U.S. DEPARTMENT OF ENERGY | OFFICE OF ENVIRONMENTAL MANAGEMENT

EPA United States Environmental Protection Agency

Embassy Science Fellows Observations and Recommendations

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SRNL-MS-2013-00103

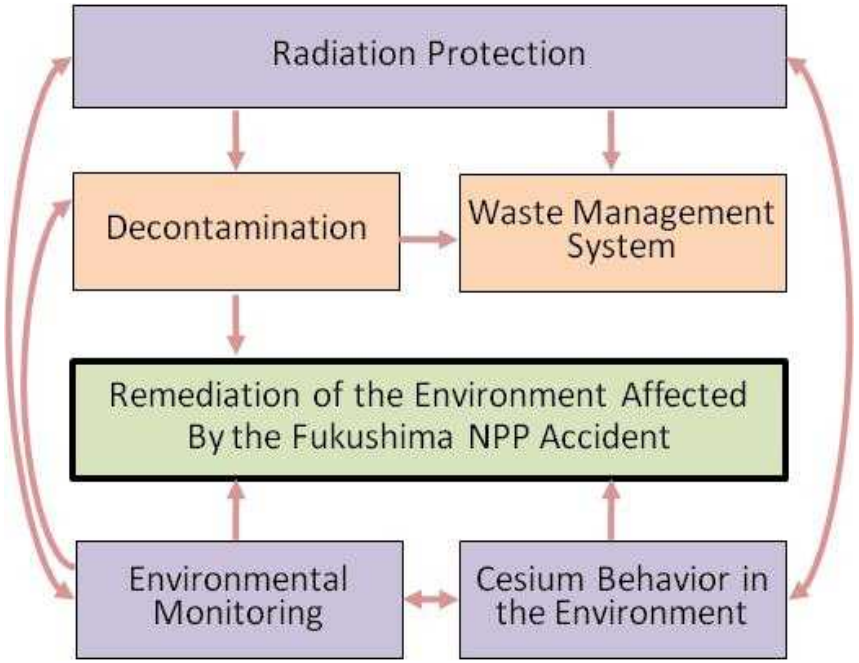
July 18, 2013

ESF Mission Overview

- US State Department's Embassy Science Fellowship Program was used to provide expert support to Japan's Ministry of the Environment (MOE) in its decontamination efforts in areas outside of the Daiichi nuclear plant site.
- Overall intent was to draw upon US DOE and US EPA remediation experience to:
  - Share methods and lessons learned
  - Offer suggestions for enhancing Japan's off-site decontamination efforts, and
  - Identify areas for future collaboration
- Assignment duration: February – March 2013
- Approach:
  - Worked closely with MOE's Decontamination Team
  - Reviewed extensive set of program documents, guidelines, procedures, methods, status, etc.
  - Met with staff from related agencies: Japan Atomic Energy Agency, National Institute for Environmental Studies, Nuclear Regulation Authority, etc.
  - Visited Fukushima Prefecture and municipal government decontamination offices
  - Visited decontamination and waste storage sites in evacuated and non-evacuated areas
  - Met with decontamination contractors carrying out full-scale remediation and demonstration projects

Systems Perspective for Fukushima Offsite Remediation

- System diagram shows key program elements for offsite remediation
- Framework was used by ESFs to organize all aspects of review including formulation of observations and recommendations
- Connections between system elements need to be developed and maintained to enhance overall remediation effectiveness.
- One cross-cutting consideration, public involvement, was identified as a having a significant role in the success of many of these program elements.



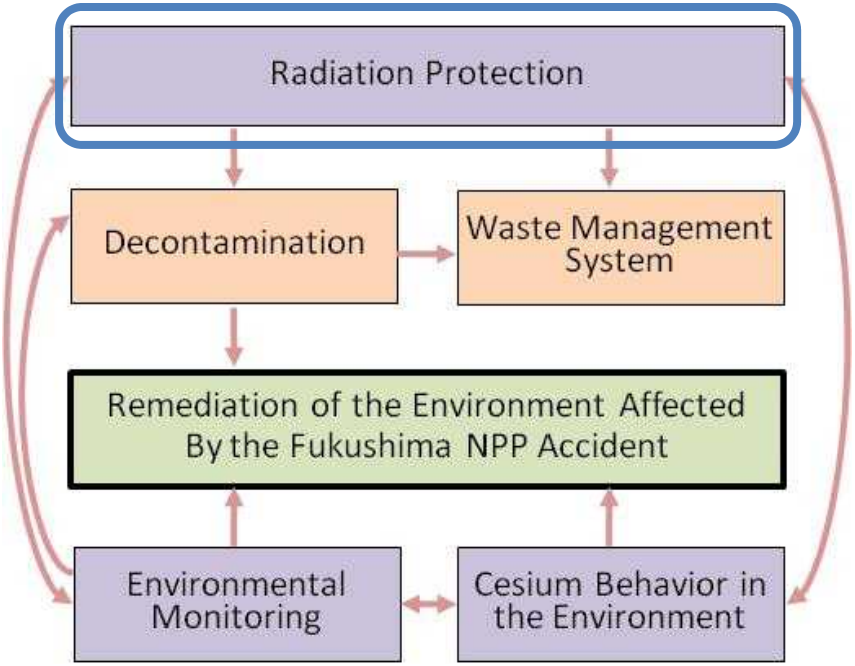
Program Elements for an Environmental Remediation System for a Populated Region Contaminated by Cesium

