

Written by Yamada Kunhiro

## “The fear of tellurium contamination during Operation Tomodachi”

At the aircraft carrier Ronald Reagan 100 km off the coast of Onagawa, Yokota Air Force Base, Tokyo, Yokosuka Air Base, Kanagawa Prefecture, Main nuclides in the atmospheric radioactivity concentration (Bq/m<sup>3</sup>) in the plume released from the Fukushima nuclear power plant at the US military camp base at Sendai Airport, Miyagi Prefecture as

Te-129, Te-129m, Te-131m, Te-132, I-131, I-132, I-133, Cs-134,

Cs-136 and Cs-137 were detected.



Association seeking a ruling on the causes of radioactive pollution damage caused by the Fukushima nuclear power plant accident

Three TECHNICAL REPORTs of “Radiation Dose Assessment in Operation Tomodachi” published by the Defense Threat Reduction Agency of the U.S.

Department of Defense : ÿ “Radiation Dose Assessment of Coastal Residents in Operation Tomodachi”

(Publication date: September 2012)



Defense Threat Reduction Agency  
8725 John J. Kingman Road, MS  
6201 Fort Belvoir, VA 22060-6201



DTRA-TR-12-001

**TECHNICAL REPORT**

## **Radiation Dose Assessments for Shore-Based Individuals in Operation Tomodachi**

DISTRIBUTION A. Approved for public release: distribution is unlimited.

September 2012

Prepared by:  
Dose Assessment and Recording Working Group

For:  
Assistant Secretary of Defense for Health Affairs

ÿ “Probabilistic analysis of radiation dose of coastal residents in Operation Tomodachi” (Publication date: May 2013)



Defense Threat Reduction Agency  
8725 John J. Kingman Road, MS 6201  
Fort Belvoir, VA 22060-6201



DTRA-TR-12-002

**TECHNICAL REPORT**

## **Probabilistic Analysis of Radiation Doses for Shore-Based Individuals in Operation Tomodachi**

Approved for public release: distribution is unlimited.

May 2013

Prepared by:

Operation Tomodachi Registry,  
Dose Assessment and Recording Working Group

For:

Assistant Secretary of Defense for Health Affairs

ÿ “Dose assessment by ship in Operation  
Tomodachi” (Publication date: September 2013)



Defense Threat Reduction Agency  
8725 John J. Kingman Road, MS-6201  
Fort Belvoir, VA 22060-6201



DTRA-TR-12-041

**TECHNICAL REPORT**

**Radiation Dose Assessments for Fleet-Based  
Individuals in Operation Tomodachi**

DISTRIBUTION A. Approved for public release: distribution is unlimited

September 2013

Prepared by:

Operation Tomodachi Registry,  
Dose Assessment and Recording Working Group

For:

Assistant Secretary of Defense for Health Affairs

PEP (estimated number of people exposed to radiation), etc. at three selected US military bases ỹ

Yokosuka US Military Base, Kanagawa

Prefecture ỹ Yokota US Military

Base, Tokyo ỹ Sendai Airport, camp

base [1] PEP (estimated number of people  
exposed to radiation) ) ỹ Yokosuka Port

Base (16,500 people) ỹ Yokota Air

Force Base (7,900 people) ỹ Camp Sendai (50-100 people), Sendai

Airport (200 people) [2] Distance from Fukushima Daiichi Nuclear

Power Plant (liter) 1liter ỹ1.6 km ỹ

Yokosuka Port Base (260 liters) ỹ

Yokota Air Force Base (240 liters) ỹ Camp Sendai (95 liters),

Sendai Airport (80 liters) [3]

Reasons for selection ỹ Yokosuka Port Base (possibility of radiation

exposure for many people ) ) ỹ Yokota Air Force Base (possibility

of radiation exposure for many people) ỹ Camp Sendai, Sendai Airport (outdoor activities near the Fukushima nuclear power

**Table 1. Locations selected for probabilistic analysis with selection rationale**

Location	Estimated PEP Size	Distance from FDNPS km (mi)	Rationale for Selection
Yokosuka Naval Base	16,500	260 (165)	Large population potentially exposed
Yokota Air Base	7,900	240 (150)	Large population potentially exposed
Camp Sendai	50 – 100*	95 (60)	Closest location to FDNPS with deployed DOD-affiliated individuals conducting forward humanitarian assistance mostly outdoors
Sendai Airport	200	80 (50)	

\*The number of personnel varied from 50-100 for most of the time. Many people passed through there, so the 50–100 is the number that were actually sleeping in the barracks at any one time. (Allen, 2012)

Figure 1: U.S. Department of Defense locations in Japan, Honshu, and Kyushu related to potential radiation exposure (U.S. military-related locations are marked with  $\star$ , Fukushima Daiichi Nuclear Power Plant is indicated in yellow)  $\star$  Yokosuka US Military Base, Kanagawa Prefecture  $\star$  Yokota US Military Base, Tokyo  $\star$  Miyagi Prefectural Sendai Airport Camp Base) Location



**Figure 1. Locations of DoD-Affiliated Populations of Concern on the Islands of Honshu and Kyushu, Japan**  
(U.S. military bases are shown with red stars. FDNPS is shown as a yellow trefoil.)

**Table 2. Age groups and locations of potentially exposed populations addressed by probabilistic and deterministic methods**

Age Group	Age Range	Deterministic Methods (Cassata et al. (2012))	Probabilistic Methods (This Study)
3 months	$0 < \text{age} \leq 1$	All locations	
1 year	$1 < \text{age} \leq 2$	All locations	Yokota Air Base
5 years	$2 < \text{age} \leq 7$	All locations	
10 years	$7 < \text{age} \leq 12$	All locations	
15 years	$12 < \text{age} \leq 17$	All locations	
Adults ( $> 17$ years)	$17 < \text{age} \leq 65$	All locations	Yokosuka Naval Base Yokota Air Base Camp Sendai
Humanitarian field workers	$17 < \text{age} \leq 65$	All locations	Sendai Airport

## Radionuclides and chemical forms considered in atmospheric radiation

and inhalation

• Aerosols Sr-89, Sr-90, Tc-99m, Te-129, Te-129m, Te-131m, Te-132, I-131, I-132, I-133, Cs-134, Cs-136, Cs-137, La-140

• Gas state (elements): I-131, I-132, I-133

• Gas (organic substances): I-131, I-132, I-133

**Table 5. Radionuclides and chemical forms considered for air activity and inhalation pathway**

Aerosols		Gaseous (Elemental)	Gaseous (Organic)
Sr-89	I-131	I-131	I-131
Sr-90	I-132	I-132	I-132
Mo-99	I-133	I-133	I-133
Tc-99m	Cs-134		
Te-129	Cs-136		
Te-129m	Cs-137		
Te-131m	La-140		
Te-132			

## Atmospheric radioactivity concentration<sup>3</sup>) and area (yBq/m<sup>3</sup>) calculated data

Main detected nuclides: Te-129, Te-129m, Te-131m, Te-132, I-131, I-132,

I-133<sup>y</sup>Cs-134<sup>y</sup>Cs-136<sup>y</sup>Cs-137

Measurement date: March 12th to April 1st

Table 32. Measured and derived data regions for air activity concentrations at Yokosuka NB (D-11)

Date (2011)	Cs-134	Cs-136	Cs-137	I-131	I-132	I-133	La-140	Mo-99	Tc-99m	Te-129	Te-129m	Te-131m	Te-132
Activity Concentration in Air ( $\mu\text{Bq m}^{-3}$ )													
Mar 12	2.0E+02	4.7E+01	2.2E+02	5.1E+02	1.5E+03	2.1E+02	1.6E+01	1.5E+01	2.8E+02	1.4E+02	2.9E+02	1.8E+01	2.5E+03
Mar 13	1.4E+05	3.8E+04	1.5E+05	4.1E+05	8.1E+05	9.4E+04	9.6E+03	1.0E+04	7.9E+05	7.7E+04	4.7E+05	1.2E+04	1.0E+06
Mar 14	6.6E+06	1.5E+06	6.3E+06	1.9E+07	4.5E+07	1.4E+06	3.6E+05	5.6E+05	6.3E+05	5.6E+04	6.4E+06	1.3E+06	4.8E+07
Mar 15	9.6E+05	2.1E+05	9.8E+05	3.5E+06	4.9E+06	6.9E+05	5.0E+04	5.4E+04	4.7E+05	3.5E+04	9.3E+05	1.2E+05	5.8E+06
Mar 16	1.4E+04	3.4E+03	2.0E+04	7.6E+04	6.3E+04	1.7E+03	1.4E+03	4.0E+04	3.2E+05	1.4E+04	2.4E+04	1.0E+05	8.9E+04
Mar 17	5.2E+03	9.4E+02	6.1E+03	1.5E+04	1.3E+04	1.2E+03	3.1E+03	2.7E+04	1.6E+05	3.1E+03	6.6E+03	8.5E+04	1.8E+04
Mar 18	8.0E+03	1.5E+03	9.1E+03	1.1E+05	2.7E+04	1.2E+03	4.9E+03	1.4E+04	1.3E+03	3.1E+03	9.2E+03	6.7E+04	3.4E+04
Mar 19	6.2E+03	1.1E+03	6.6E+03	1.1E+05	1.1E+04	2.3E+04	6.6E+03	5.6E+02	7.9E+04	3.0E+05	4.7E+03	5.0E+04	1.2E+04
Mar 20	1.2E+06	2.1E+05	1.3E+06	2.5E+06	2.0E+06	4.5E+04	8.4E+03	7.5E+04	1.6E+05	6.0E+05	9.6E+05	3.2E+04	2.3E+06
Mar 21	1.4E+05	3.5E+04	1.8E+05	4.2E+05	2.9E+05	6.7E+04	1.3E+04	1.2E+04	2.3E+05	5.5E+04	1.2E+05	1.5E+04	3.1E+05
Mar 22	3.0E+03	4.6E+03	1.9E+04	7.1E+04	3.2E+04	7.3E+03	1.4E+03	1.3E+03	2.5E+04	6.0E+03	1.3E+04	1.6E+03	3.4E+04
Mar 23	5.9E+03	1.8E+03	5.7E+03	2.7E+04	9.4E+03	2.2E+03	4.2E+02	4.0E+02	7.5E+03	1.8E+03	3.9E+03	4.8E+02	1.0E+04
Mar 24	5.7E+05	1.2E+03	6.9E+05	1.3E+06	1.1E+06	2.6E+05	5.0E+04	4.8E+04	9.0E+05	2.2E+05	4.6E+05	5.8E+04	1.2E+06
Mar 25	1.1E+06	1.7E+03	1.4E+06	2.6E+06	2.2E+06	5.2E+05	1.0E+05	9.6E+04	1.8E+06	4.3E+05	9.2E+05	1.2E+05	2.4E+06
Mar 26	1.7E+06	5.3E+02	2.1E+06	3.7E+05	3.4E+06	7.7E+05	1.5E+05	1.4E+05	2.7E+06	6.4E+05	1.4E+06	1.7E+05	3.6E+06
Mar 27	9.3E+02	4.0E+02	3.1E+02	1.0E+04	5.0E+02	1.1E+02	2.2E+01	2.1E+01	4.0E+02	9.5E+01	2.1E+02	2.6E+01	5.3E+02
Mar 28	5.2E+05	1.1E+03	5.2E+05	1.9E+06	8.5E+05	1.9E+05	3.8E+04	3.6E+04	6.8E+05	1.6E+05	3.5E+05	4.3E+04	9.0E+05
Mar 29	2.7E+05	2.0E+03	5.1E+03	1.0E+04	8.4E+03	1.9E+03	3.7E+02	3.6E+02	6.7E+03	1.6E+03	3.4E+03	4.3E+02	8.9E+03
Mar 30	1.3E+04	4.8E+03	1.2E+04	2.3E+04	1.9E+04	4.4E+03	8.6E+02	8.2E+02	1.5E+04	3.7E+03	7.9E+03	9.9E+02	2.0E+04
Mar 31	1.4E+06	6.0E+02	1.4E+06	1.0E+06	2.4E+06	5.5E+05	1.1E+05	1.0E+05	1.9E+06	4.5E+05	9.7E+05	1.2E+05	2.5E+06
Apr 1	1.1E+06	3.9E+02	7.1E+06	4.0E+05	1.2E+07	2.7E+06	5.2E+05	4.9E+05	9.3E+06	2.2E+06	4.8E+06	6.0E+05	1.2E+07

