Result of whole body counting for JAEA staff members engaged in emergency radiological monitoring for the Fukushima nuclear disaster

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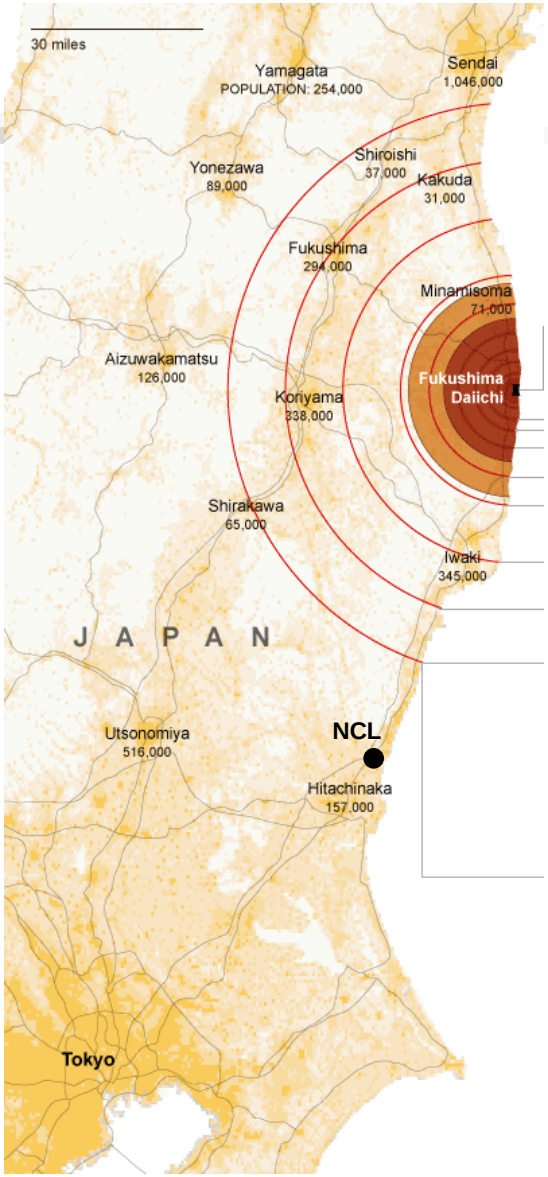
Location


1000km


30 miles
Yamagata
POPULATION: 254,000
Sendai
1,046,000
Yonezawa
89,000
Shiroishi
37,000
Kakuda
31,000
Fukushima
294,000
Minamisoma
71,000
Aizuwakamatsu
126,000
Fukushima
Daiichi
Koriyama
338,000
Shirakawa
65,000
Iwaki
345,000
J A P A N
Utsonomiya
516,000
NCL
Hitachinaka
157,000
Tokyo

Timeline of JAEA's early response against this nuclear disaster (1)

11 Mar.2011

14:46 = Occurrence of the earthquake.

Around 15 = Establishment of the JAEA emergency response headquarters.

21:54 = Announce of the ordered to stay indoors in the area within a 10 km-radius around the site.

22:46 = Request to JAEA from MEXT to dispatch of experts to the scene.

Timeline of JAEA's early response against this nuclear disaster (2)

12 Mar.2011

before dawn = The 1st monitoring team left Ibaraki for Fukushima.

6:30 = Arrive at Okuma Off-site Center.

Around 8 = Start the emergency radiation monitoring.

15:36 = The reactor unit 1 was damaged with hydrogen explosion.

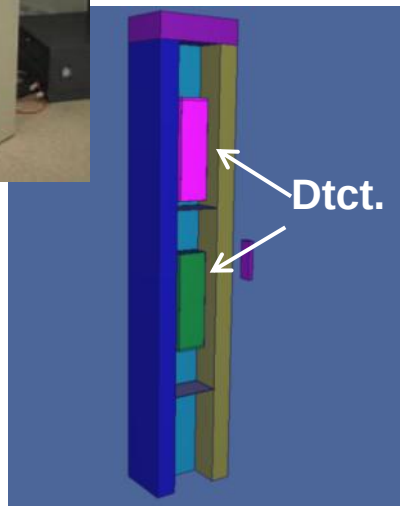
13 Mar. 2011

Eary morning = Start the monitoring by the 2nd team.