Presentation Topics

This presentation addresses the following topics regarding each program element of the environmental remediation system plus the cross-cutting consideration:

- Overview
- Key Observations
- Recommendations
- Discussion and Follow-up Topics

Radiation Protection: Overview

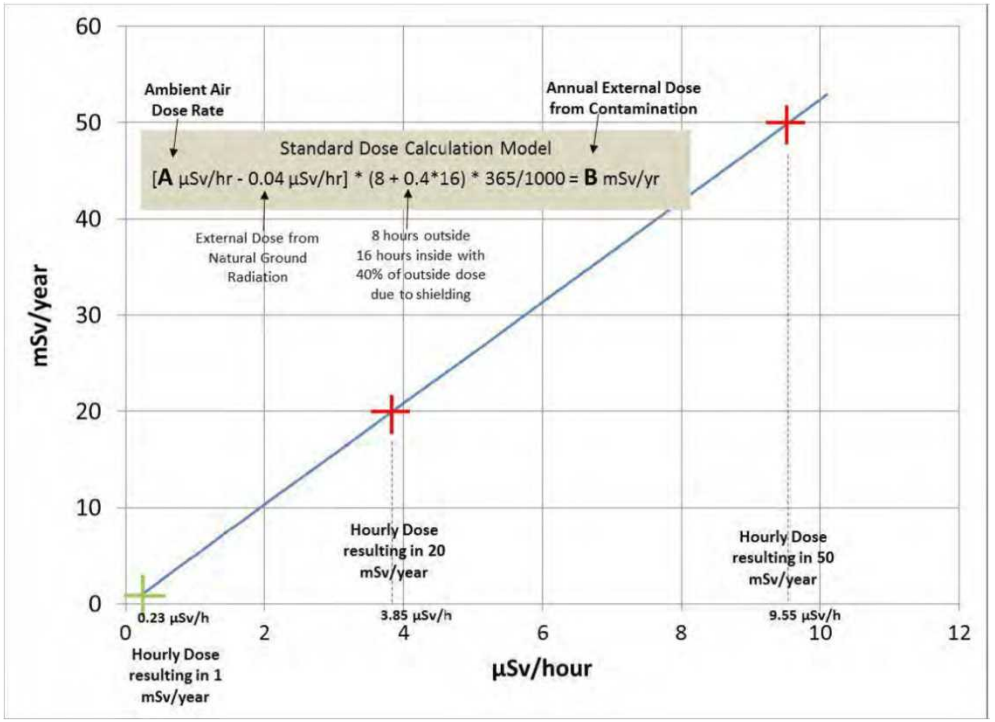


Radiation protection helps to:

- develop practices aimed at protecting people who are living in contaminated regions
- set goals or targets for decontamination activities
- develop guidelines for re-population (or reoccupancy) of currently evacuated areas

Radiation Protection: Key Observations

- The decontamination policy established by MOE to achieve the long-term goal for an effective dose rate of 1 mSv/year or less is the Act on Special Measures.
- The current GOJ model is considered to be too general to apply to specific individuals and lacks the flexibility needed to accommodate the circumstances for various population groups.
- Various programs have been conducted to assess the radiation exposure of the population in the impacted area: Health Management Survey, Whole-body Counting, Children Thyroid Monitoring, Dosimeter Program .



- The national government has developed various information booklets to inform the local governments, stakeholders, and general public on how to reduce further radiation dose under normal living routines.

Radiation Protection: Recommendations

1. Develop repopulation and dose reduction framework and implementation process for application at a community specific level.

2. Establish a radiation dosimetry program for residents who return to evacuated areas to provide the best information possible for understanding and managing population radiation exposure

3. Regularly review environmental monitoring results, dosimetry results and impacts from decontamination efforts to adapt the framework in Recommendation #1.