Source of Air Concentration Value

Yokota AB data directly substituted



Calculation using Cs-137 ratios



DOD measurement at Yokosuka NB



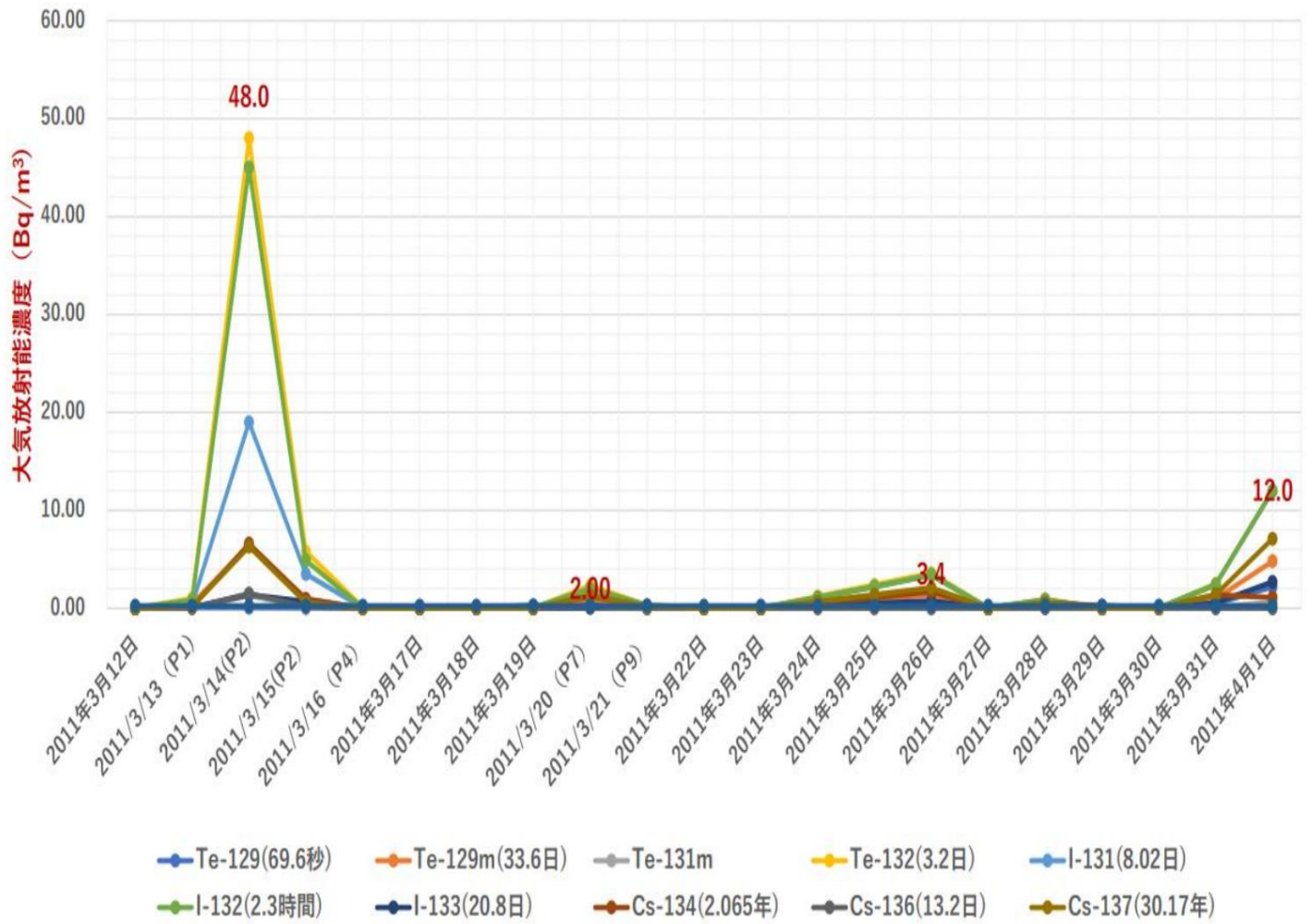
Linear interpolation between adjacent values



Decay adjusted



Atmospheric radioactivity concentration (Bq/m time change) at Yokosuka Port U.S. military base from March 12 to April 1, 2011, created from the table on the <sup>3</sup>) of previous page.



## Atmospheric radioactivity concentration (Bq/m<sup>3</sup>)

3 )

Main detected nuclides: Te-129, Te-129m, Te-132, I-131, I-132, Cs-134, Cs-136,

Cs-137

Date of determination: 3/11/2111j4/4/2011

Date	Cs-134	Cs-136	Cs-137	I-131	I-132	La-140	Mo-99	Te-129	Te-129m	Te-132
(Bq m <sup>-3</sup> )										
3/11/2011	—	—	—	—	—	—	—	—	—	—
3/12/2011	1.97E-04	4.66E-05	2.15E-04	5.06E-04	1.46E-03	—	—	1.35E-04	2.85E-04	2.47E-03
3/13/2011	1.41E-01	3.76E-02	1.45E-01	4.11E-01	8.05E-01	9.56E-03	—	7.65E-02	4.69E-01	1.02E-00
3/14/2011	6.59E+00	1.46E+00	6.34E+00	1.92E+01	4.45E+01	3.59E-01	5.63E-01	—	6.41E+00	4.82E+01
3/15/2011	9.61E-01	2.08E-01	9.84E-01	3.47E+00	4.90E+00	4.95E-02	5.38E-02	—	9.30E-01	5.76E+00
3/16/2011	1.40E-02	3.44E-03	1.98E-02	7.59E-02	6.33E-02	1.38E-03	—	1.39E-02	2.42E-02	8.86E-02
3/17/2011	5.19E-03	9.44E-04	6.06E-03	1.47E-02	1.30E-02	—	—	3.05E-03	6.61E-03	1.80E-02
3/18/2011	8.05E-03	1.52E-03	9.13E-03	1.08E-01	2.66E-02	2.75E-04	4.92E-04	3.05E-03	9.21E-03	3.37E-02
3/19/2011	6.22E-03	1.10E-03	6.56E-03	1.13E-01	1.05E-02	1.66E-03	5.60E-04	2.45E-03	4.71E-03	1.23E-02
3/20/2011	1.21E+00	2.12E-01	1.26E+00	2.53E+00	2.05E+00	8.37E-03	7.48E-02	6.05E-01	9.64E-01	2.32E+00
3/21/2011	4.84E-02	3.48E-02	6.52E-02	1.89E+00	2.65E-01	—	—	1.09E-01	1.97E-01	3.13E-01
3/22/2011	2.60E-02	4.57E-03	3.34E-02	9.71E-01	6.99E-02	—	—	3.04E-03	5.65E-02	8.19E-02
3/23/2011	1.42E-02	1.82E-03	1.56E-02	3.76E-01	2.71E-02	—	—	8.19E-03	1.65E-02	1.81E-02
3/24/2011	7.95E-03	1.16E-03	1.09E-02	4.74E-02	2.06E-02	—	—	5.41E-03	1.08E-02	8.90E-03
3/25/2011	1.23E-02	1.66E-02	1.69E-01	6.77E-01	1.72E-01	—	—	8.14E-02	1.51E-01	1.11E-01
3/26/2011	4.46E-03	5.32E-03	5.84E-02	1.61E-01	2.87E-02	—	—	2.55E-02	3.98E-02	3.20E-02
3/27/2011	4.45E-03	4.04E-03	5.36E-02	3.33E-01	1.63E-02	—	—	2.91E-02	5.49E-02	3.26E-02
3/28/2011	1.66E-02	1.11E-02	1.89E-01	6.78E-01	5.71E-02	—	1.68E-02	5.42E-02	9.30E-02	3.97E-02
3/29/2011	2.78E-02	2.02E-02	2.95E-01	3.36E-01	2.62E-02	—	—	4.46E-02	9.40E-02	2.94E-02
3/30/2011	7.92E-02	4.78E-02	9.53E-01	5.22E-01	8.09E-02	4.29E-01	5.36E-02	1.14E-01	2.08E-01	6.43E-02
3/31/2011	8.12E-03	6.00E-03	9.78E-02	1.10E-01	1.51E-02	—	—	2.35E-02	5.02E-02	1.08E-02
4/1/2011	4.99E-03	3.93E-03	6.05E-02	1.54E-01	1.33E-02	—	—	2.28E-02	4.50E-02	8.29E-03
4/2/2011	6.29E-03	4.96E-03	7.68E-02	1.46E-01	1.34E-02	—	—	3.09E-02	4.78E-02	9.14E-03
4/3/2011	8.43E-03	5.02E-03	9.82E-02	1.96E-01	1.25E-02	—	—	3.47E-02	6.63E-02	9.50E-03
4/4/2011	6.27E-03	4.37E-03	7.67E-02	1.11E-01	8.47E-03	—	—	2.63E-02	4.96E-02	6.27E-03