WBC counting for staff members

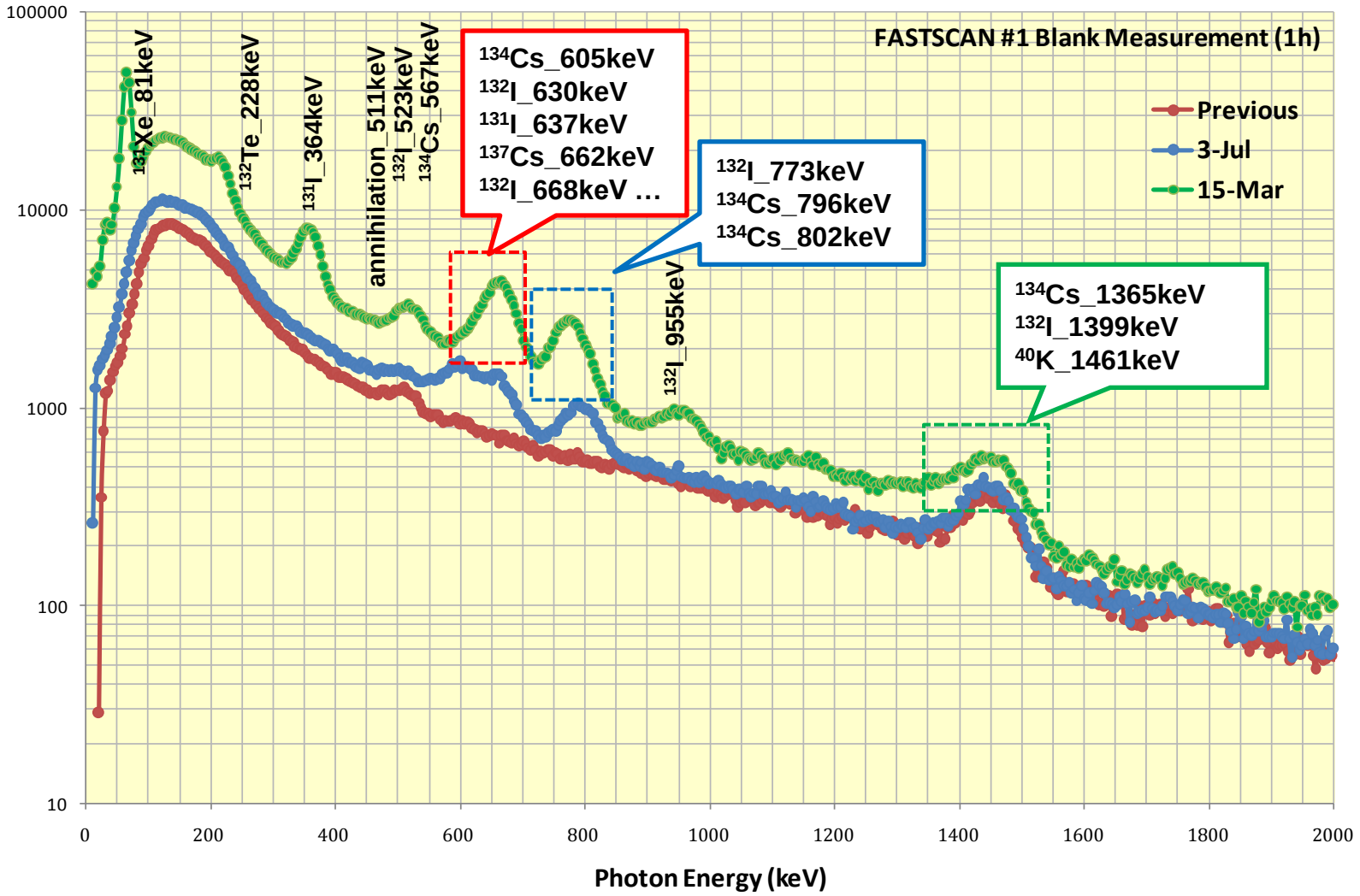
- WBC counting for the staff members engaged in the emergency radiological monitoring were made at their ordinary work site.
- The WBC monitoring program in NCL was started 28 March.
- This presentation is intended for 50 workers who were engaged in the monitoring from 12 March to 11 April and examined until the end of April.
- Stable iodine tablets were not taken by all of them.
- By comparison, the results of the 3 WBC operating staff who stayed in Tokai-mura are used.

