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Progress in Implementing U.S. Support to Japan – *PNNL's Assistance to Japan Atomic Energy Agency (JAEA)*

WAYNE JOHNSON, P.E., Division Director
DR. YASUO ONISHI, Chief Scientist

Energy and Environment Directorate
Pacific Northwest National Laboratory

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Response Efforts (Mar-May 2011)

Initial Response

PNNL provided immediate assistance to the Fukushima response efforts (March 2011 – May 2011)

- ▶ PNNL first to detect radiation in the U.S., fielded numerous dose and impact related questions
- ▶ PNNL staff supported the NE Response Teams (NERT)
- ▶ International expert contacted by Japanese during the Fukushima Nuclear Accident to provide insight and suggestions on:
 - Reactor and spent-fuel pool situations
 - Public communications
 - Responses and countermeasures
 - Monitoring

Earthquake & Tsunami Impacts



Response Efforts (Mar-May 2011)

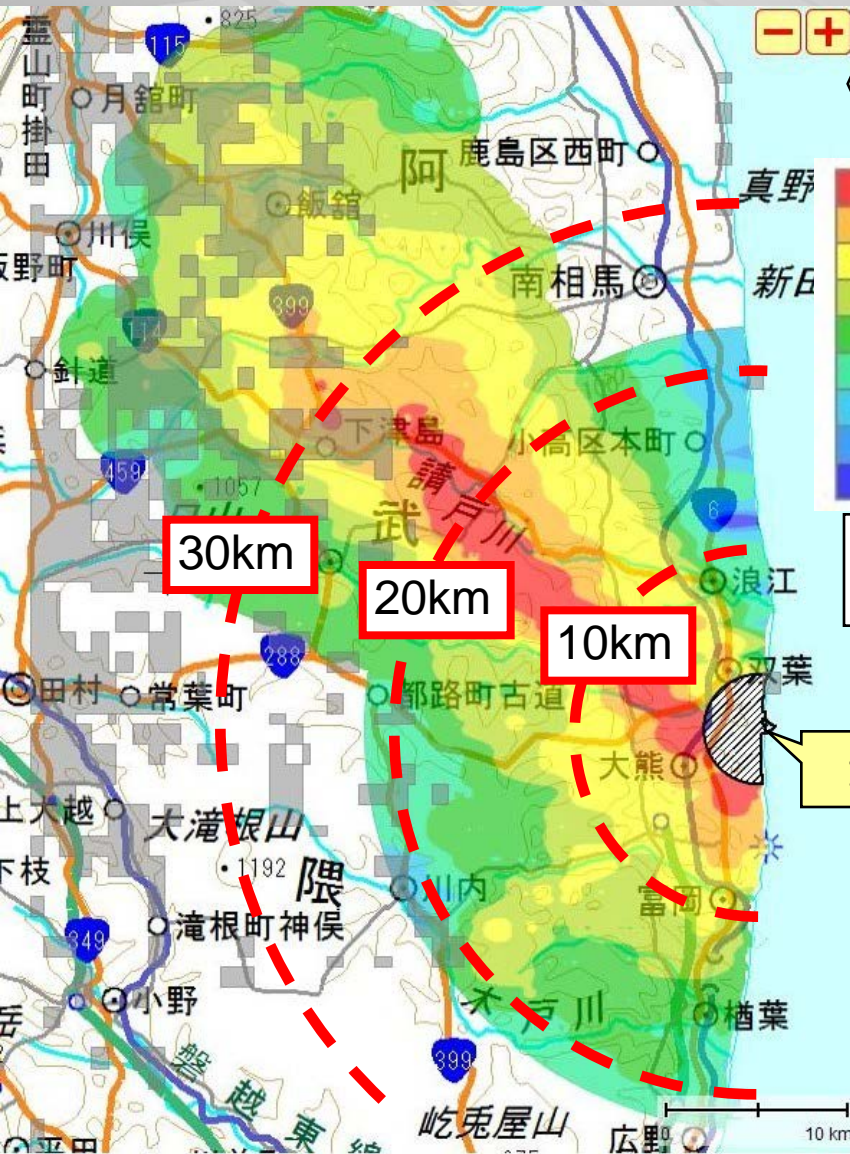
Initial Response (cont.)