Atmospheric radioactivity concentration (Bq/m<sup>3</sup>) of selected nuclides measured at the U.S. Yokota Air Base ,

They were I-131, I-132, Cs-134, Cs-136, and Cs-137 .

Note 2: The Te-132 concentration at Yokota Air Base on March 14 was 48.2Bq/m<sup>3</sup>.

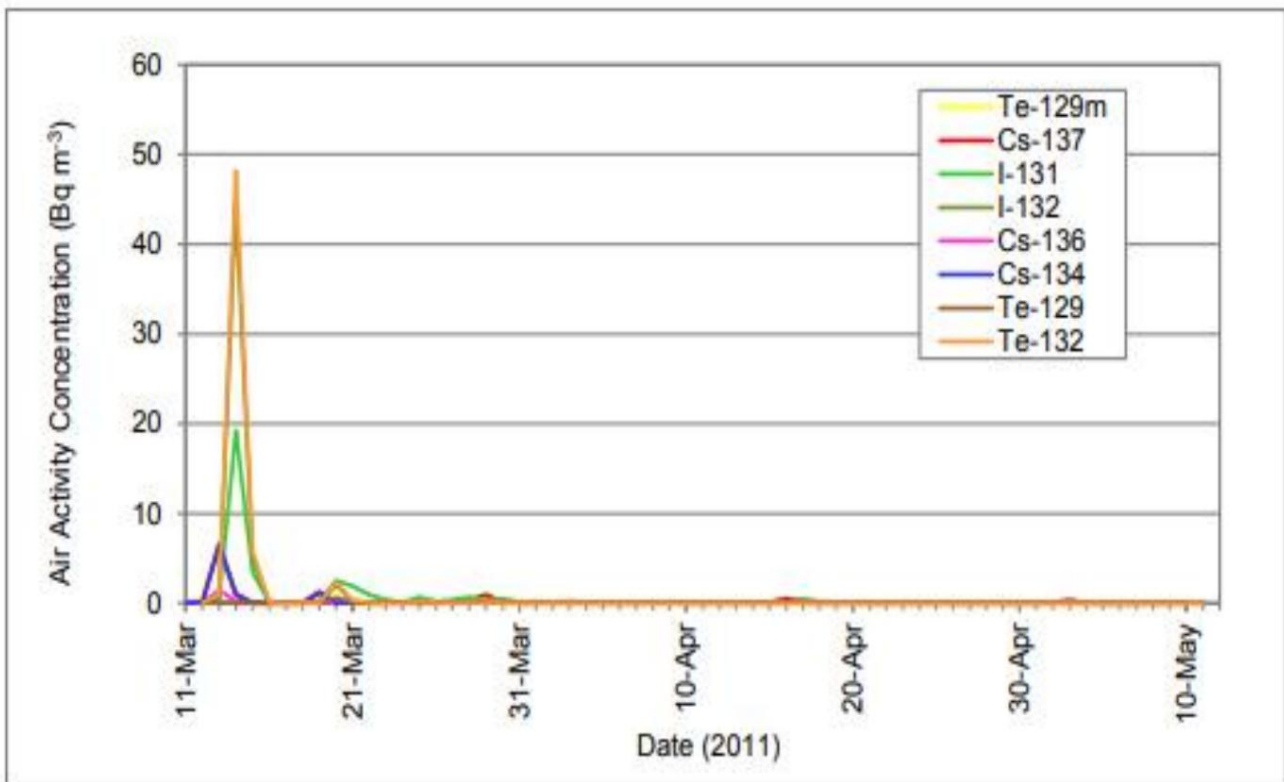


Figure 25. Air activity concentrations measured at Yokota Air Base for selected radionuclide

## Modeled atmospheric radioactivity concentration (Bq/m

3 )

