AMEC Experience with Post-Fukushima Characterization and Remediation in Japan

Steve Rima, CHP, CSP
Vice President, AMEC Environment & Infrastructure
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Plume (units m^-3), Release: 0.10E+19 Units
Cesium Surface Deposition Plume Map
Special Decontamination Area

- 11 municipalities* in (former) restricted zone or planned evacuation zone (<20km from the nuclear power plant, or where annual cumulative dose is >20mSv).
- 1400 square km
- Decontamination is implemented by the national government.
- (*) Entire area of Naraha, Tomioka, Okuma, Futaba, Namie, Katsurao, and litate. Some areas of Tamura, Minami Soma, Kawamata, and Kawachi.
Intensive Contamination Survey Area

- 104 municipalities in 8 prefectures*, where an air dose rate of over 0.23 µSv/hour (equivalent to over 1 mSv/year) was observed, were designated.

- Decontamination is implemented by each municipality. The national government will take the necessary financial and technical measures.

- (*) Iwate, Miyagi, Fukushima, Ibaraki, Tochigi, Gunma, Saitama and Chiba
Problem

- Approximately 1,300 square kilometers are evacuated and must be cleaned prior to return of residents
  - Includes towns, agricultural land, forests, rivers, etc.
- Very large volume of low level radioactive waste will be generated
- No permanent disposal for radioactive waste exists in Japan
- Some types of land, e.g. forests, mountains, cannot be cleaned without destroying it
- Cost effective waste minimization techniques are badly needed
Demonstration Projects

- Objective: Demonstration of remediation technologies toward full remediation of evacuation areas
- Overseen by Japanese Atomic Energy Agency (JAEA) and Japanese Ministry of Environment (MOE)
- AMEC on team led by Obayashi JV
  - Included 114 ha (1,140,000 m²)
  - Demonstration of characterization, decontamination and remediation of towns, buildings and land
  - Included towns of Hirono, Naraha, Okuma and Kawauchi
- AMEC deployed its proprietary Orion ScanPlot℠ and ScanSort℠ technologies
  - Both use real-time, laboratory-quality, gamma spectroscopy in the field
Issues

- Definition of “clean” not yet defined.
  - Soil concentration limit v. dose rate above ground surface
  - 2,000 – 4,000 Bq/kg used as sorting criteria during Demonstration Project
  - Concentration limit can be applied in situ or ex situ
  - Dose rate can only be applied in situ

- One interesting discovery was that some property owners outside of evacuated areas have already undertaken remediation of their property
  - Scrape ground surface
  - Bury removed contaminated soil temporarily on site
Orion ScanPlot Platforms

- Automated Gamma Spectroscopy instead of Decades-Old Gross Gamma “Walkover” method
- Faster, cheaper and much higher quality data
ORION ScanSort at a Project

- Conveyors integrated with radiological scanning system
- Over-excavate, scan/sort resulting in up to 95% reduction in waste disposal
- NRC license for remediation in US
Orion ScanPlot Platforms in Japan
Orion ScanPlot Platforms in Japan
Orion ScanPlot Platforms in Japan
Ichinoseki City Road Survey Results
Challenging Field Conditions
Survey of School Yard after Remediation by Owner
Characterization

- Pre- and Post-Remediation Surveys of School Yards outside evacuation zone
ORION ScanSort in Japan
Rice Paddies Before Remediation
ScanPlot Pre-Remediation Survey of Rice Paddies
Cs137 Concentration by Depth in Rice Paddy

<table>
<thead>
<tr>
<th>Soil Layer [mm] Range</th>
<th>Temporal Observation Numbers</th>
<th>Average Concentration [Bq/kg]</th>
</tr>
</thead>
<tbody>
<tr>
<td>0 to 30</td>
<td>165 to 202</td>
<td>10918</td>
</tr>
<tr>
<td>30 to 60</td>
<td>247 to 283</td>
<td>5041</td>
</tr>
<tr>
<td>60 to 100</td>
<td>206 to 244</td>
<td>512</td>
</tr>
<tr>
<td>0 to 100 (mixed*)</td>
<td>386 to 448</td>
<td>2692</td>
</tr>
</tbody>
</table>
Typical Urban Remediation Methods

Roof: water cleaning, cleaning with brush

Wall: wiping

Gutter (vertical): high-pressure water cleaning

Concrete floor: High-pressure water cleaning

Concrete floor: Shot blast

Concrete floor: Surface grinding machine

Garden: removal of topsoil
Typical Urban Remediation Methods

- High-pressure water cleaning by vehicle for recovering functions of water drainage pavement
- Cleaning of tree trunk (with water and brush)
- Surface grinding by shot blast
- Removal of topsoil
Vegetation Growth Over Roads
Minimum PPE for Work in Evacuation Zone
Typical Short-Term Post-Remediation Waste Storage
Temporary Waste Storage Near Fukushima City on Ball Field
Temporary Waste Storage Near Fukushima City on Ball Field
Interim Waste Storage Facilities

- 5 to be built, all near Fukushima Dai-ichi plant
- For waste from off site remediation only
- Estimated waste volume 15-28 million m$^3$
- One site to have incinerator
- Operate for 3-5 years starting in early 2015
  - Schedule slippage already happening
- Siting process is very political
  - Governor of Naraha recently announced he will not allow proposed facility there
- Relocate material to permanent disposal site after 30 years
Conceptual Interim Storage Facility

(Before the storage)
Near-Term Challenges

1. Seeking more efficient/effective technology for decontamination from the perspective of cost, time, etc, including soil/waste minimization and volume reduction

2. Promotion of public communication for securing temporary storage sites, interim storage facilities, etc.

3. Siting and construction of up to 5 interim storage facilities – operational by Jan 2015

4. Restoring public trust and confidence

5. Siting Interim Waste Storage Facilities
Tsunami Damage
Tsunami Damage
Tsunami Damage
Tsunami Damage