

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS IN JAPAN DUE TO THE FUKUSHIMA DAIICHI NPP ACCIDENT

**M.A. Lopez (CIEMAT, Spain), P. Fojtik, D. Franck and J. Osko**

EURADOS WG7 "Internal Dosimetry"

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS IN JAPAN DUE TO THE FUKUSHIMA DAIICHI NPP ACCIDENT

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# EURADOS WG7 - Internal Dosimetry

## Collaboration of EURADOS WG7 with NIRS



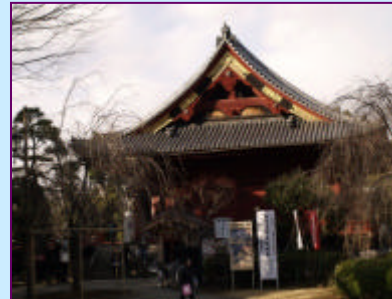
### - National Institute of Radiological Sciences, Japan -

- ✓ EURADOS WG7 was contacted in June 2012 for the revision of the proceedings of 1<sup>st</sup> NIRS Symposium on “Reconstruction of Early Internal Dose in the TEPCO Fukushima Daiichi Nuclear Power Station Accident”, Chiba, Japan, 2012
- ✓ Osamu Kurihara, NIRS (Japan) attended the EURADOS WG7 meeting in Budapest in October 2012

## Invitation to WG7

### 2nd NIRS Symposium and Technical visit to Fukushima

“Reconstruction of Early Internal Dose in the TEPCO FDNPS Accident”,  
Tokyo, January 27-28, 2013



# EURADOS WG7 - Internal Dosimetry

January 2013: some WG7 members attended 2<sup>nd</sup> NIRS Symposium in Tokyo

- ✓ Visit at Fukushima NPP area including J-Village and Fukushima Daiini NPP
- ✓ Proposal of **EURADOS Survey**: **WG7 will collect information about monitoring data of exposed foreigners in Japan, obtained in their respective countries at early stage after Fukushima Daiichi NPP accident**



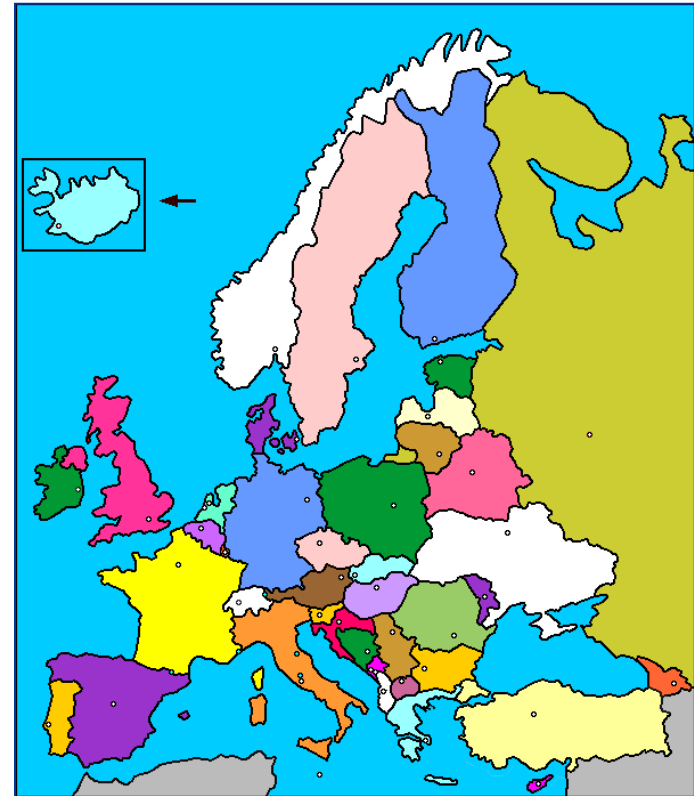
# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

## ➤ EURADOS Survey 2013:

- ✓ 300 foreigners in-vivo monitored from 15 countries (adults and children)

## ➤ 176 exposed persons (adults) from

- ✓ Belgium (9),
- ✓ Canada (1),
- ✓ Czech Republic (8),
- ✓ Finland (1),
- ✓ France (76),
- ✓ Germany (58),
- ✓ Greece (5),
- ✓ Hungary (2),
- ✓ Norway (3),
- ✓ Poland (7),
- ✓ Sweden (1),
- ✓ UK (1)
- ✓ Ukraine (4)



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

## EARLY MEASUREMENTS (MAR- APR 2011)

	No. of cases
Akita	1
Sendai	32
Yonezawa	2
Fukushima City	18
Minamisoma	1
Koriyama	4
Centre (around NPP)	9
Tamura	1
Iwaki	6
Utsunomiya	1
Mito	7
North of Tokyo	2
Chiba	3
Tokyo	49
Osaka	3
Hiroshima	1

**TOTAL: 139**

## LATE MEASUREMENTS (= MAY 2011)

	No. of cases
Miyagi Pref.	1
Sendai	1
Fukushima City	5
Koriyama	1
Tamura	1
NPP	4
Utsunomia	1
Hitachi	3
Tsukuba	1
Ushiku	1
Tokyo	5
Chiba	2
Yokohama	2