Applied WBC – FASTSCAN®

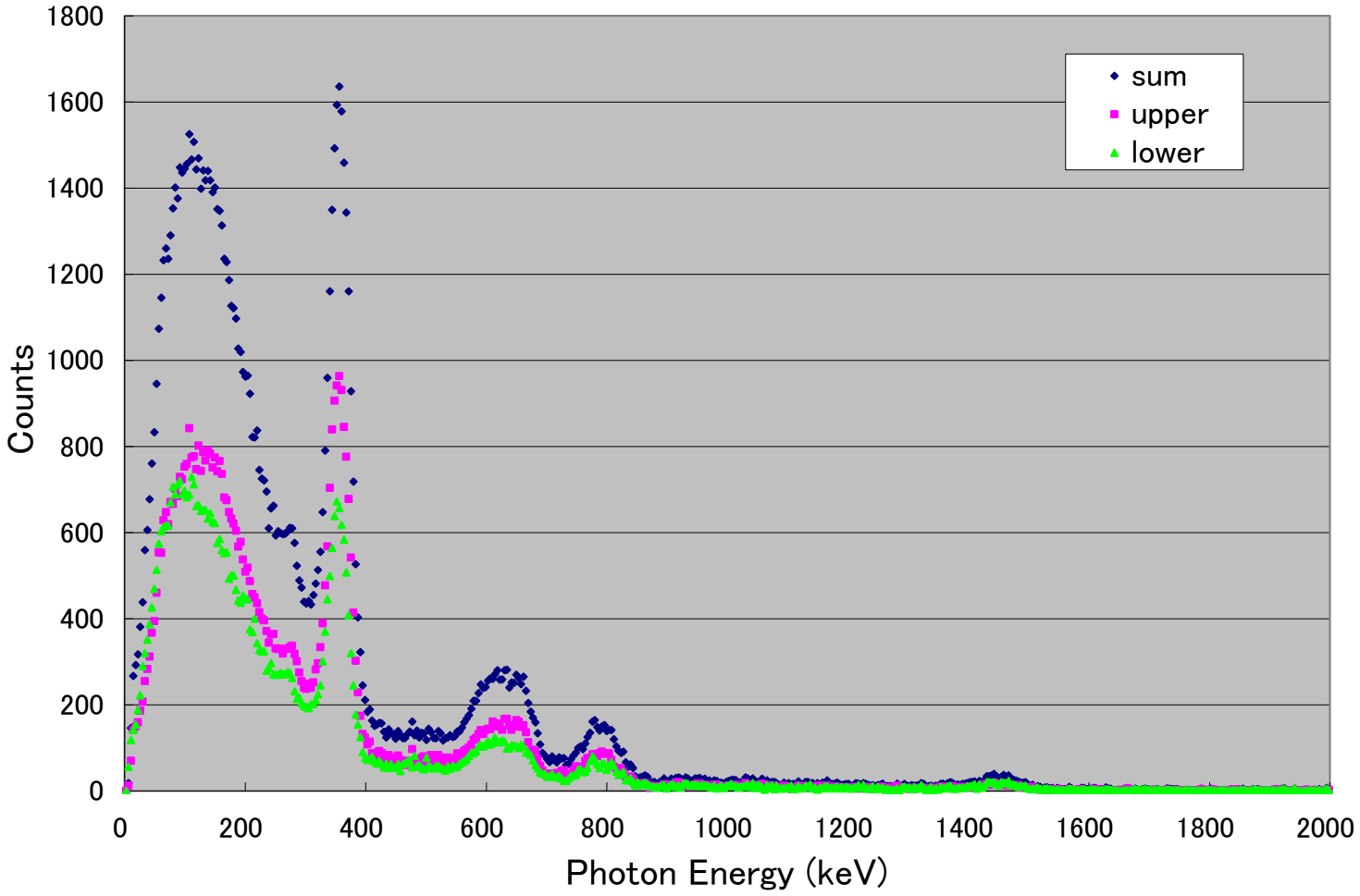


- Canberra, FASTSCAN®
- Vertical Linear Geometry
- Two 7.6 x 12.7 x 40.6 cm (3 x 5 x 16 in.) NaI(Tl) Detectors.
- Shielded in all straight-line directions by 10 cm (4 in.) of low background steel.
