# **Environmental Remediation in Fukushima Prefecture**

January 31 2013

Hideki Kawamura, Obayashi Corporation

# Outline

- 1. Objectives
- 2. Targets
- 3. Procedure
- 4. Applied technologies and results
- 5. Temporary storage
- 6. Quality assurance programme
- 7. Operational safety
- 8. Communication
- 9. Conclusions and open issues

# **1. Objectives**

# > Testing various cleanup technologies:

Assessment measures – Engineering Practicality, Performance (dose reduction), Speed, Cost, Waste generated (volume and characteristics)

# Scope of work:

- Monitoring (Before/After)
- Decontamination
- Waste handling/treatment
- Temporary Storage
- Communication
- Quality Assurance
- Safety
- Restoration

Obtaining data, confirming practicality and training staff to provide experience for full scale projects

# 2. Targets in Group C

Targets of cleanup: Buildings, Houses (and gardens), Parks, Roads/Parking lots, Farms, Forests,...

Target areas: Within 30km of FDI, area is about 100 hectares (about 250 acres)



Ref. Ministry of Education, Culture, Sports, Science and Technologies, Nov.5, 2011



# **3. Procedure**

# **Common procedure for all model projects**



In order to initiate cleanup, we need to get permission and approval of plans from landowners and local residents and also agree temporary storage locations.

# **Forest/Trees: Clearing, cutting, incineration**

Ref. JAEA. Mar. 26, 2012



Bagging



**Cutting/trimming** 



Prototype incinerator		Volume Reduction: Ave. 98.5%		
i rototype memerator	-		Cs concentration	
		Combustible material	45 ~ 723 kBq/kg	
		Bulk ash	443 ~ 2,048 kBq/kg	
		Fly ash	289 ~ 2,380 kBq/kg	
		Exhausted gas (bag filter)	N.D. ~ 1.40 Bq/m <sup>3</sup>	
2012/ 12:90		Exhausted gas (HEPA filter)	N.D.~ 1.40 Bq/m <sup>3</sup>	

Processing capability: 50kg/h, Temperature: 800°C, Test runs: 5h/day

### Farmland/open ground: Soil inversion, separation /removal

### Motor grader removal



### Backhoe removal



### Hammer knife removal



### **Exchange of soil**



Ref. JAEA. Mar. 26, 2012

### Separation by "Orion Scan-sort"



Automatic separation of soil by screening level of radioactive contamination⇒reduction of waste

# Buildings/houses: Sweeping, washing, surface removal

### **Roof sweeping**



### **Roof washing**



### Floor "hydro cutting"



Ref. JAEA. Mar. 26, 2012

### **Gutter sweeping**



### Contaminated water treatment



**Filtration and precipitation** 

### Water treatment record at Okuma Town

Water treatment		380 m <sup>3</sup>
Cs concentration	before	6,700 ~ 9,600 Bq/L
	after	N.D. ~ 340 Bq/L
Ave. treatment throughput	filtration	2.2 m <sup>3</sup> /day
	precipi - tation	18 m³/day

# **Road/Parking lot: High pressure washing, Surface removal**

### Sampling



### Define Cs penetration depth---select removal technology

-Impermeable pavement: about 2 -3 mm depth -Permeable pavement: around 5mm depth

Ref. JAEA. Mar. 26, 2012 7



### **Ultra HPW**



### Shot blasting



### **Fine milling**





Highest contaminated region in the pilot project Targeting area:  $1.7 \times 10^4 \text{ m}^2$  Ave.>50µSv/h





Ref. Ministry of Education, Culture, Sports, Science and Technologies, Nov.5, 2011

### Monitoring: Spatial radiation dose distribution Before cleanup After cleanup



Place	Before cleanup	After cleanup	Removal
Forest	110 – 160µSv/h (Ave. 140)	61 – 65µSv/h (Ave. 63)	About 54%
Farm	40 – 83µSv/h (Ave. 63)	5.7 – 33µSv/h (Ave. 12)	About 80%
Road	42 – 84µSv/h (Ave. 55)	26 – 46µSv/h (Ave. 17)	About 67%
Housing	46 - 63µSv/h (Ave. 55)	10 – 24µSv/h (Ave. 15)	About 74%

Ref. JAEA. Mar. 26, 2012 11

# **Applying novel scanning tools to Kindergarten & Nursery**

# Eases identification of "Hot Spots" and choice of cleanup technologies Good communication with mothers

Before cleanup



After cleanup



E.g. decide on additional cleanup by shot blasting of asphalt pavement Ref. JAEA. Mar. 26, 2012

# **5. Temporary Storage**

### **Construction tailored to site conditions**

Ref. JAEA. Mar. 26, 2012

# On a flat surface In a valley







# **6. Quality Assurance Programme**

# Assuring traceability and transparency of radioactive waste management during transfer of responsibilities





**Recording waste properties** 

- Date of collection
- Place of collection
- Surface dose
- Contents
- Weight

Metal Tag



# 7. Operational Safety

Radiological safety was a key concern. A full exposure record of workers was maintained: no significant doses were recorded The required protection level was defined based on dust monitoring.





Level-1 Full-face mask

Level-2 Half-face mask

Screening point : before and after work

# 8. Communication

# Key to assure quick and efficient cleanup and confidence-building to allow return of evacuated residents

Phased information:
What we will do
What we are doing
What we have done





# Information plaza

http://josen-plaza.env.go.jp/



Ref. MOE homepage 16

# 9. Conclusions and lessons learned

# Experience and knowledge from the model project

- Various cleanup technologies have been developed and demonstrated.
- Fundamental supporting data have been obtained.
- Practical know-how and experience have been accumulated.

# **Recognized key issues:**

- Quality assurance of radiation measurements, especially "Hot Spots"
- Judgment of sufficient decontamination; 1 to 20mSv/y ?(not to easy to reduce below 1mSv everywhere)
- Management of forest, more than 70% of the evacuation area but low contribution to population dose

# **10. Moving forward**

Now we are conducting full scale remediation project with following spirits;

- Improve speed, performance and costeffective implementation with minimum waste.
- Work together with local residents and land owners based on good communication. Public-Private-Partnership is expected.

Difficulties not only technical aspects but also social acceptance

- > Getting more difficult:
  - obtaining temporary storage locations
  - permission of clean up from local residents