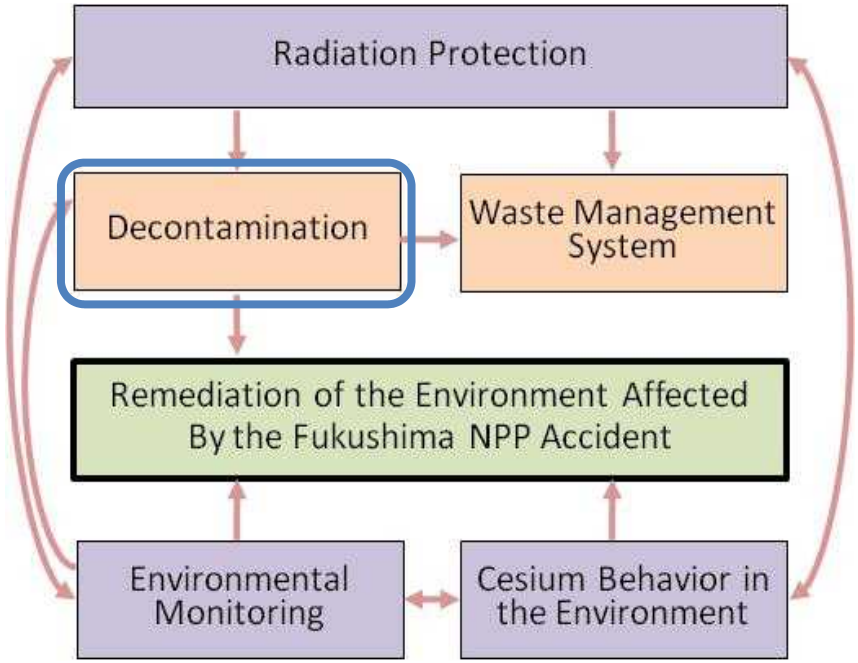
4. Establish an Expert Advisory Group on radiation protection to provide technical assistance to prefectural and municipal government officials, and to provide necessary information to the public and stakeholder groups.

Radiation Protection: Discussion and Follow-up Topics

Discussion on GOJ's re-population process for the evacuated area

- Exposure assessment programs: dosimetry program, monitoring strategy, exposure assessment model
- Institutional or engineering controls
- US experiences for developing an expert advisory workgroup and public/ stakeholder workgroup

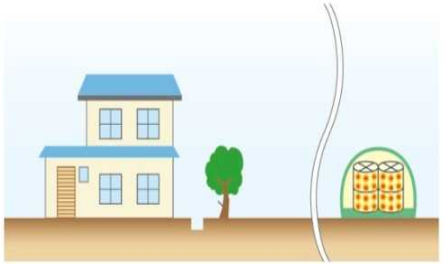
Decontamination: Overview



Decontamination involves:

- development of controlled methods to remove cesium from man-made and natural surfaces
- application of decontamination methods to reduce the air dose rate above the surface

Radioactive materials settled on soil, vegetation, and buildings



Radioactive materials consolidated and shielded

Decontamination: Key Observations

- Simple methods have been institutionalized for various surfaces
  - o Buildings – water spray, wipes
  - o Roofs – water spray, wipes
  - o Roads – shot blast, CO_2, high pressure water spray (15 Mpa)
  - o Fields – cut grass
  - o Soils (farmland) – mixing soil or removal
- Forests – remove litter, fell trees, natural attenuation
- Advanced technologies investigated (e.g. soil particle separation), few adopted
- Methods listed in GOJ-MOE Decontamination Guidelines and in Common Specifications
- High variability observed in decontamination effectiveness

Shot-blast cleaning of sidewalk

Decontamination: Recommendations

1. Develop and ensure application of a set of standard protocols for measuring the **effectiveness of decontamination methods (before-after) for all applicable targets** of decontamination (e.g., roads, soil, etc.).

2. Conduct a systematic analysis of the existing performance data to identify potential factors or practices that could improve effectiveness of future decontamination efforts and that identifies situations where specific practices are not likely to be effective.

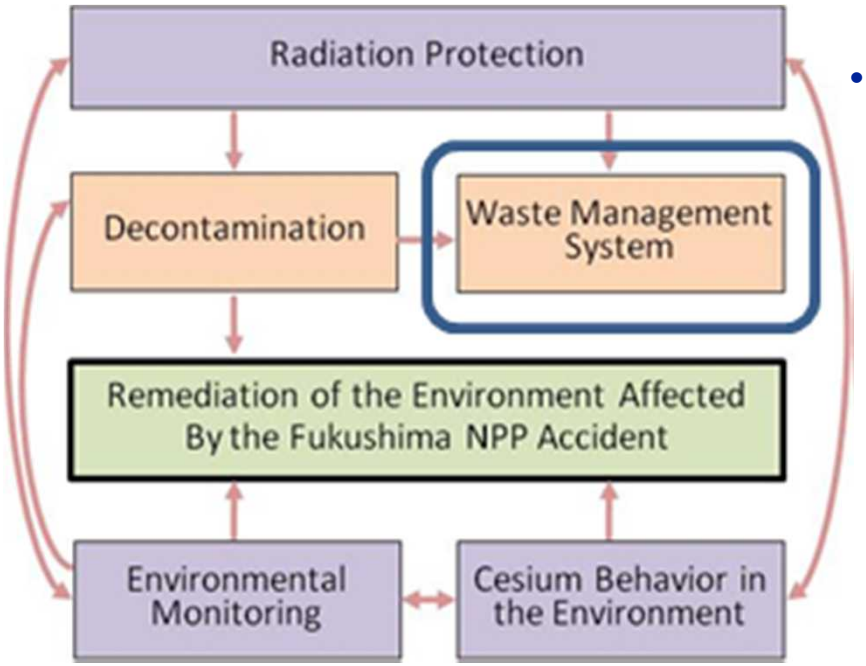
3. Develop and maintain a comprehensive catalog of decontamination technology performance (based on systematic methods for assessing effectiveness).