Main detected nuclides: Te-129, Te-129m, Te-131m, Te-132, I-131, I-132, Cs-134,

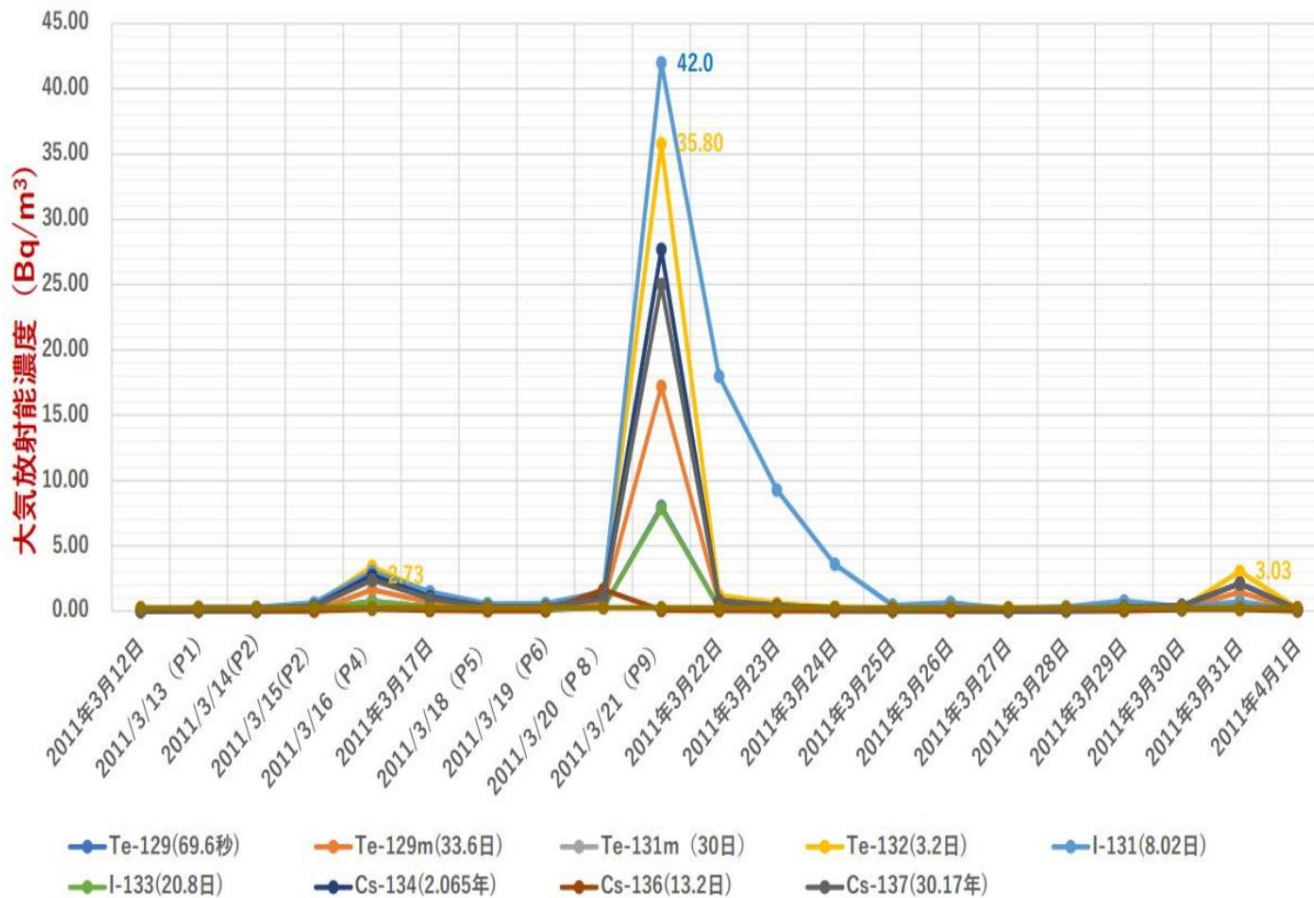
Cs-136, Cs-137

Date	Cs-134	Cs-136	Cs-137	I-131	I-132	La-140	Mo-99	Tc-99m	Te-129	Te-129m	Te-131m	Te-132
(Bq m <sup>-3</sup> )												
3/11/2011	0.00E+00	0.00E+00	1.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-02	0.00E+00	1.00E-02	0.00E+00	1.00E-02
3/12/2011	0.00E+00	0.00E+00	1.00E-02	0.00E+00	0.00E+00	0.00E+00	0.00E+00	3.00E-02	0.00E+00	1.00E-02	0.00E+00	1.00E-02
3/13/2011	1.40E-01	1.00E-02	1.30E-01	2.90E-01	4.00E-02	1.00E-02	1.00E-02	3.70E-01	4.00E-02	9.00E-02	1.00E-02	1.80E-01
3/14/2011	1.40E-01	1.00E-02	1.30E-01	2.90E-01	4.00E-02	1.00E-02	1.00E-02	3.70E-01	4.00E-02	9.00E-02	1.00E-02	1.80E-01
3/15/2011	3.80E-01	2.00E-02	3.50E-01	6.40E-01	1.10E-01	2.00E-02	2.00E-02	9.90E-01	1.10E-01	2.40E-01	3.00E-02	4.90E-01
3/16/2011	2.73E+00	1.60E-01	2.38E+00	3.02E+00	7.50E-01	1.10E-01	1.60E-01	6.86E+00	7.60E-01	1.64E+00	2.00E-01	3.41E+00
3/17/2011	1.09E+00	6.00E-02	9.70E-01	1.47E+00	3.10E-01	4.00E-02	7.00E-02	2.80E+00	3.10E-01	6.70E-01	8.00E-02	1.39E+00
3/18/2011	3.20E-01	2.00E-02	2.90E-01	5.60E-01	9.00E-02	1.00E-02	2.00E-02	8.30E-01	9.00E-02	2.00E-01	–	4.10E-01
3/19/2011	3.30E-01	2.00E-02	3.00E-01	5.70E-01	9.00E-02	1.00E-02	2.00E-02	8.60E-01	1.00E-01	2.00E-01	–	4.30E-01
3/20/2011	1.10E+00	6.00E-02	9.80E-01	1.48E+00	3.10E-01	4.00E-02	7.00E-02	2.82E+00	3.10E-01	6.70E-01	–	1.40E+00
3/21/2011	2.77E+01	1.65E+00	2.50E+01	4.20E+01	7.85E+00	1.13E+00	1.71E+00	7.20E+01	8.01E+00	1.72E+01	–	3.58E+01
3/22/2011	7.50E-01	6.00E-02	8.40E-01	1.80E+01	2.60E-01	4.00E-02	–	–	2.70E-01	5.70E-01	–	1.20E+00
3/23/2011	4.10E-01	3.00E-02	4.30E-01	9.27E+00	1.30E-01	2.00E-02	–	–	1.40E-01	2.90E-01	–	6.10E-01
3/24/2011	2.20E-01	1.00E-02	2.00E-01	3.59E+00	6.00E-02	1.00E-02	–	–	6.00E-02	1.40E-01	–	2.90E-01
3/25/2011	1.20E-01	1.00E-02	1.40E-01	4.50E-01	4.00E-02	1.00E-02	–	–	4.00E-02	1.00E-01	–	2.00E-01
3/26/2011	1.90E-01	1.00E-02	2.20E-01	6.50E-01	7.00E-02	1.00E-02	–	–	7.00E-02	1.50E-01	–	3.10E-01
3/27/2011	7.00E-02	0.00E+00	7.00E-02	1.50E-01	2.00E-02	0.00E+00	–	–	2.00E-02	5.00E-02	–	1.10E-01
3/28/2011	7.00E-02	0.00E+00	7.00E-02	3.20E-01	–	0.00E+00	–	–	2.00E-02	5.00E-02	–	1.00E-01
3/29/2011	3.10E-01	2.00E-02	2.90E-01	7.70E-01	–	1.00E-02	–	–	9.00E-02	2.00E-01	–	4.20E-01
3/30/2011	4.30E-01	2.00E-02	3.80E-01	3.20E-01	–	2.00E-02	–	–	1.20E-01	2.60E-01	–	5.40E-01
3/31/2011	2.12E+00	1.40E-01	2.12E+00	7.00E-01	–	1.00E-01	–	–	6.80E-01	1.45E+00	–	3.03E+00
4/1/2011	1.50E-01	1.00E-02	1.50E-01	1.00E-01	–	1.00E-02	–	–	5.00E-02	1.00E-01	–	2.20E-01
4/2/2011	1.00E-01	1.00E-02	1.00E-01	1.50E-01	–	0.00E+00	–	–	3.00E-02	7.00E-02	–	1.50E-01
4/3/2011	1.30E-01	1.00E-02	1.30E-01	1.30E-01	–	1.00E-02	–	–	4.00E-02	9.00E-02	–	1.80E-01
4/4/2011	2.40E-01	1.00E-02	2.20E-01	3.50E-01	–	1.00E-02	–	–	7.00E-02	1.50E-01	–	3.10E-01
4/5/2011	1.20E-01	1.00E-02	1.20E-01	1.30E-01	–	1.00E-02	–	–	4.00E-02	8.00E-02	–	1.70E-01

Atmospheric radioactivity concentration at Sendai Airport US Military Camp Base from March 12, 2011 to April 1, 2011, created from the table on the previous page.

( $\text{Bq}/\text{m}^3$ ) change over time

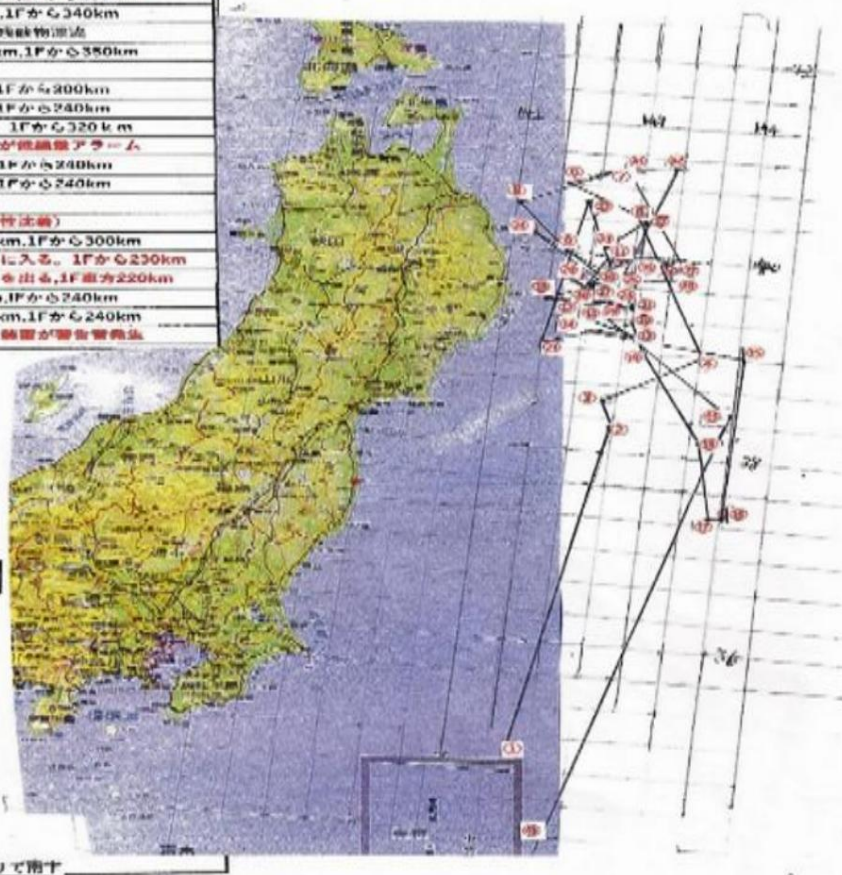
Note 1: Te-132 concentration on March 21st was 35.8Bq/m<sup>3</sup>.



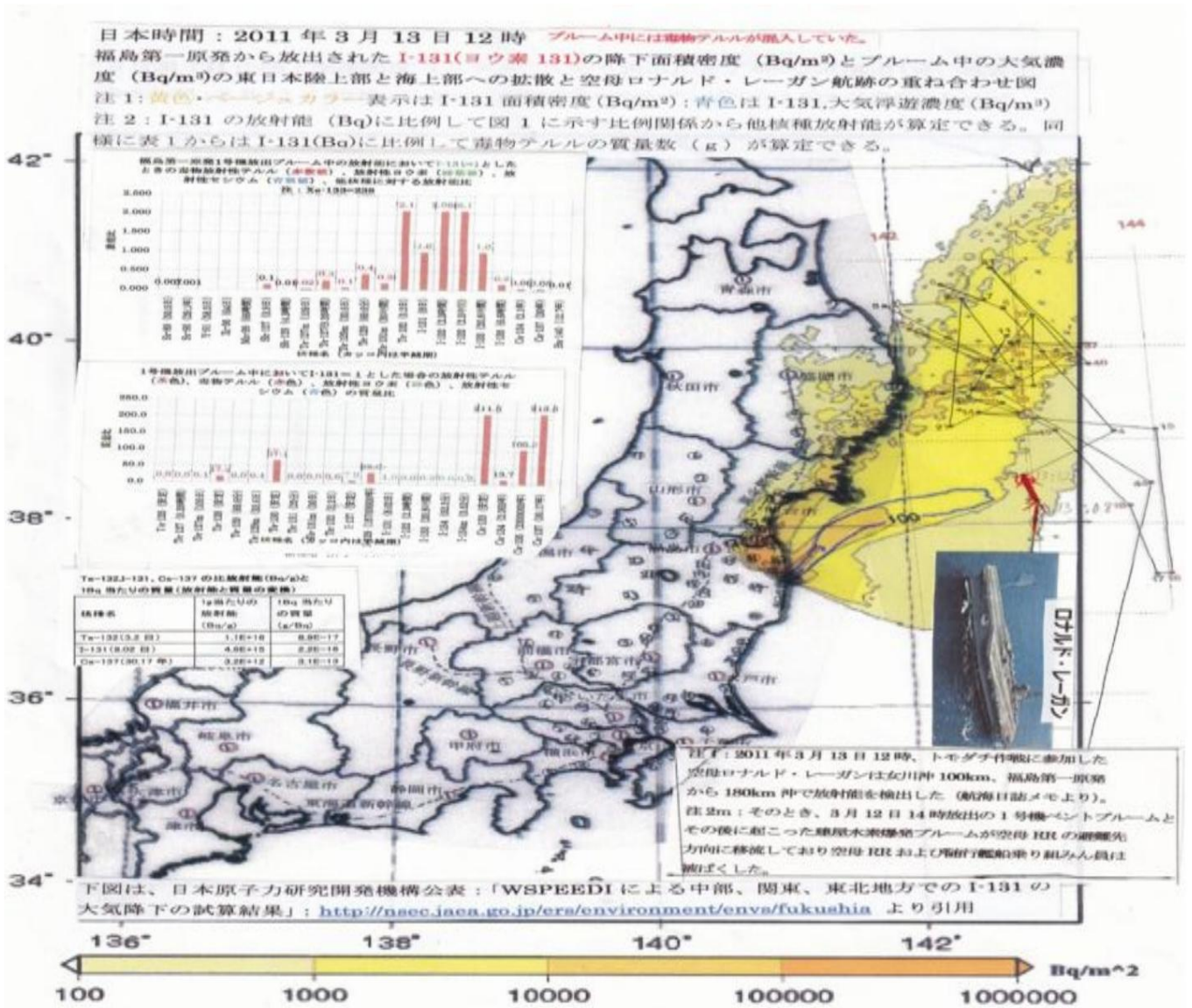
Note 1: 12:00, March 13, 2011: There is a record of "radiation detection" in the sea area 100m east of Onagawa, point y . Note 2: March 16, 2011, 20:00: There is a record of "radiation measuring instrument alarm" at point y. Note 3: March 17, 2011, 5 Figure 7 minutes: At point y, "radiation plume enters". , 230 km from the 1st floor. Note 4: March 22, 2011, 9:00 a.m.: There is a record that "Bell tower washdown (decontamination) work will be carried out" at Point y.

