



HSS Support to Fukushima Incident



Office of Health, Safety and Security
U.S. Department of Energy
Office of Environmental Policy &
Assistance
(HS-22)

Carlos Corredor





Overview

- **Fukushima Federal Response Group**
- **References and Tools**
- **Cultivating Rice after the Accident (Apr 2011)**
- **Dose from Seafood Consumption (Apr 2011)**
- **Train Ride on Tohoku Shinkansen (May 2011)**



Combined Effort





Fukushima Federal Response Group



- Federal Response Group (FRG)
created at request of the White House
 - NRC: Lead
 - DOE
 - EPA
 - DHS
 - FDA
- NNSA lead for DOE response.
- HSS requested to support effort by NNSA



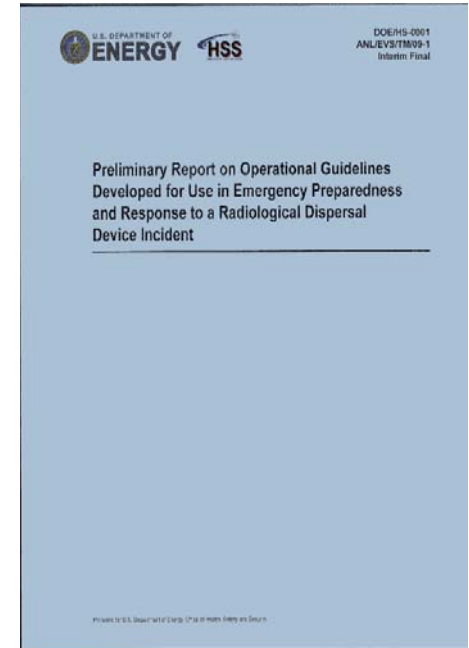
References and Tools



- **Preliminary Report on Operational Guidelines (known also as OGT)** available for use and comment: February 2009
 - ✓ Supports Implementation of DHS Planning Guidance released in 2008
 - ✓ Provides methodology, Operational Guidelines(OG), and some end-user guidance



- **RESRAD-RDD** software available for use and comment
 - ✓ Companion assistance tool for implementing OG.
 - ✓ Allows for calculation of incident-specific OG.
- Products are available through the OGT Web Site
 - ✓ OGT document at <http://ogcms.energy.gov>
 - ✓ Or link from RESRAD Web site: <http://web.ead.anl.gov/resrad/home2/rdd.cfm>





OGT Groups

- **Group A: Access Control During Emergency Response Operations**
- **Group B: Early Phase Protective Actions (Evac or Shelter)**
- **Group C: Relocation and Critical Infrastructure Utilization**
- **Group D: Temporary Access and Relocation Areas for Essential Services**
- **Group E: Transportation and Access Routes**
- **Group F: Release of Real Property from Radiologically Controlled areas**
- **Group G: Food Consumption**



Cultivating Rice





Cultivating Rice

(April 2011)



- Question: Can rice be planted within weeks of the Fukushima accident?
- Answer: Determine OG for growing rice in contaminated soil with Cs-137 and Sr-90
 - If soil surface concentrations $<$ than OG calculated, then you can cultivate rice as Cs-137 and Sr-90 is less than Planning Values (PV) (same as Derived Intervention Levels(DILs))
 - PVs:
 - Annual Effective dose = 500 mrem
 - Committed Effective Dose = 5000 mrem to an organ or tissue



Cultivating Rice

Data



- Derived Concentration Factors (DCF's) from ICRP 72 used
- Japanese Rice Consumption:
 - Average 66 Kg/yr or 164.8 gm/day
 - Japanese National Data, Ministry Health Labor and Welfare, 2006
- Root Uptake Factors used in OGT Group G, Subgroup 3 for Cs-137 and Sr-90: 0.6 and 0.1 respectively
- Transfer Factors Soil → Rice
 - IAEA TRS 472 (2010)
 - Radioprotection (Shang & Leung, 2002)
 - Environmental Radioactivity (Wang Et al., 1998)



Cultivating Rice

OGT Calculated

$$\text{Cs-137} = 1.45\text{E}7 \text{ pCi/m}^2$$

$$\text{Sr-90} = 6.76\text{E}6 \text{ pCi/m}^2$$

- This is a conservative assessment
- Transfer factors for rice are high end of literature
- Assumed
 - Plowing depth: 15 cm
 - Depending on Plowing depth exposure can be reduced by a factor of 2 or 3
- Rice is cultivated in 5 -15 cm layer of water.
- Under flooding conditions: resuspension and deposition are eliminated on rice crops