4. Enhance existing processes for facilitating the development and maturing advanced decontamination technologies.

Decontamination: Discussion and Follow-up Topics

- Discuss advanced decontamination to achieve including volume reductions at clean-up site (e.g. soil washing on in a portable system)
- Discuss approaches for challenging areas of forests, agricultural lands, oceans
- Discuss test beds for advanced decontamination technology for the more intractable decontamination challenges such as forest lands and **agricultural lands. The test-bed provides a readily available area with** representative contamination conditions that can be available to companies, universities, laboratories, or others offering innovative or experimental methods

Waste Management: Overview



- Categories of Waste
  - Contaminated soil and decontamination waste – waste that results from decontamination activities in Fukushima Prefecture, including removed soil
    - 15–30 million m^3 with ~10% combustible
  - Designated waste – Other waste materials > 8,000 Bq/Kg resulting from tsunami/earthquake debris, municipal/industrial sludge, sewage sludge, municipal/industrial incinerator ash, agricultural waste, etc.
    - Outside of Fukushima Prefecture, disposal uses existing or new municipal landfill facilities

- Types of Storage for decontamination waste in Fukushima Prefecture
  - On-site storage – storage at the point of generation
  - Temporary storage – new storage facilities in communities undergoing full-scale decontamination; planned for ~3 years
  - Interim storage -- ~3 facilities planned to consolidate decontamination waste in Fukushima Prefecture; storage up to 30 years before disposal outside of Fukushima Prefecture

- Temporary storage in non-evacuated vs. evacuated areas
  - In non-evacuated areas decontamination work proceeds with or without Temporary Storage
  - In evacuated areas full-scale decontamination requires available Temporary Storage

Waste Management: Key Observations

- Significant delays in the development of temporary and interim storage facilities
- Effective volume reduction methods for some categories of waste are available (e.g., incineration) but there is substantial public opposition
- There is no explicit decision process to evaluate “system wide” treatment methods (e.g., soil washing, incineration, volume reduction, segregation, recycling/reuse) for decontamination waste.
- The estimated volume of decontamination waste to be generated in Fukushima Prefecture has not been updated since 2011.
- There is a lack of an overall inventory or rollup of decontamination waste generation and storage.
- The transportation of decontamination waste from thousands of locations to Interim Storage Facilities is likely to be difficult challenge.

Waste Management: Recommendations

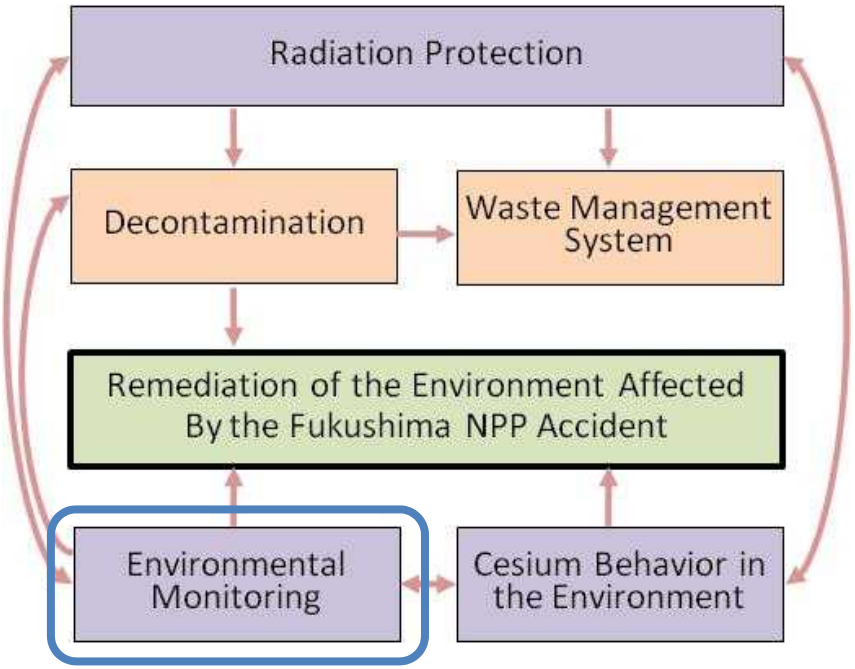
1. Expedite implementation of Temporary Storage Facilities (TSFs) in Intensive Decontamination Survey Areas and in Special Decontamination Areas.
2. Develop a waste inventory forecasting and tracking capability that incorporates a systems approach.
3. Promptly implement modular, expandable Interim Storage Facilities (ISFs).
4. Conduct systematic evaluation of treatment options for stabilization and/or volume reduction of decontamination waste.
5. Develop final disposal standards and regulations for decontamination waste.

Tomioka Town Sports Complex: On-site storage of decontamination waste on a baseball field

Waste Management: Discussion and Follow-up Topics

- Discuss approaches to incorporate volume reduction, soil treatment, etc. into Interim Storage Facility concept
- Technical exchange with US large scale radioactive soil treatment, transportation, storage and disposal operations.
- Discuss pathway for permanent disposal to eliminate multiple waste handling steps and to achieve real remediation progress.