「原子力空母ロナルドレーガンはいつどこで被ばくしたのか」 航路口録記録より  
 ①航路地点ポイント番号②地点の日時③地点の緯度④地点の経度⑤備考 (放射線検出など)  
 ◎2011年3月12日20時の東海沖から4月8日8時の房総半島沖から特設保護池へ向けた航路の口録まで。

①航路地点のポイント番号	②ポイント番号地点の日時	③ポイント番号地点の緯度(北緯)	④ポイント番号地点の経度(東経)	⑤備考
①	3月12日20時	38度22分	142度27分	船浦沖
②	3月13日0時			目的地を韓国釜山から日本に空軍
③	13日4時	38度16分	142度59分	鹿島山直下20km,1Fから100km
④	13日12時	38度42分	142度40分	文川東方100km,1Fから180km(12日12時から14日12時まで放射線検出)
	13日12時			運河飛行甲板で30倍の放射線検出。東海経路へ1Fから50マイルの日本領海(ひゅうが)に降りた。北から毎分2500カウントも高い放射線検出
⑤	13日20時	39度25分	143度43分	大船座東方160km,1Fから280km
⑥	14日4時	40度24分	142度56分	福島東方100km,1Fから240km
⑦	14日11時43分	40度40分	142度28分	海上に津波被害残骸物漂流
⑧	14日12時	40度22分	141度45分	八戸東方100km,1Fから380km
⑨	14日18時5分	40度32分	141度44分	津波被害
⑩	15日5時	40度5分	142度28分	黒松東方40km,1Fから300km
⑪	15日12時	39度40分	142度45分	田舎東方80km,1Fから240km
⑫	16日20時	40度14分	142度51分	久米東方80km,1Fから320km 放射線測定器が放射線アラーム
⑬	16日8時	39度22分	142度50分	大船座東方160km,1Fから300km
⑭	16日12時	39度14分	142度40分	放射線アラームに入る,1Fから230km
⑮	16日18時18分	39度18分	142度31分	碓氷東方70km,1Fから240km 2隻の小型船
⑯	16日19時3分			雷で低視界(悪天候)
⑰	16日20時	39度8分	144度6分	大船座東方160km,1Fから300km
⑱	16日21時	37度28分	144度0分	放射線アラームに入る,1Fから230km
⑲	17日5時7分	37度25分	143度54分	放射線アラームが出る,1Fから220km
⑳	17日8時	36度10分	143度45分	碓氷東方210km,1Fから240km
㉑	17日12時	36度4分	142度16分	大船座東方120km,1Fから240km 放射線アラーム装置が警告音を出す
㉒	17日13時39分			
㉓	17日20時	39度19分	142度42分	
㉔	18日4時	39度15分	142度21分	
㉕	18日12時	40度38分	142度39分	
㉖	18日20時	39度37分	142度57分	
㉗	19日4時	40度14分	142度7分	
㉘	19日20時	39度40分	142度14分	
㉙	20日12時	39度29分	142度18分	
㉚	20日20時	39度20分	142度50分	
㉛	21日4時	39度40分	142度39分	
㉜	21日20時	39度30分	142度40分	
㉝	22日8時	39度31分	142度34分	
	22日10時10分			ベトナムのウォッシュダウン(船体)
				作業終了
㉞	22日12時	39度22分	142度4分	
㉟	24日18時	40度21分	143度11分	
㊱	25日12時	40度5分	143度54分	
㊲	26日12時	40度3分	142度56分	
㊳	27日12時	40度18分	142度10分	
㊴	28日12時	40度59分	142度16分	
㊵	29日12時	40度59分	143度28分	
㊶	30日12時	40度6分	142度0分	
㊷	31日12時	39度40分	142度40分	
㊸	4月1日12時	39度50分	143度31分	
㊹	4月2日12時	40度12分	142度49分	
㊺	4月3日12時	40度10分	143度20分	
㊻	4月4日12時	39度27分	142度27分	
㊼	4月4日20時	39度26分	143度50分	
㊽	4月5日8時	39度13分	142度48分	特設保護池へ向けて出す



I-131 plume radioactivity concentration (Bq/ m3: shown in blue line), atmospheric fallout radioactivity concentration (Bq/m3 : shown in beige color), and aircraft carrier RR from WSPEEDI at 12:00 on March 13, 2011 Overlaid map of the track map (red arrow indicates navigation position) Note 1: According to the logbook, at 12:00 on March 13, 2011, the aircraft carrier RR made the first radioactivity detection in an area 100 km off the coast of Onagawa. Note 2: According to WSPDDI, the tip of the P1 plume released by Unit 1 on the afternoon of March 12th (blue line plume in the figure: 100Bq/m3) was approaching the aircraft carrier RR, so it is true that the aircraft carrier RR was The unit began to be exposed to radiation due to the plume released from the unit. Note 3: WSPEEDI display is the radioactivity concentration display of I-131, but the US military observation system at that time displays Te-129, Te-129m, Te-131m, Te-132, I-132, I-133, Cs-134, Cs-137 was also detected at the same time.



Tellurium isotopes that cause acute atomic bomb illness in the reactor of a nuclear power plant, there are stable tellurium (Te-128, Te-130) and radioactive tellurium (Te-127, Te-130). Te-127m, Te-129, Te-131, Te-131m, Te-132) were deposited in large quantities and were released during the nuclear power plant accident.

ORIGEN2E デル：福島第一原発事故直後・核分裂停止後の1号機（1日後）、2号機（3日後）、3号機（3日後）の炉心に堆積していたホットパーティクルを形成する核分裂物質の放射能(Bq)と質量(g)及び毒性の分類

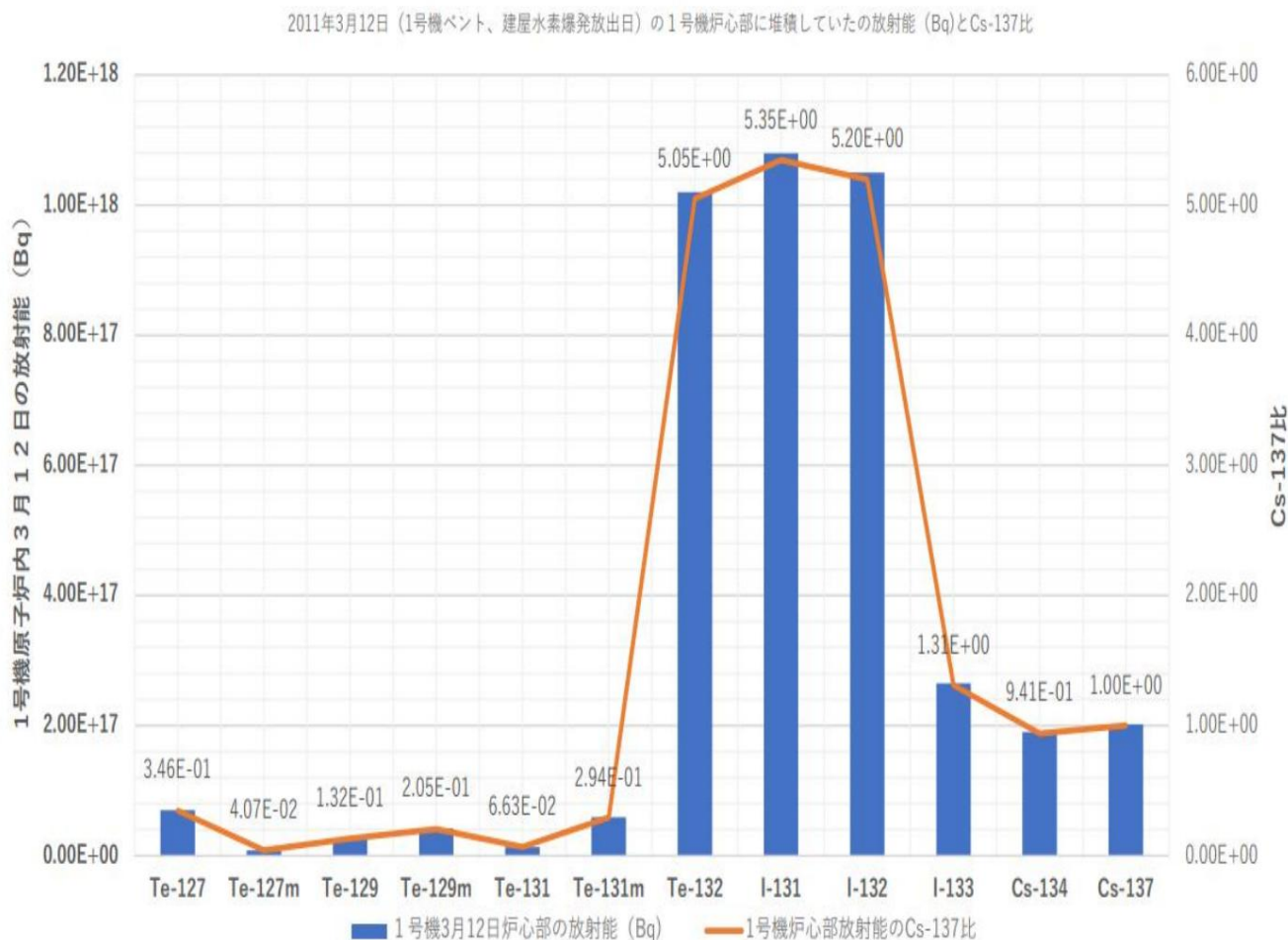
福島第一原発の1号機から6号機の核燃料と原子炉炉心部と使用済み核燃料にホットパーティクルを形成する核分裂物質（毒物テルル1族、放射性ヨウ素、放射性セシウム）が大量に蓄積されているデータは、原子力研究開発機構が発行している「JAEA-Data/Code 福島第一原子力の燃料組評価」に存在していた。