- ~300 Bq ^{137}Cs LLD with person in shield for 2 minutes count under the background affected by the desaster.

Background spectrum of FASTSCAN in NCL



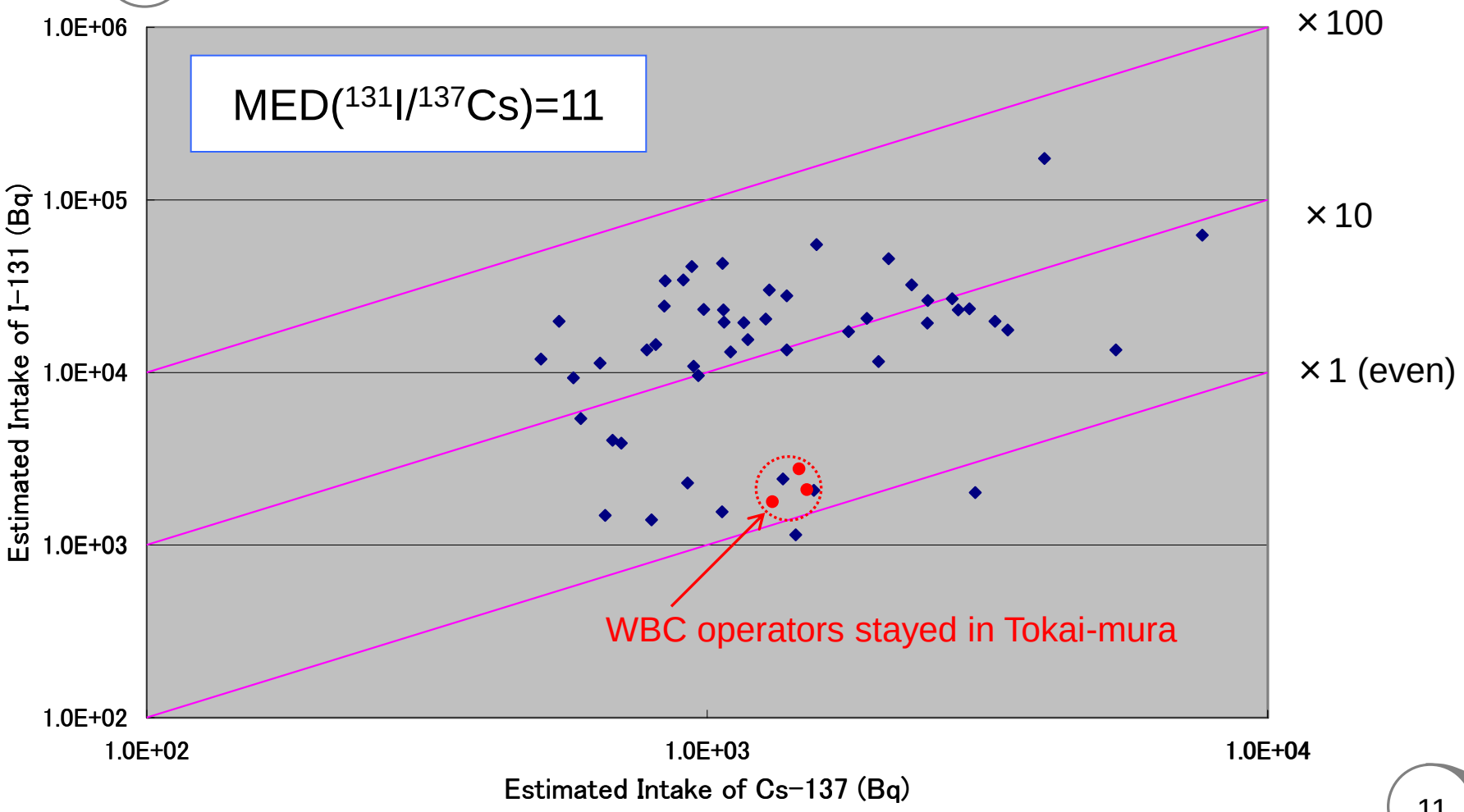
Energy Spectrum of gamma-rays from the worker who detected maximum activity of body content with the WBC



