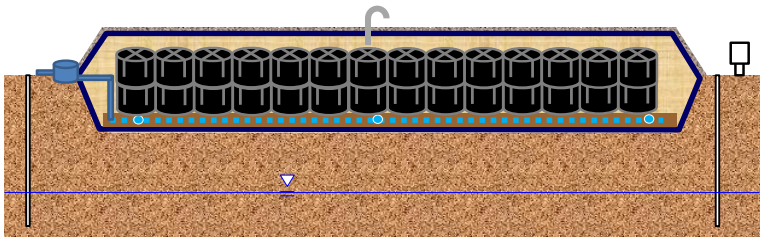
Above ground storage type (on flat ground)



Above ground storage type (on slopes)



Underground storage type

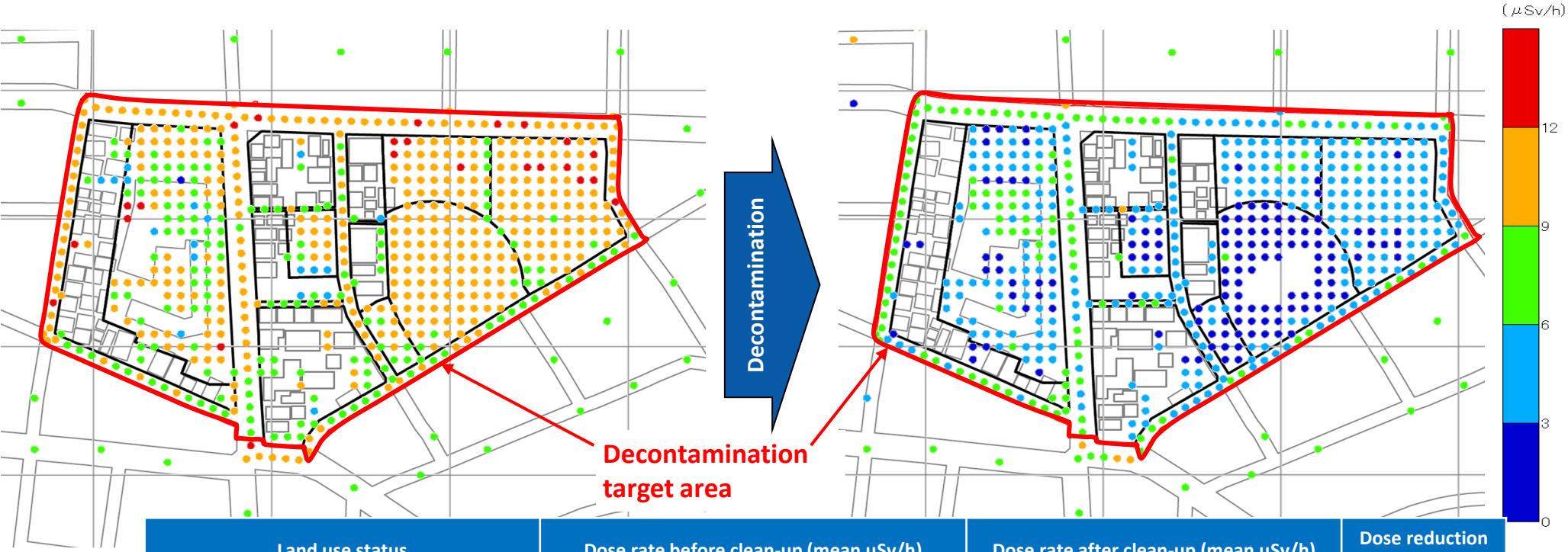


Semi-underground storage type

Results of Dose Reduction by Wide Area Decontamination
[Example Tomioka Town (Yonomori Park area, 9 ha)]

Dose rate before clean-up

Dose rate after clean-up



Land use status	Dose rate before clean-up (mean μSv/h)	Dose rate after clean-up (mean μSv/h)	Dose reduction (%)
Residential area	8	4	50
Large buildings	9	5	50
Playing field	11	2	80
Roads	9	5	40
Forests	10	4	60
Outside the decontamination target area	8	7	10

Results of Dose Reduction by Wide Area Decontamination

- Estimated annual dose reduced to less than 20 mSv/y, for areas with 20 – 30 mSv/y before decontamination
- Estimated annual dose could not be reduced below 20 mSv/y, for areas exceeding 40 mSv/y before decontamination
- In case of agricultural and residential area of Ottozawa, Ohkuma, the dose rate reduced by 70 %. However, estimated annual dose could not be reduced below 50 mSv/y
- The fractional dose rate reduction was smaller in areas of relatively low dose rate, compared with high dose rate areas

Status and Lessons Learned

- The decontamination model projects have provided:
  - Experience and tools for planning and coordinating efficient, safe and cost-effective remediation programmes
  - Evaluation of the applicability of remediation technology with an assessment of the pros and cons of different approaches
  - Guidelines for tailoring of projects to the conditions found in different sites
- Practical experience has shown that stakeholder involvement in implementation of clean-up activities is essential
  - Material for explaining remediation to stakeholders and providing the basis for establishing dialogue with them has been developed

A look to the future

- During future remediation:
  - Experience can be used to constantly update the cleanup knowledge base with the intent of continuous improvement of methodology and toolkits
  - An advanced communication platform can be implemented to facilitate information exchange between all those involved and, in particular , encourage dialogue with local communities and their involvement in decision-making
  - Waste management will be a special focus for R&D to support optimisation in terms of both volume reduction and easing / increasing safety of temporary storage, interim storage and eventual final disposal
- The regional work will:
  - Allow displaced populations to return home to normal lifestyles as quickly as possible
  - Provide the knowledge and experience needed for later decontamination of the Fukushima Dai-ichi site.