		原発事故前から1号機、2号機、3号機の炉心に堆積していた②放射能 (Bq) と③質量 (g)								
		①半減期	1号機炉心の放射能 (Bq)	1号機炉心の質量 (g)	2号機炉心の放射能 (Bq)	2号機炉心の質量 (g)	3号機炉心の放射能 (Bq)	3号機炉心の質量 (g)	④Bq当たりの質量(g/Bq)	⑤毒性の分類
毒物テルル1族	Te-127	9.35時間	9.48E+16	0.7	1.16E+17	1.2	1.20E+17	1.23	1.02E-17	化学毒+放射毒
	Te-127m	109日	8.19E+15	2.4	1.23E+16	3.5	1.34E+16	3.83	2.86E-16	化学毒+放射毒
	Te-128	7.7×10 <sup>24</sup> 年	0	7070	0	6160	0	5810	0	化学毒
	Te-129	69.6秒	3.97E+16	0.03	4.28E+16	0.1	4.53E+16	0.584	1.29E-18	化学毒+放射毒
	Te-129m	33.6日	4.33E+16	37.3	6.95E+16	62.4	7.07E+16	63.5	8.98E-16	化学毒+放射毒
	Te-130	2.7×10 <sup>21</sup> 年	0	19840	0	24100	0	22700	0	化学毒
	Te-131	25分	4.06E+16	0.01	2.26E+16	0.01	2.31E+16	0.0109	4.72E-19	化学毒+放射毒
	Te-131m	30日	1.80E+17	2.0	1.01E+17	3.4	1.03E+17	3.49	3.39E-17	化学毒+放射毒
	Te-132	3.2日	1.57E+18	90.8	1.76E+18	157	1.76E+18	157	8.90E-17	化学毒+放射毒
放射性ヨウ素	I-129	1.57×10 <sup>7</sup> 年	6.2E+9	9490	7.5E+9	10500	7.1E+9	10800	1.53E-07	放射能毒
	I-131	8.02日	1.26E+18	236	1.87E+18	408	1.86E+18	406	2.18E-16	放射能毒
	I-132	2.3時間	1.84E+18	2.8	1.81E+18	4.7	1.81E+18	4.74	2.62E-18	放射能毒
	I-133	20.8時間	2.65E+17	6.3	4.58E+17	10.9	4.57E+17	10.9	2.38E-17	放射能毒
放射性セシウム	Cs-134	2.065年	1.90E+17	3970	2.76E+17	5770	2.51E+17	5250	2.09E-14	放射能毒
	Cs-137	30.17年	2.02E+17	62700	2.55E+17	79100	2.41E+17	74700	3.10E-13	放射能毒

Radioactivity (Bq) and Cs-137 deposited in Unit 1 on March 12, 2011 (the day of Unit 1 venting and hydrogen explosion release in the building) Note 1:

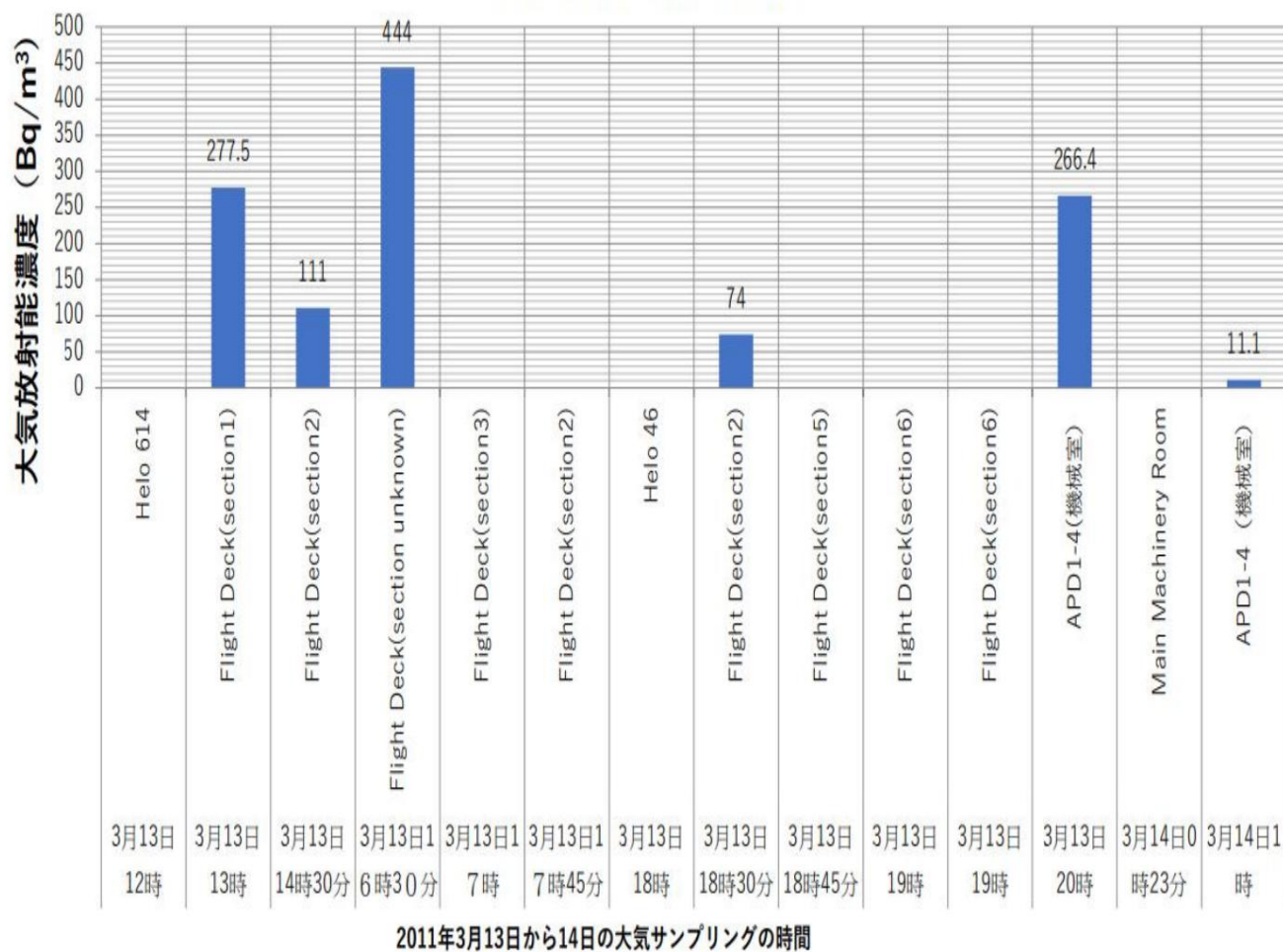
The main nuclides in the Unit 1 emitted plume were Te-129, Te-129m, Te-131, Te-131m, Te-132, I-131, I-132, I-133, Cs-134, and Cs-137. Note

2: When the main nuclide Cs-137 in the Unit 1 plume is set to 1, the radioactivity ratio is Te-129=0.13, Te-129m=0.2, Te-131=0.07, Te-131m=0.3, Te-132 =5.1, I-131=5.4, I-132=5.2, I-133=1.3, Cs-134=0.94, Cs-137=1