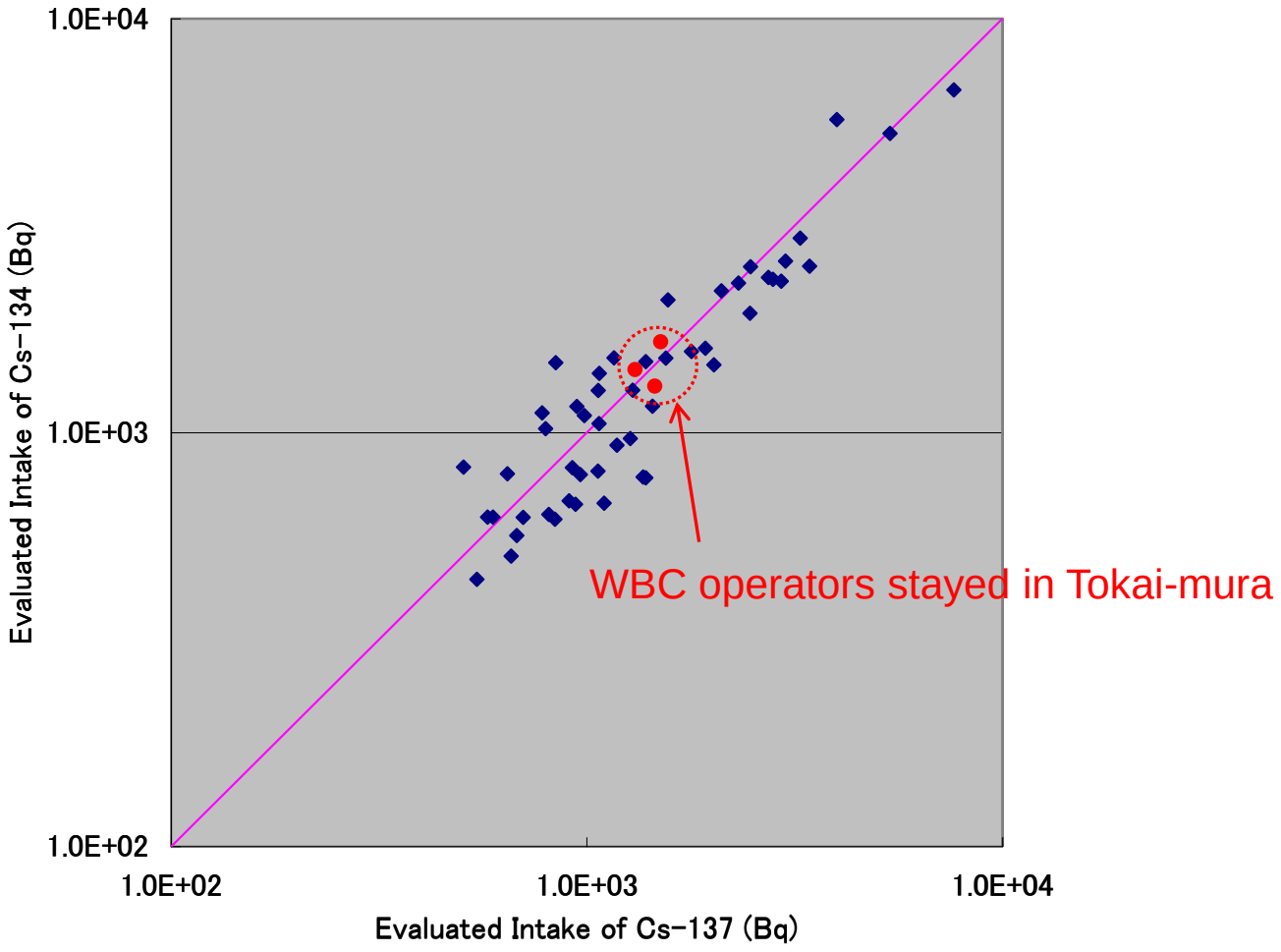
Results of the evaluated CEDs

Period of Monitoring in Fukushima	Number of workers	MAX CED (mSv)	AVG. CED (mSv)
12-14 Mar.	3	0.39	0.34
13-14 Mar.	10	0.70	0.28
14-18 Mar.	7	0.54	0.35
15-20 Mar.	5	0.80	0.30
18-22 Mar.	8	0.25	0.18
Around 4 days of 20 Mar.-11 Apr.	17	0.54	0.13
TOTAL	50	0.80	0.27
[3/15, Tokai-mura]	3	0.05	0.05

Correlation of estimated intakes between ^{137}Cs and ^{131}I



Correlation of estimated intakes between ^{137}Cs and ^{134}Cs



Summary

Whole body counting for 50 staff members engaged in emergency radiological monitoring during the initial month were made.