Dose from Seafood Consumption





Dose from Seafood Consumption

- Isotope of concern: I-131
- Assumptions:
 - I-131 continuously released and reaches equilibrium at 2000 bq/kg
 - Seafood consumed fresh and 0 storage time
 - No decay adjustments of I-131 in Seafood



Dose from Seafood Consumption

Data



- ICRP 72 Age Dependent DCF's used. Six different age groups.
- Seafood Ingestion Rates Japanese National Data 2006.
 - Fishes and Shellfishes intake per person/day
 - Nine different age groups



Dose from Seafood Consumption Contaminated with I-131 2000 Bq/kg*



Age Group	Dose (mrem)
1 y/o	580**
5 y/o	320
10 y/o	250
15 y/o	190
Adult	200

*For calculations purposes assumed that I-131 is continuously released and that seafood reaches equilibrium concentration of 2000 Bq/kg

**Possible over estimation. Seafood Ingestion rate 1-6 y/o



Dose from Seafood Consumption Discussion



- Delay between harvesting and consumption of fish. I-131 short half life of 8.05 days.
- Contamination level of 2000 Bq/Kg of fish will not remain for 1 year.
- Possible yearly dose over estimated because of I-131 short life.



Train Ride Tohoku Shinkansen





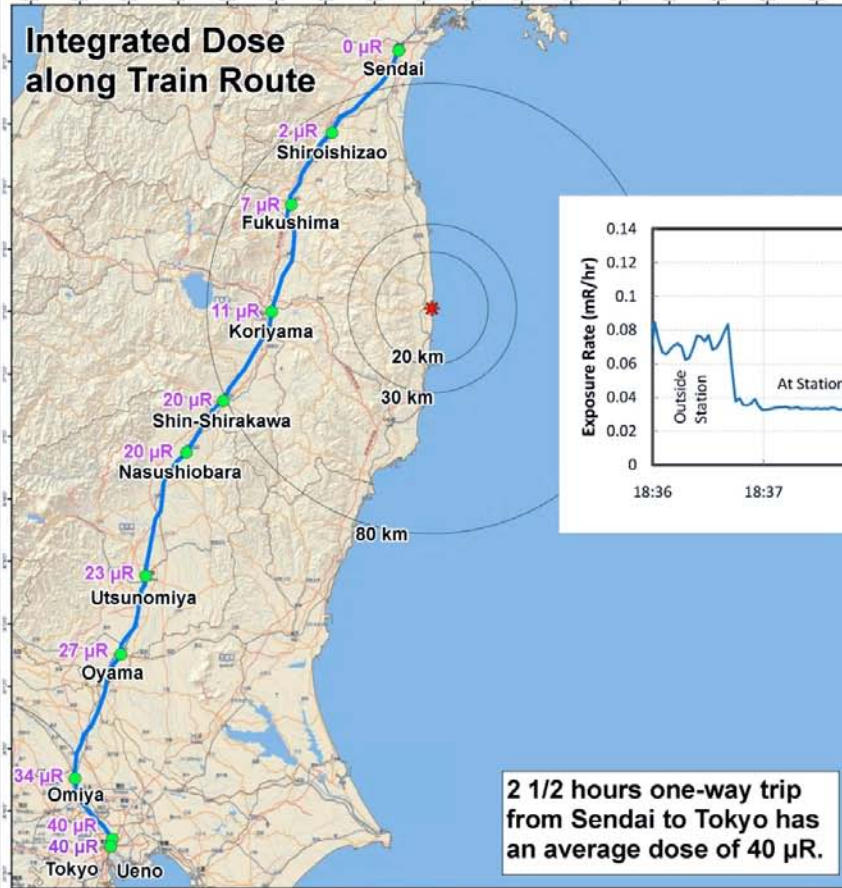
Train Ride

325 Km (202 miles) Tokyo to Sendai

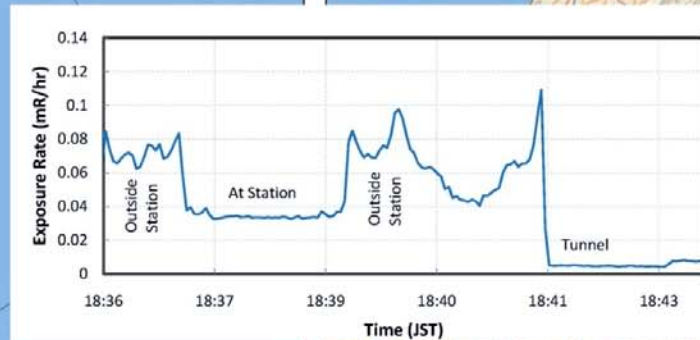
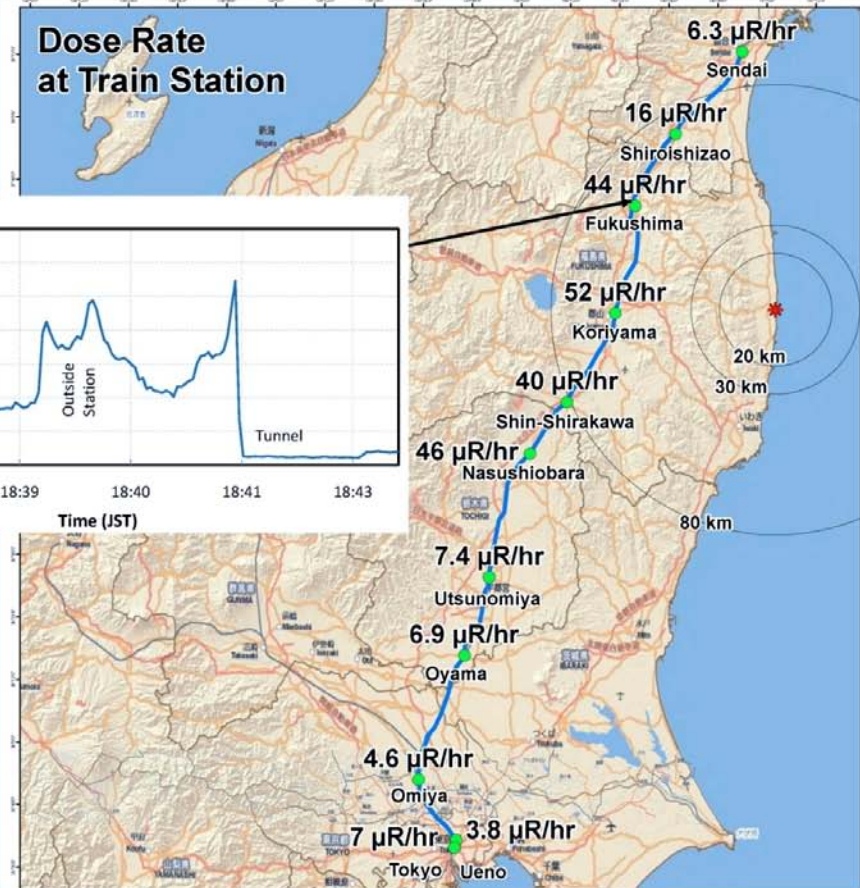


Tohoku Shinkansen 05/03/2011