Environmental Monitoring: Overview

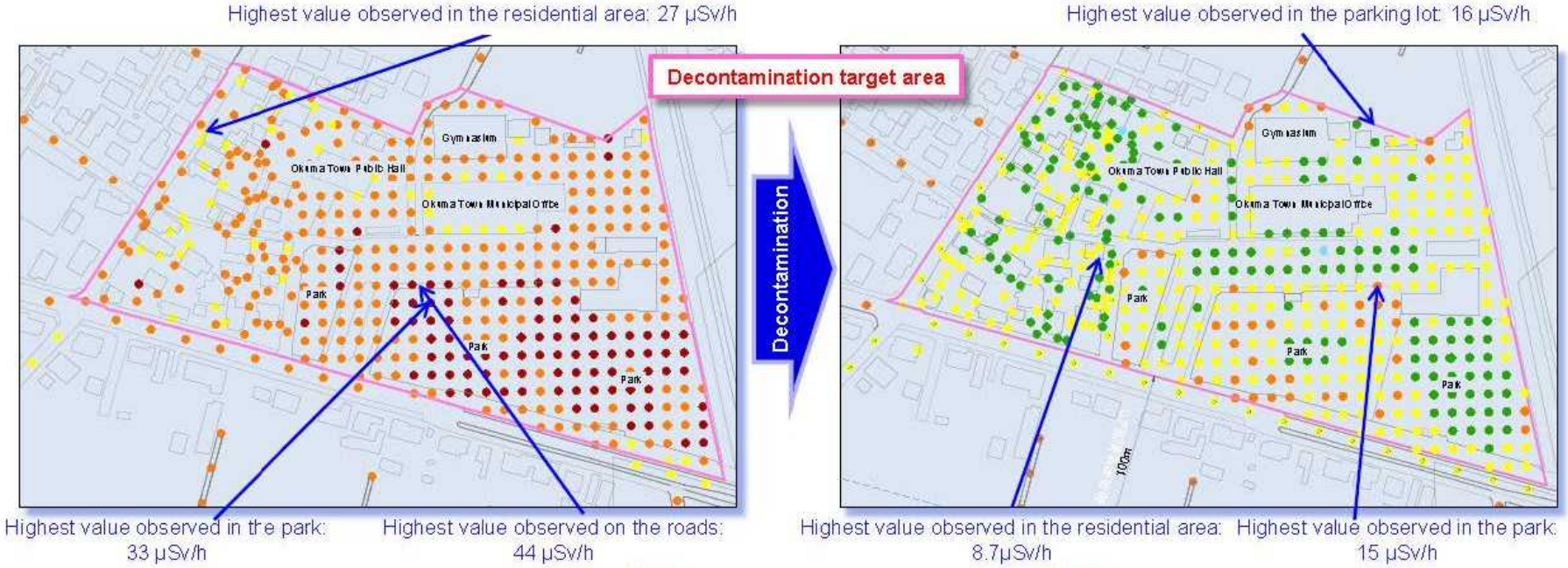


Environmental monitoring supports all other elements of the remediation system

- Feedback on the distribution of contaminants resulting from the accident and on the progress of remediation efforts
- contaminant transport models more representative of actual behavior
- Development of radiation protection strategies for people living in areas with long-term contamination from the accident

Environmental Monitoring: Key Observations

- Nuclear Regulation Authority: nuclear regulation in Japan and overall coordination responsibility for Fukushima-related environmental monitoring
- Multiple monitoring data sets collected by national, prefectural and municipal government entities: more than 10 national agencies and many separate prefecture and municipal agencies
- Multi-agency "Radiation Monitoring Coordination" function to periodically review and update the Comprehensive Radiation Monitoring Plan.



Environmental Monitoring: Recommendations

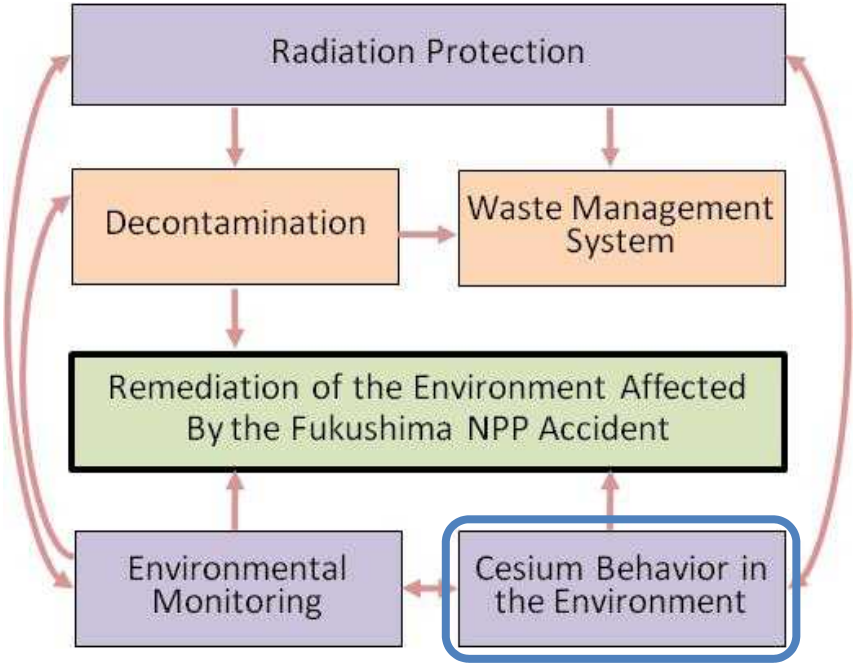
1. Develop and implement an overall environmental monitoring plan that strengthens the linkage between the purpose/need for data and the data collection and management protocols
2. Enhance the data management systems to improve the consistency of data storage methods and accessibility to facilitate visualization and multi-disciplinary data evaluation and analysis
3. Conduct periodic reviews and evaluations of monitoring data to ensure appropriate feedback with other strategic functions including efforts to optimize decontamination strategies, efforts to improve understanding of cesium behavior in the environment, and efforts to optimize the long-term monitoring program