- ^{131}I, ^{134}Cs and ^{137}Cs were detected in most of the workers
- the internal effective doses of all : < 1 mSv
- the maximum internal effective dose : 0.8 mSv
- the dominant radionuclide for high exposure case : ^{131}I

Future Tasks

- The uncertainty in WBC measurement should be analyzed.
- The difference of correlation of intake activities between ^{137}Cs and ^{131}I would be reviewed.
- CEDs of the person who stayed in Tokai-mura (background of Fukushima activities) should be compared with the airborne data.

Thank you for your kind attention!

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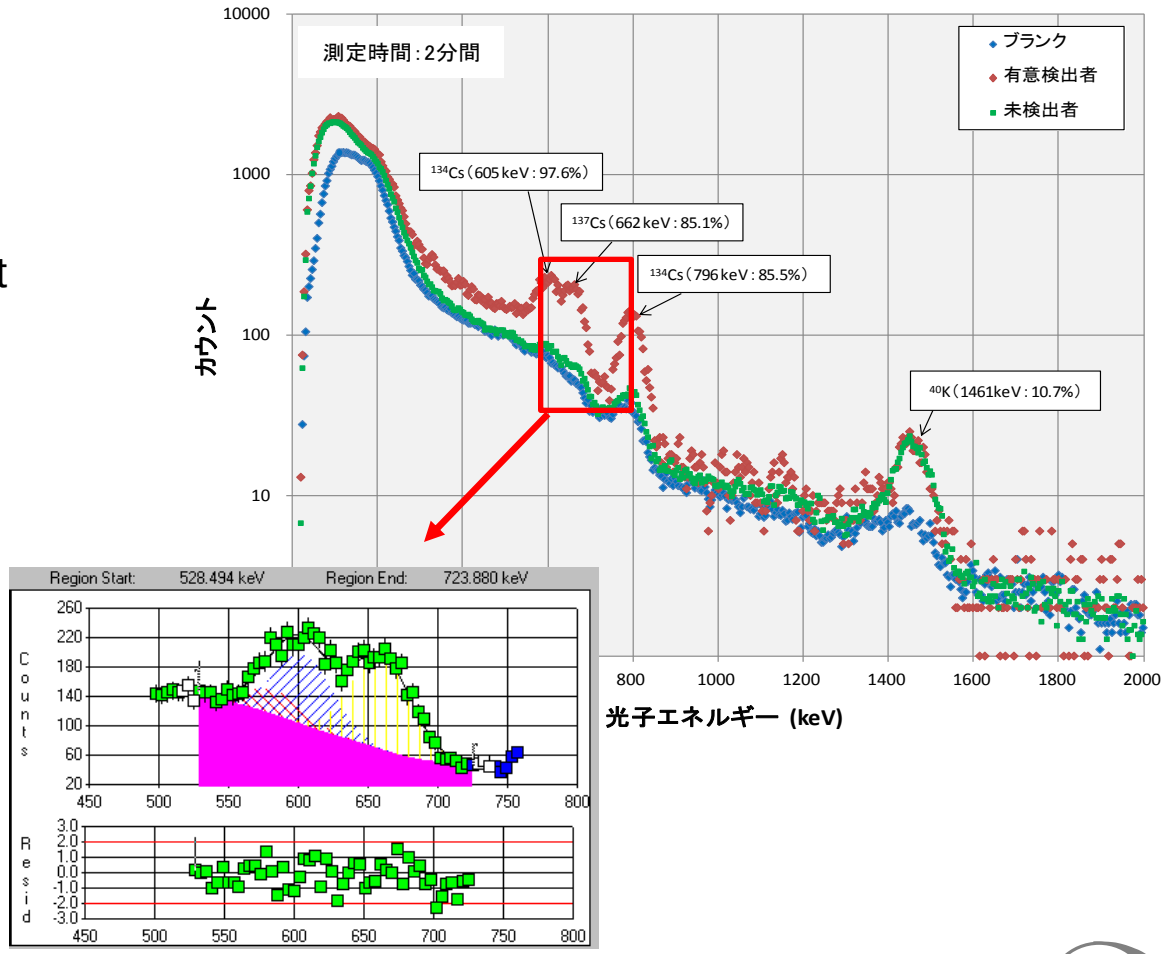
for Supplement