Integrated Dose along Train Route



Dose Rate at Train Station



2 1/2 hours one-way trip from Sendai to Tokyo has an average dose of 40 μR.

Map created on 5/06/2011 16:00:00 JST
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Train Ride

(Tohoku Shinkansen)



- Inside Train
- Measurements every 3 sec
- Upper resuspension factors: $4.97\text{E-}7 \text{ m}^{-1}$ to $4.71\text{E-}5 \text{ m}^{-1}$ (Beal, Krauss & Okada). Used $1\text{E-}6 \text{ m}^{-1}$
- Exposure Rates were back calculated to external surface concentrations.
- Conservative exposure to dose conversion: 1 rem/R
- Default factors Group C and E from OGT:
 - Filtration and external dose shield factors : 1 and 0.4 respectively.
- US EPA Exposure Factor Handbook
 - Inhalation and Ingestion Rates: $1.2 \text{ m}^3 / \text{hr}$ and $1.25 \text{ E-}5 \text{ m}^2 / \text{hr}$ respectively
- ICRP 60 DCFs used



Train Ride

(Tohoku Shinkansen)

Results



- Average Surface Concentrations
 - Tokyo → Sendai
 - Cs-137: 1.98 E6 pCi/m²
 - Cs-134: 1.95E6 pCi/m²
 - Sendai → Tokyo
 - Cs-137: 2.34E6 pCi/m²
 - Cs-134: 2.30E6 pCi/m²
 - Surface concentrations compare well with data in AMS Surface Deposition map
- Estimated total dose:
 - Tokyo → Sendai: 0.046 mrem
 - Sendai → Tokyo: 0.070 mrem
 - Total Round Trip: 0.120 mrem



Questions?



Torii gate, Miya-jima