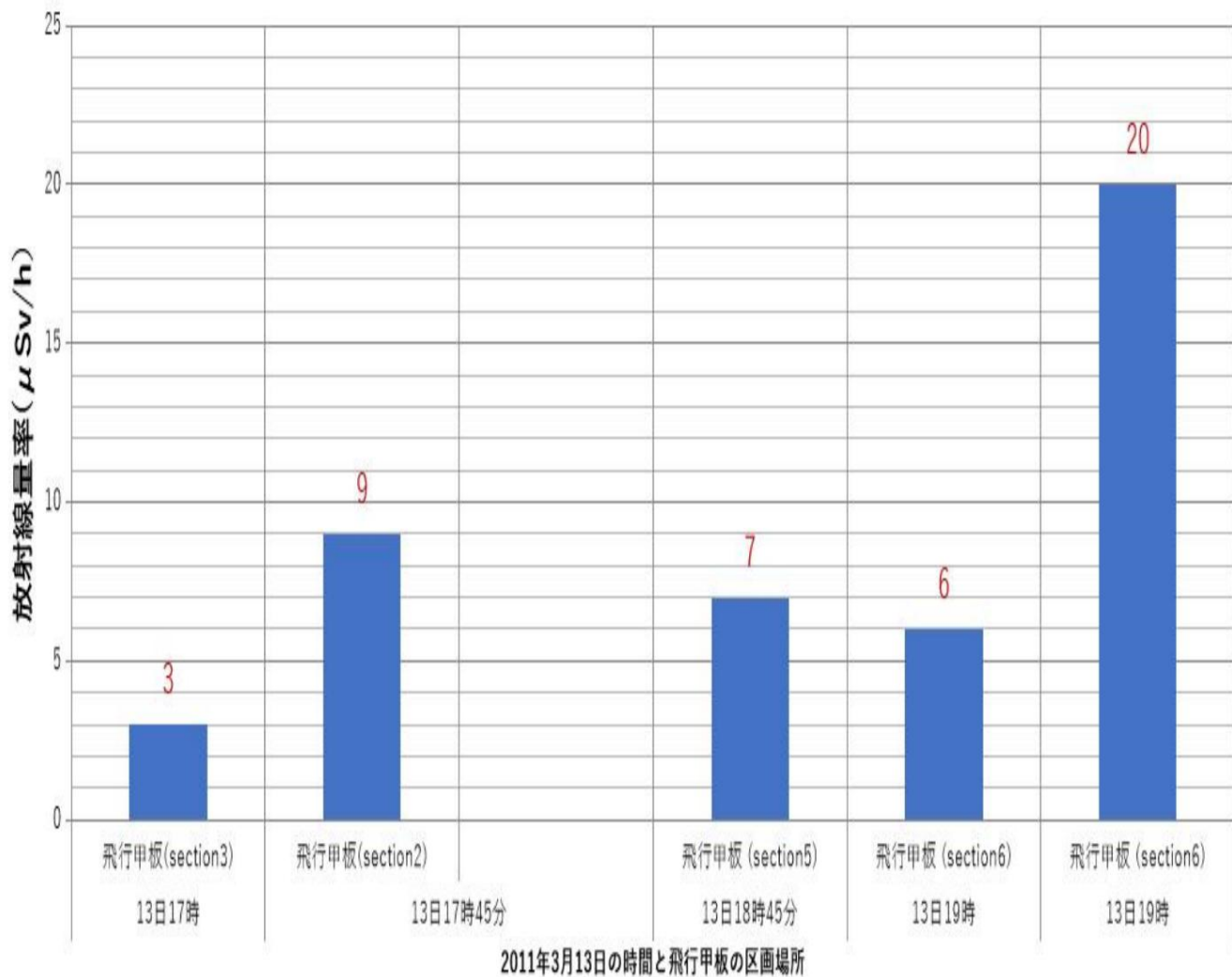
Total atmospheric radioactivity concentration (Bq/m Note: 12:00 on March 13, 2011 by simple measurement method on the deck (by section) and main machinery room of the aircraft carrier USS Ronald Reagan from 12:00 on March 13, 2011 to 1:00 on March 14, 2011 The plume from 1:00 to 1:00 on the 14th was the Unit 1 emission plume, so its Cs-137 radioactivity ratio had the following constituent nuclide ratios: Te-129=0.13, Te-129m=0.2, Te-131=0.07, Te-131m=0.3, Te-132=5.1, I-131=5.4, I-132=5.2, I-133=1.3. It is given by Cs-134=0.94, Cs-137=1 .

図15-1 2011年3月13日12時から14日1時の空母ロナルドレーガンの甲板(セクション別)、主機械室における簡易測定法による大気放射能核種合計濃度 (Bq/m<sup>3</sup>)



**Radiation dose rate ( $\mu\text{Sv/h}$ ) in each section of the flight deck of the aircraft carrier Ronald****Reagan on March 13, 2011** Note: 20 $\mu\text{Sv/h}$  in flight deck

section 6 at 7:00 p.m. on March 13, 2011 is the same as that of March 15, 2011. The radiation dose was comparable to the average value for Fukushima City.

図15-2 2011年3月13日の空母ロナルド・レーガン飛行甲板の各区画場所における放射線量率( $\mu\text{v/h}$ )

Location and radioactivity concentration distribution of R (Aircraft Carrier Ronald Reagan) and M (Destroyer USS John S. McCain) during the 8-hour period on March 13,

2011 Note 1: According to the logbook, aircraft carrier Unit 1 P1 plume at 12:00 on the 13th.”

Radiation dose detected.

Note 2: According to Figure 14, the aircraft carrier RR was at the position with the highest atmospheric concentration at 1:00 on March 13th.

Note 3: Destroyer M was navigating in waters with higher radioactivity concentration than aircraft carrier RR, but destroyer

Due to its highly closed structure, the exposure dose is lower than that of an aircraft carrier RR, which has an open working deck.

It was worth it.

The legend is “Atmospheric concentration of total radioactivity (Ci/m<sup>3</sup>): Ci (Curie) = 3 billion Bq

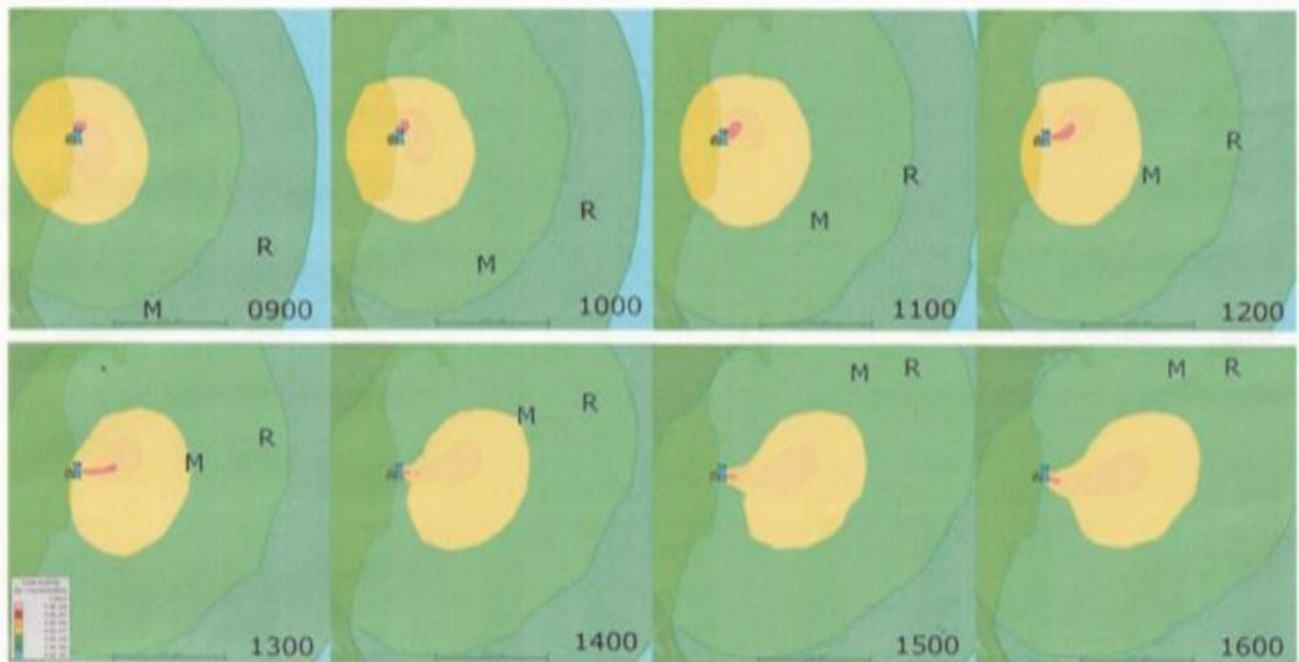


Figure 14. Locations of the USS Ronald Reagan (R) and the USS John S. McCain (M) at eight times on March 13, 2011

Total Activity	
Isotope Air Concentration	
Ci/m <sup>3</sup>	
1.0E-04	1.0E-04
1.0E-05	1.0E-05
1.0E-06	1.0E-06
1.0E-07	1.0E-07
1.0E-08	1.0E-08
1.0E-09	1.0E-09
1.0E-10	1.0E-10

Aircraft carrier Ronald Reagan's PAS (Provided Air Sampling System)

Comparison of HEPA (Hazard Prediction and Assessment Ability Model) atmospheric measurements

Note 1: Unit conversion method  $\dot{\gamma}$  Ci (Curie) = 3 billion Bq (Berel)

Note 2: At 12:00 on March 13, 2011, the radioactive concentration was rising rapidly on aircraft carrier RR No. 1.

This was due to exposure to the released P1 plume. Note 3 : PAS

(Portable air Sample) stands for "portable air pollutant sampling method."

Ru. note4: Aircraft carrier RR's atmospheric radioactivity concentration rose sharply from around 12:00 on March 13th, reaching its peak around 2:00 p.m.

High concentrations were recorded and then decreased around

midnight on the 14th. Note 5: When Cs-137, the main nuclide in the Unit 1 plume, is set to 1, the radioactivity ratio is

Te-129=0.13 $\dot{\gamma}$ Te-129m=0.2 $\dot{\gamma}$ Te-131=0.07 $\dot{\gamma}$ Te-131m=0.3 $\dot{\gamma}$ Te-132=5.1 $\dot{\gamma}$ I-131=5.4 $\dot{\gamma}$

I-132=5.2, I-133=1.3, Cs-134=0.94, and Cs-137=1 .