- ▶ Requested by the Japanese Prime Minister's Office to come to Japan to work on Fukushima (April 2011)
- ▶ Participated in daily Fukushima accident response joint meetings of the Japanese Government and TEPCO
- ▶ Provided reach back into PNNL
- ▶ Provided Fukushima plant situation updates to DOE
- ▶ Interactions led to the initiation of a contract with Japan Atomic Energy Agency (JAEA) supporting Fukushima response & recovery efforts (June 2011)
- ▶ Dr. Yasuo Onishi received Secretarial Award for his contributions

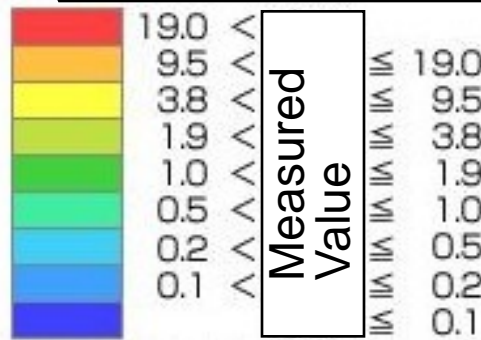
Evolving Challenges



Radiation Dose around Fukushima Daiichi



Aerial Radiation Dose Map
($\mu\text{Sv/h}$ at 1 m above ground; as of Feb. 2012)



1 $\mu\text{Sv/h}$ = 8.76 mSv/y
2.3 $\mu\text{Sv/h}$ = 20 mSv/y



- :Evacuation Release Prepared Area
- :Residence Restricted Area
- :Return Difficulty Area
- :Restricted Area
- :Deliberate Evacuation Area

(Source) <http://www.meti.go.jp/earthquake/nuclear/kinkyu.html#shiji>

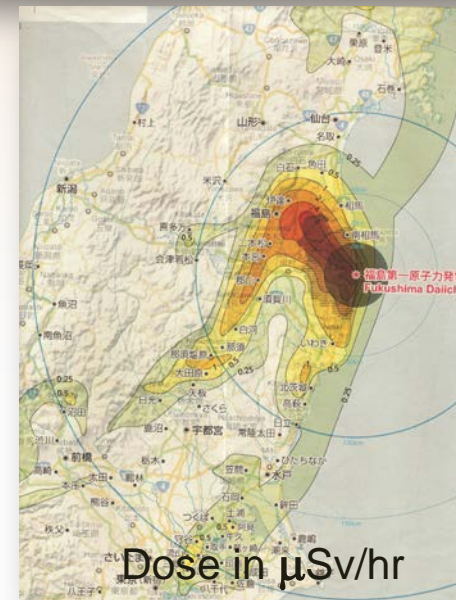
- ▶ Primary radionuclides of concern are ^{131}I , ^{134}Cs , and ^{137}Cs
- ▶ Small amounts of ^{89}Sr , ^{90}Sr , ^{238}Pu , ^{239}Pu and ^{240}Pu were also released
- ▶ Most of these radionuclides deposited on forests and agricultural fields

(Source) <http://ramap.jaea.go.jp/map/map.html>

PNNL Support to JAEA

- ▶ General consultation on:
 - Land, river and ocean monitoring
 - Cesium transport and adsorption/desorption
 - Environmental assessment
 - Off-site remediation
 - Public participation
- ▶ Reviewed 11 remediation demonstration site projects
- ▶ Provided information and input on:
 - Relevant U.S. and Chernobyl experiences
 - Development of several government environmental remediation manuals and guideline documents
 - Development of concepts for environmental waste storage site(s)
- ▶ Remediation technology proposal review