Analysis of the spectrum

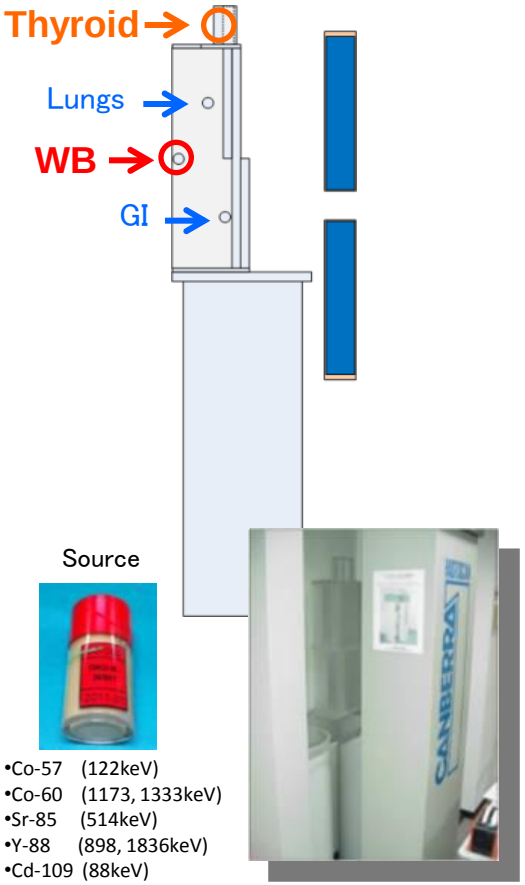
- GENIE2K (Canberra Inc.)
- Sequence of analysis
  - Peak locate: Gamma-M (Peak erosion method)
  - Peak area: LSQ-Gaussian fit
  - Area Correction: BG-strip
  - DL: Currie's MDA

Nuclide Library

Nuclide	Energy (keV)	Yeild (%)
K-40	1461	10.7
I-131	364* 637	81.7 7.2
Te-132	228*	88.0
Cs-134	566 605 796.6* 1167.94 1365	23.8 97.6 92.4 1.8 3.0
Cs-137	662	85.1