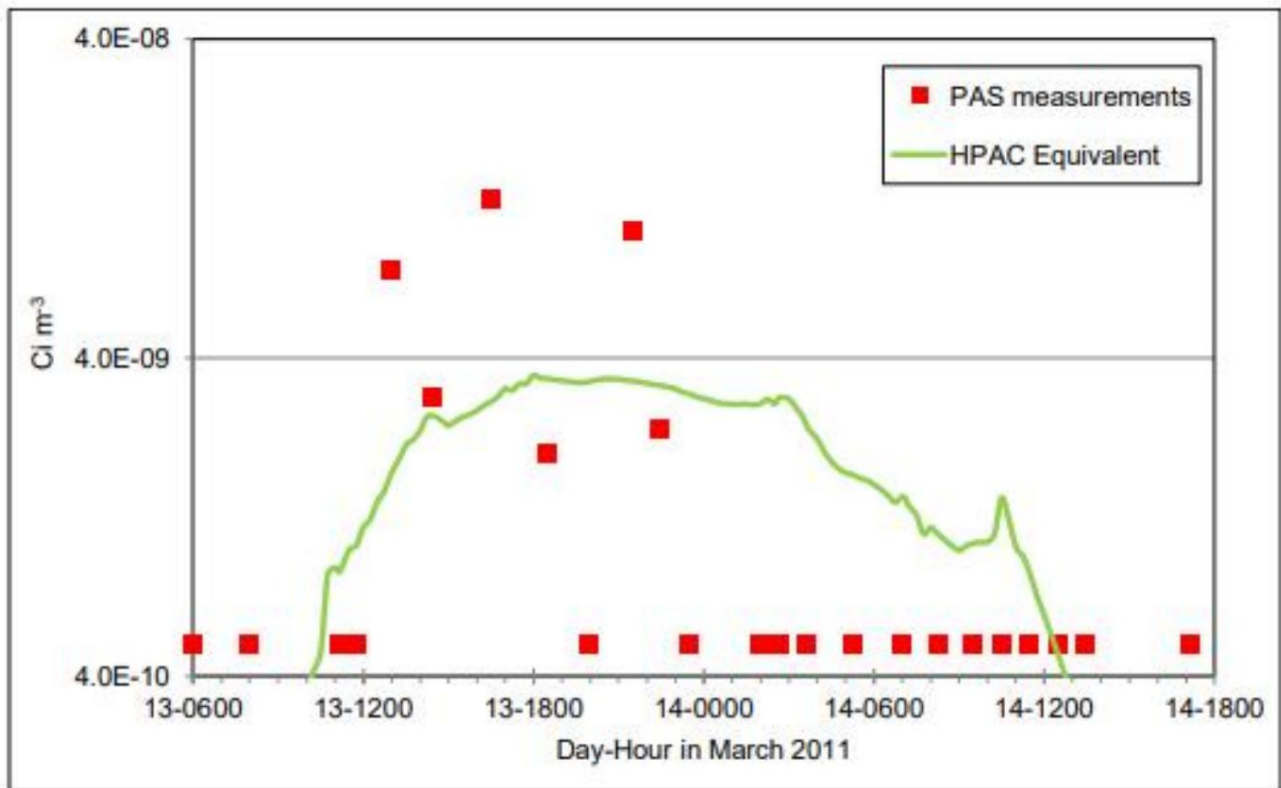


Figure 15. Comparison of USS Ronald Reagan measured and HPAC-generated air concentrations

## Coefficient efficiency and nuclide list in PAS (Provided Atmospheric Sampling System) analysis of the aircraft carrier Ronald Reagan

Note 1: Target nuclides for air ingestion exposure assessment of aircraft carrier RR : Te-129, Te-129m, Te-132, I-131, I-132, I-133, Cs-134, Cs-136, Cs-137

Note 2: Internal exposure radioactivity is "Overall Detection Efficiency" (total nuclide detection efficiency: cpm/dpm)  
It is determined by

Note 3: When measuring a radioactive sample, the ratio of the coefficient rate (cpm) to the decay rate (dpm) is called the "counting efficiency".

Counting efficiency = counting rate (cpm)/disintegration rate (dpm).

**Table H-10. List of isotopes and associated efficiencies for PAS analysis**

Isotope	Beta Particles				Gamma Weighted Efficiency <sup>‡</sup> (cpm dpm <sup>-1</sup> )	Overall Detection Efficiency, <sup>**</sup> $E_i$ (cpm dpm <sup>-1</sup> )
	$E_{max}$ (MeV)	Frequency <sup>*</sup>	G-M Efficiency (cpm dpm <sup>-1</sup> )	Weighted efficiency <sup>†</sup> (cpm dpm <sup>-1</sup> )		
Cs-134	0.622	1.0	0.20	0.20	0.020	0.22
Cs-136	0.341	0.93	0.14	0.14	0.030	0.17
	0.657	0.070	0.20			
Cs-137	0.541	0.93	0.18	0.18	0.010	0.19
	1.18	0.070	0.24			
I-131	0.606	1.0	0.20	0.20	0.010	0.21
I-132	2.12	1.0	0.28	0.28	0.030	0.31
I-133	1.27	1.0	0.25	0.25	0.010	0.26
Te-129	1.45	1.0	0.26	0.26	0.004	0.26
Te-129m	1.60	0.36	0.26	0.094	0.0006	0.095
Te-132	0.220	1.0	0.060	0.060	0.011	0.070

\* Frequency is emissions per disintegration (dis).

† Weighted efficiency for beta particles is the sum of the products of frequency and G-M efficiency for all beta particles.

‡ Weighted efficiency for gamma rays is the product of gamma frequency and an efficiency of 1% (0.01).

\*\* Overall detection efficiency is the sum of weighted efficiency for beta particles and the gamma weighted efficiency.

Summary of "Fear of Tellurium Contamination in Operation Tomodachi" (1) The U.S. Department of Defense Threat Reduction Agency has identified Te-129, Te-129m, Te-131, and Te in the form of atmospheric aerosols as nuclides to which Operation Tomodachi participants are internally exposed. -131m, Te-132, I-131, I-132, I-133, Cs-134, Cs-136, and Cs-137 were recognized as nuclides that should be measured.

(2) According to the U.S. Military Threat Reduction Agency's "Crisis Prediction and Evaluation Capability System" (1) Sailing 100 km off the coast of Onagawa Aircraft carrier Ronald Reagan ̄ Yokota Air Force Base in Fussa City, Tokyo ̄ Yokosuka Port Rice, Kanagawa Prefecture Military Base ̄ Atmospheric radioactivity concentration (Bq/m<sup>3</sup>) measurement  
In, Te-129, Te-129m, Te-131, Te-131m, Te-132, I-131, I-132, I-133, Cs-134 and Cs-136 were actually measured.

(3) According to the "JAEA-Data/Code fuel composition analysis of Fukushima Daiichi Nuclear Power Plant" data, Inside the reactors of Units 1, 2, and 3, which caused the accident, were Te-129, Te-129m, Te-131, Along with short half-life radioactive tellurium Te-131m and Te-132, stable tellurium with an infinite half-life Lulu (Te-128, Te-130) was deposited in "several hundred times more mass than Te-132."

(4) Atmospheric aerosol radioactivity measurements after the nuclear power plant accident at Tsukuba City Meteorological Research Institute: Te-129̄Te-129m̄Te-131̄Te-131m̄Te-132̄I-131̄I-132̄I-133̄Cs-134̄ Cs-136, Cs-137, etc. were detected, but trace chemical analysis using Spring Eight revealed that Stable tellurium was also detected along with cesium.

(5) Considering (3) and (4) above, atmospheric aerosols detected on the aircraft carrier Ronald Reagan In addition to radioactive tellurium (Te-129, Te-129m, Te-131, Te-131m, Te-132), Chemical poisons Te-138 and Te-130, which have an infinite period and zero radioactivity, are mixed in in large quantities. It could have been.

(6) In "Tellurium Poison Book No. 2 The Tragedy of Tellurium in Operation Tomodachi", it is stated that "the plaintiff's opinion in the Operation Tomodachi radiation exposure trial that the damage symptoms are closely related to the chemical poison of tellurium"; In other words, we proved the relationship between ̄ health damage theory and ̄ toxicity theory.

(7) Due to "Tellurium Poison Book No. 3 Fear of Tellurium Contamination in Operation Tomodachi", "̄ Health Exposure" We have been able to prove the three factors that prove the causal relationship: harm theory, ̄ toxicity theory, and ̄ contamination theory. It becomes.

[Author introduction] Profile of Mr. Kunihiro Yamada

Born in Osaka in 1943. After completing graduate school at Kyoto Institute of Technology in 1996, became an assistant at the Faculty of Engineering at Osaka University. Professor of Humanities at Kyoto Seika University since 1997. Director of the NPO Kino Environment, Doctor of Engineering, currently professor emeritus at Kyoto Seika University.

Around 1970, he began research on environmental pollution in the Seto Inland Sea and Lake Biwa. Since 1980, he has been working on issues of trihalomethane in tap water and groundwater contamination. Since the late 1980s, he has been working on the problem of overdevelopment of golf courses, practicing environmental studies that find solutions from the perspective of the victims at the sites where environmental problems occur.

His books include "Golf Course Ruins (Fujiwara Shoten)", "CFCs Destroying the Earth (Iwanami Booklet)", "Why are 600,000 more people suffering from cancer in the Tokyo metropolitan area (Fyhysha)", and "Nuclear Fission and Toxic Substances"? The Discovery of Tellurium (Fujiwara Shoten) and many others.

Tellurium Poison Book No. 3 "The Fear of Tellurium Contamination in Operation Tomodachi"

Distribution price: 500 yen (tax included)

Publication date: December 1, 2023 First edition first printing published

Author: Kunihiro Yamada

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Publisher: 2-19-2 Shimokaizuka, Ichikawa, Chiba 272-0821 Fujiwara-kata