Focus on Environmental Issues



Remediation Methods

- ▶ Remove top several cm of soil
- ▶ Remove weeds, other groundcover, fallen leaves around houses
- ▶ Cut low-hanging tree branches and remove moss
- ▶ Wash roof, structure's outside wall, and road with high-pressure water jet
- ▶ Sand-blast the surface of a concrete road
- ▶ Remove dissolved cesium in water (e.g., a swimming pool) with zeolite
- ▶ Institutional control
 - Evacuate people within the 20-km zone and high radiation exposure areas (i.e., 20 mSv/year or greater radiation exposure)
 - Prohibit consumption of contaminated foods with 100 Bq/kg or higher

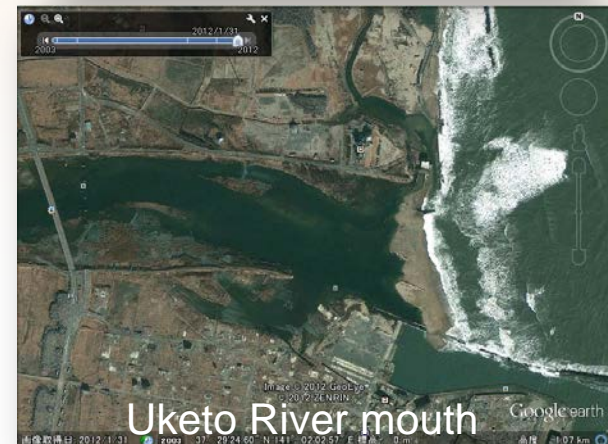
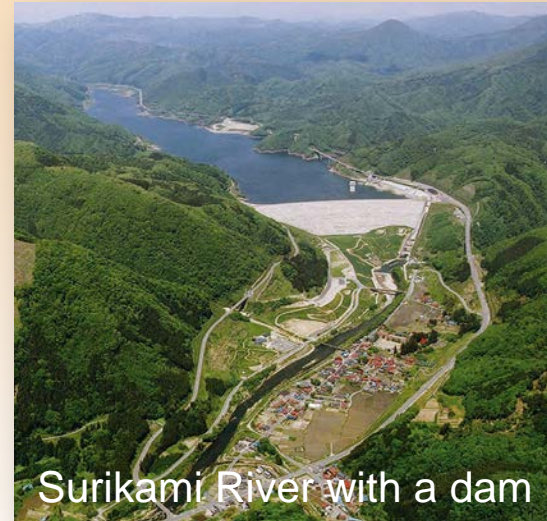
Remediation Demonstrations



Fate & Transport Modeling

- ▶ On-going cesium migration simulations in Fukushima Rivers
 - PNNL-developed 1-D TODAM code applications to Fukushima Rivers
- ▶ Planned simulations
 - PNNL-developed 3-D FLESCOT code application to Fukushima coastal water
 - Molecular modeling of Cesium adsorption
- ▶ Under discussion on future modeling
 - Watershed modeling for Fukushima areas
 - Expansion of FLESCOT computational capability for HPC
- ▶ JAEA researcher to participate in the cesium migration modeling as a PNNL visiting scientist for a year

River Settings



Waste Challenges

- ▶ Handling large volumes of collected soils, leaves and plants
- ▶ Waste storage of collected radioactive materials
- ▶ Concepts for waste volume reduction
- ▶ Waste treatment for cesium-contaminants
 - Removal of cesium from soils
 - Treatment of secondary waste
- ▶ Ultimate waste disposal plans, facilities and locations

Local Waste Storage



Minamisoma City Onsite Waste Storage

Contact Information



Wayne L. Johnson, P.E.

Director, Earth Systems Science Division
Pacific Northwest National Laboratory
902 Battelle Boulevard
P.O. Box 999, MSIN K6-84
Richland, WA 99352 USA
Tel: 509-372-4791
Cell: 509-521-6926
Fax: 509-371-7150
wayne.johnson@pnnl.gov



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Dr. Yasuo Onishi

Chief Scientist, Fluid & Computational Engineering
Pacific Northwest National Laboratory
902 Battelle Boulevard
P.O. Box 999, MSIN K7-15
Richland, WA 99352 USA
Tel: 509-375-7203
Cell: 509-942-4367
Fax: 509-375-3865
Yasuo.Onishi@pnnl.gov



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