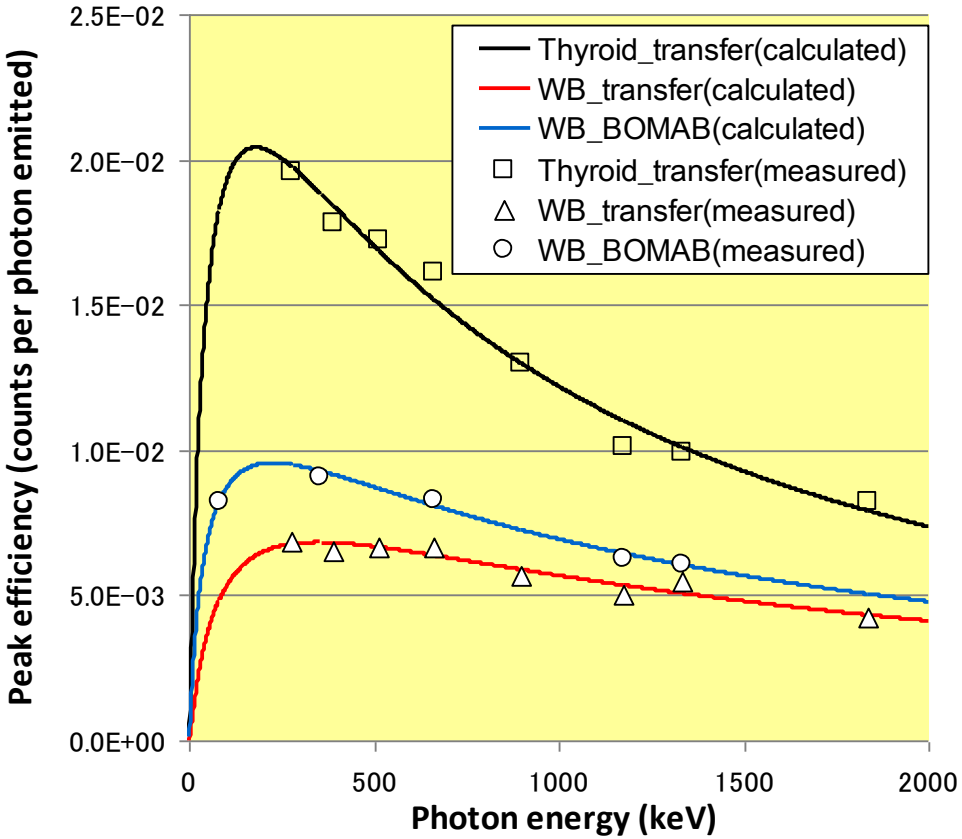


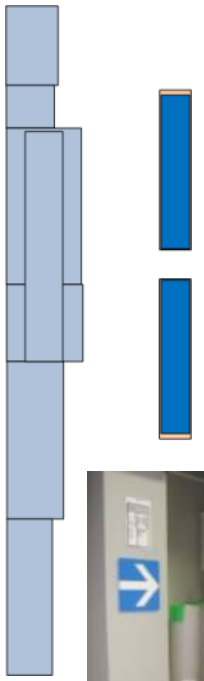
Calibration of Efficiency



•Co-57 (122keV)
•Co-60 (1173, 1333keV)
•Sr-85 (514keV)
•Y-88 (898, 1836keV)
•Cd-109 (88keV)
•Sn-113 (392keV)
•Cs-137 (662keV)
•Ce-139 (166keV)
•Hg-203 (279keV)

Canberra's transfer phantom





BOMAB phantom

Evaluation of the committed effective doses (CEDs)

- CED [Sv] = A_{intake} [Bq] × e (50) [Sv Bq^{-1}]CEDs

  e(50) : the dose coefficient taken from ICRP Publ. 78.

  A_{intake} : estimated intake activity derived by dividing the measured body content by the retention function calculated by the MONDAL3 code.

- The retention function assumed the class of lung solubility with type-F and the particle size with a default AMAD (activity median aerodynamic diameter) of 5 μm for workers.
- On the case of no detection of ^{131}I, ^{134}Cs or ^{137}Cs, the MDA value is assigned for more conservative evaluation.