Environmental Monitoring: Discussion and Follow-up Topics

Technical exchange with US for environmental monitoring strategy, experience, available tools, etc.

- Focus collaborative discussions on US sites that have built and maintained comprehensive monitoring programs: Highlight role of conceptual models (understanding of cesium behavior) in defining monitoring activities
- Explore best practices for providing public/open access to monitoring data to improve public understanding
- Focus collaborative reviews of monitoring program elements (are monitoring actions driven by a valid conceptual model?): Marine environment and terrestrial areas subject to accumulation

Cesium Behavior: Overview



- Understanding of cesium behavior in the environment is important for:
  - o predictive characterization of the change in its distribution with time
  - o characterizing the impact on biota
- Use scientific investigations

Cs Behavior: Key Observations

- Sponsored research in:
  - Multimedia environmental monitoring
  - Field monitoring
  - Ecosystem impact evaluation
  - Long-term human exposure estimation
  - Analytic method development (for ultra-sensitive cesium detection)
- Models and analysis supported key findings to date
  - Initial contamination based on prevailing weather
  - Initial hold-up of cesium in the soils
- MOE plan for continued sponsorship of research center

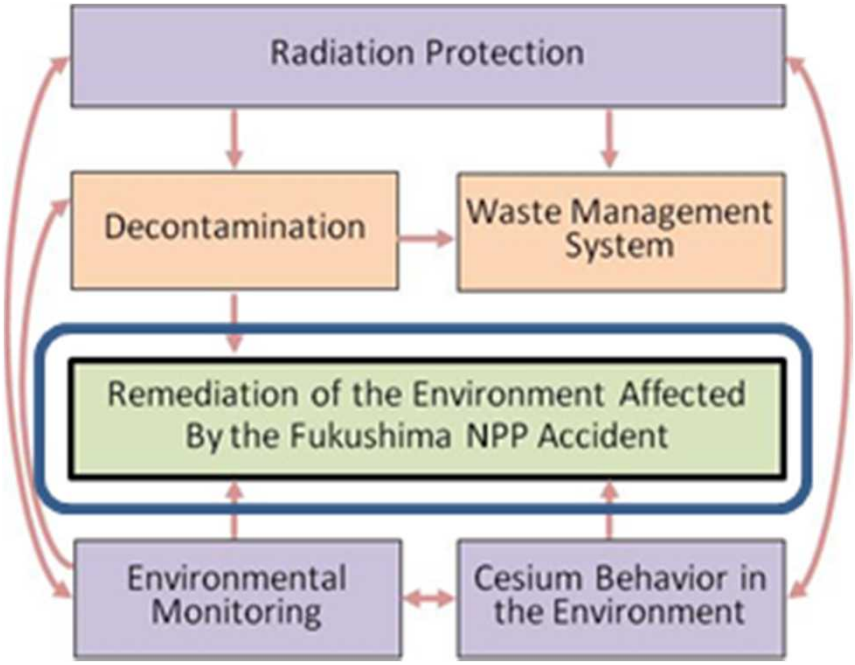
Cs Behavior: Recommendations

1. Continue development of cesium fate and transport models to enhance the ability to predict cesium movement and accumulation in the affected environment
2. Develop and apply models to evaluate and enhance the effectiveness of decontamination strategies and technologies
3. Develop and apply models to inform urgent radiation protection strategies for people living in areas with residual contamination (re-entrainment) and for re-population of evacuated areas
4. Develop and apply models to guide long-term monitoring approaches that will enhance the long-term understanding of cesium (and other contaminants) behavior in the environment
5. Investigate cesium effects on environmental receptors

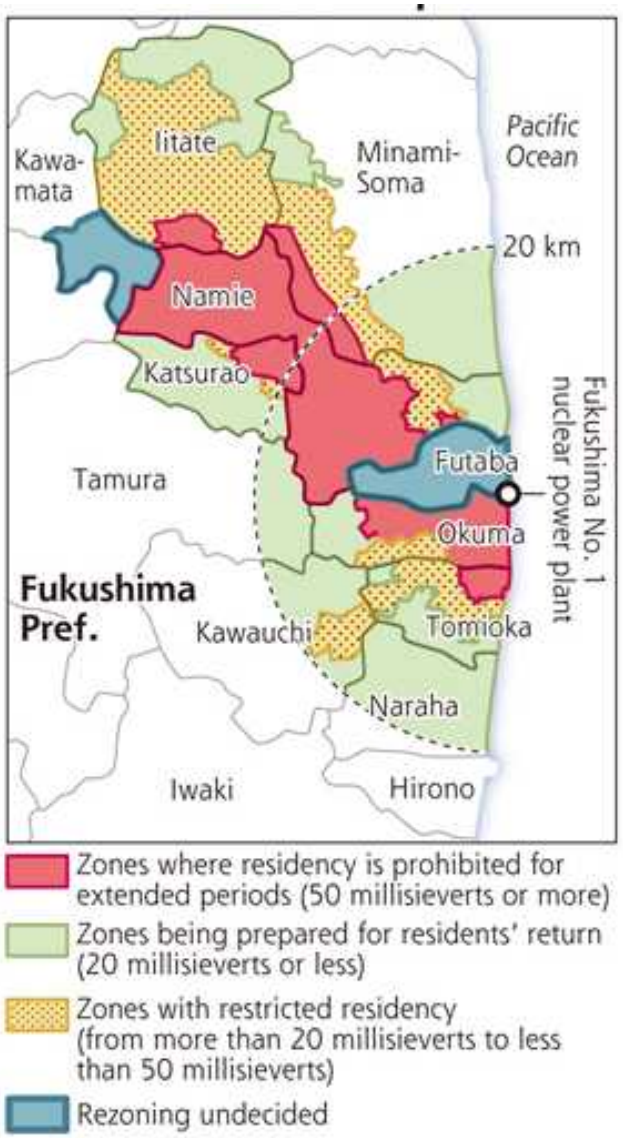
Cs Behavior: Discussion and Follow-up Topics

- Discuss leading models and new model needs to provide predictive tools for cesium transport in natural and man-made environments
- Discuss areas for improvement of understanding impacts to biota (human and non-human)
- Interfaces with radiation monitoring
- Advanced decontamination methods (discussed briefly in Decontamination)

Remediation Strategy



Remediation Strategy: Overview



Intensive Contamination Survey Area (Non-Evacuation Areas) – Decontamination Led by Municipalities

< 20 mSv/y

Special Decontamination Area (Evacuation Areas) – Decontamination Led by National Government

< 20 mSv/y

20 – 50 mSv/y

> 50 mSv/y

Full Scale Remediation Underway as of:

	Dec. 2012	Apr. 2013
Tomioka		
Okuma		
Futaba		
Namie		
Katsurao		
Iitate		
And portions of: Minami-Soma		
Naraha		
Kawauchi		
Tamura		
Kawamata		

Remediation strategy defines the overall priorities and sequence for applying decontamination resources to specific problems types and locations within the affected regions

Remediation Strategy: Key Observations

- There is a substantial and growing base of information and experience on decontamination effectiveness and costs resulting from the municipal-led efforts in the Intensive Contamination Survey Areas, from MOE-led efforts in low dose Special Decontamination Area, and from prior model project work in the SDA.
- There are multiple challenges for completing the currently planned decontamination work: lack of a defined or established waste management system; potential budget allocation issues; and lack of trained workers.
- The current March 2014 target date for completion of decontamination work in the SDA (other than the higher-dose areas) does not appear to be feasible.
- There is considerable uncertainty surrounding the viability of conducting decontamination work in the higher dose portions of the SDA.
- There does not appear to be a clearly defined process for evaluating options for full-scale decontamination or for making the national decision of whether and how to proceed for the high dose areas.

Remediation Strategy: Recommendations

1. Conduct a systematic review of the decontamination work that has been completed to date (cost, effectiveness, waste generation, etc.) to provide the information base for extrapolating to implementation of remaining decontamination work.
2. Develop the baseline definition of the total set of decontamination work that needs to be completed.
3. Develop and maintain an overall remediation strategy complete with life cycle cost estimates, resource allocation strategies (e.g., manpower, etc.), and analysis of critical strategic alternatives.

Remediation Strategy: Discussion and Follow-up Topics

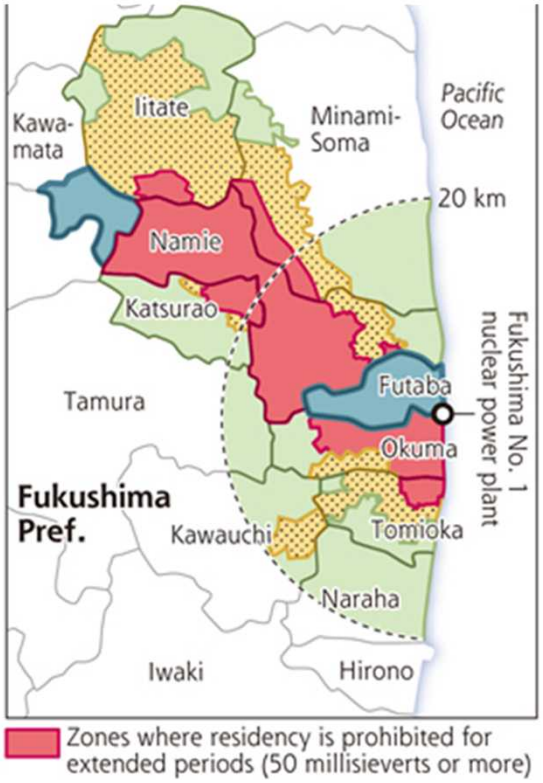
- Much of the information needed to systematically assess the cost and effectiveness of remediation efforts exists. Consider a joint US-Japan effort to compile, analyze and report remediation impact to date.
  - o Beneficial to setting priorities for next phases of offsite remediation
  - o Beneficial to US EPA planning for US radiological response planning efforts
- Consider a joint US-Japan effort to evaluate strategies for remediation of the highest dose evacuated areas (> 50 mSv/y).

Progress of the decontamination of the Joban Expressway and special decontamination area are as follows.

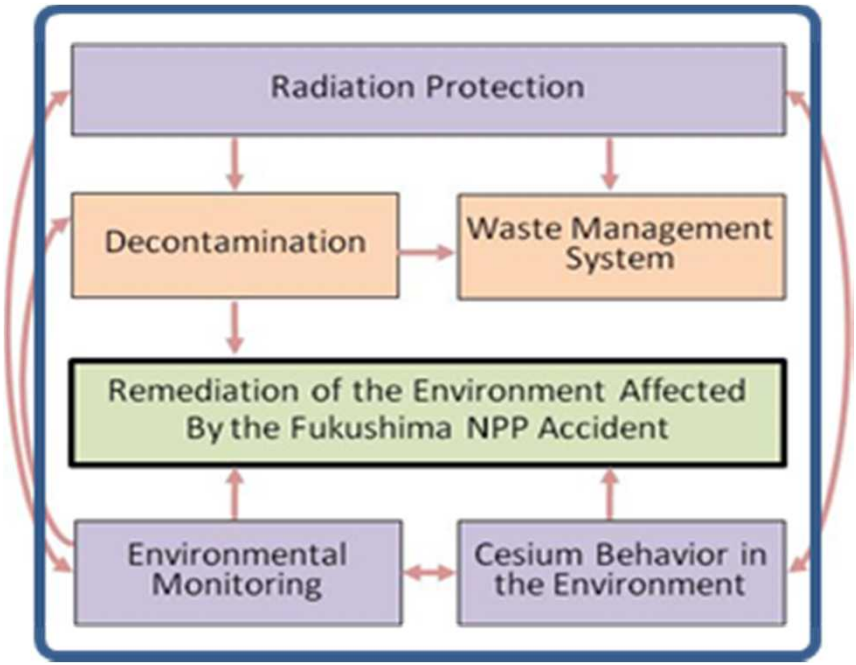
	Prior decontamination (base facilities, etc.)	Development of decontamination plan	Full-scale decontamination
Tamura	End	Already established (April 13 2012)	End of decontamination based on the decontamination implementation plan
Naraha	End	Already established (April 13 2012)	Already started (6 - September 2012)
Kawauchi village	End	Already established (April 13 2012)	Already started (4th to September 2012)
Iitate	End	Already established (May 24, 2012)	Already started (25 - September 2012)
Minamisoma	End	Already established (April 18 2012)	Agreement in preparation (the 26th public announcement in April 2013)
Katsurao village	End	Already developed (September 28, 2012)	Already started (25 - April 2013)

Additional towns not shown

Areas with annual dose, 50 mSv/y only



Public Involvement: Overview



Public participation is required to effectively implement many aspects of Fukushima remediation. These aspects include acceptance or consideration of:

- Temporary storage facility sites
- Interim storage facility sites
- Incineration of specified and designated waste (other than decontamination waste)
- Community-specific decontamination plans
- Re-population and reconstruction plans for evacuated communities, including institutional controls for public protection.

Public Involvement: Key Observations

- Effective public involvement mechanisms to support large-scale remediation activities have not been widely developed and implemented.
- There is significant variation among municipalities in how effective they are in involving their citizens in remediation decisions.
- GOJ agencies do not have experience in establishing effective public involvement institutions to support remediation.
- Effective public participation seems to be aggravated by unresolved compensation issues related the Daiichi nuclear plant.
- GOJ has engaged numerous advisory groups on matters associated with radiation protection, decontamination methods, cesium behavior and other technical and scientific topics. But, these efforts, while essential, do not substitute for effective public involvement.
- There are multiple communities, very diverse interests and value sets, and a variety of decisions and topics that that make designing effective public involvement strategies difficult.

Public Involvement: Recommendations

1. There is an immediate need to develop more effective processes for public involvement in remediation system decisions (e.g., site selection for treatment and storage facilities, re-population strategies for evacuated areas).

Public Involvement: Discussion and Follow-up Topics

- Discuss approaches for adapting Citizen Advisory Board concept for use in Japan.
- Commission expert group to review current public involvement practices and provide expert recommendations for implementing effective approaches.
- Identify US-Japan information exchange opportunities (e.g., Iitate village and Bunker Hill Superfund site).

Contact Information

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