**TOTAL: 27**

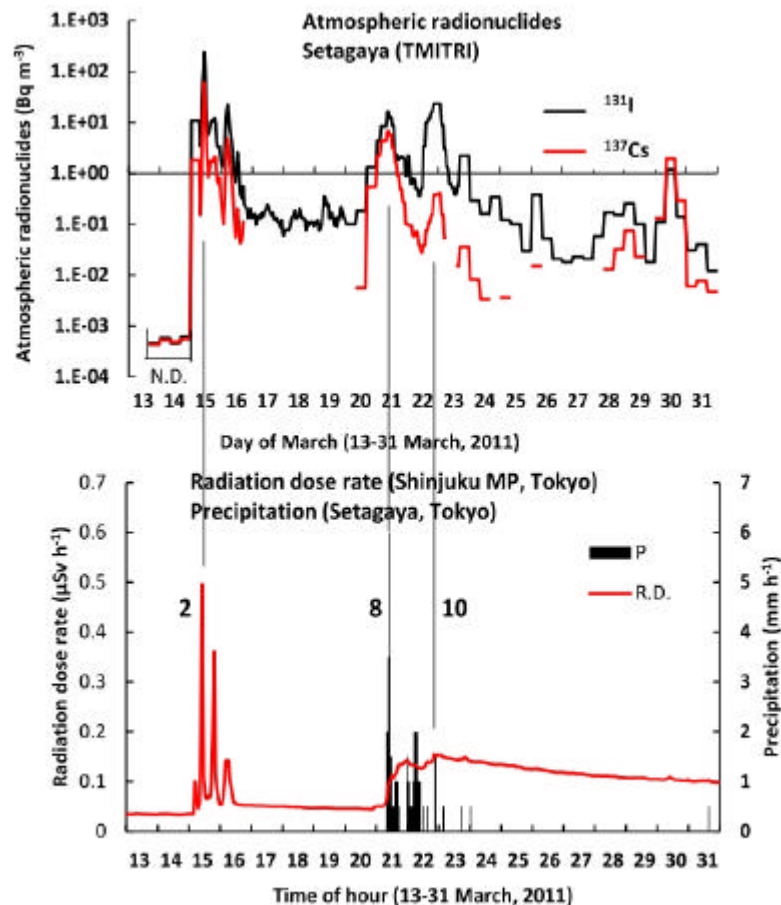
● Internally exposed persons (EURADOS Survey)



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident



## The Internal Exposure:



(4) Setagaya (TMITRI)

H. Tsuruta 2012, 1st NIRS Symposium

- **Release events** from Fukushima Daiichi reactors on **12-25 March 2011**
- Largest releases before 17 March
- **Tokyo:** higher concentration of gamma emitters in the air on 15 March and 21-22 March 2011
- **Internal exposures:** mainly radioiodine and radiocaesium; also Tellurium
- **Fallout** started to be significant on 16 March 2011

## Scenario of EURADOS Survey (I): EXPOSED PERSONS

- Foreigners returned at home after suffering the earthquake and its consequences, concerned about radiological exposure received in Japan.
- Contact with regulatory bodies and/or National Administration and Dosimetry labs.
  - **Questionnaires to collect information** about location in Japan during the Fukushima Daiichi NPP accident, diet habits, time spent indoor/outdoor,...
- **Internal dosimetry services/laboratories:** not easy to make public understand and trust in the results of in-vivo and in-vitro monitoring and dose. It was required social skills and empathy with the exposed persons being monitored.
- **Members of the public** with no knowledge about radioactivity, had to trust in authorities and dosimetrists to understand the results of the measurements.  
Main concern: health effects of the intakes detected



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

## Scenario of EURADOS Survey (II): INTERNAL DOSIMETRY SERVICES/LABORATORIES

- **Capabilities required for in-vivo monitoring of gamma emitters:**
  - Whole Body Counter for the measurement of gamma-emitters in total body (radiocaesium isotopes, also  $^{132}\text{Te}$ )
  - Thyroid counting for evaluation of radiiodine in thyroid ( $^{131}\text{I}$ ,  $^{132}\text{I}$ )
  - Calibration for adults and for children
- **Assumptions for interpretation of monitoring data & dose calculations.** 1st approach:
  - Inhalation of gamma emitters from the radioactive plume (release phase)
  - Time of intake; 12 March 2011
  - Members of the Public: particle size AMAD= 1  $\mu\text{m}$
- **Communication with people being in-vivo monitored:** language of science with “easy words” in order people understand and trust in the results of measurements and dose

# EURADOS SURVEY:

## IN-VIVO MONITORING of gamma emitters in total body and radioiodine in thyroid

### (1) HP Ge detectors for gamma emitters in Total Body:

Mobile Units:



WBC- Shielded Rooms: Chair and bed counting geometries:

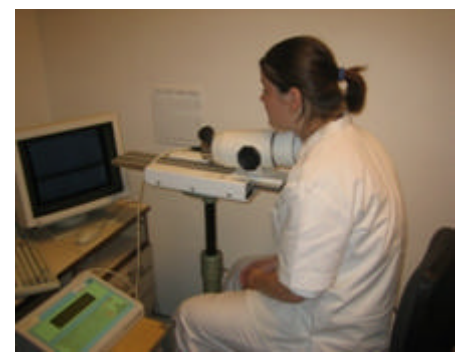


### (2) NaI(Tl) detectors:

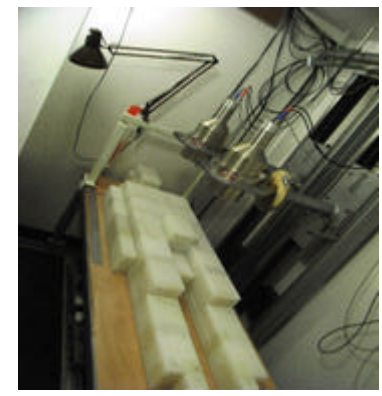
**FASTSCAN WBC:**  
2 NaI(Tl)  
Total Body &  
Thyroid  
Monitoring, also  
in Fukushima  
site



NaI(Tl) detector:  
<sup>131</sup>I, <sup>132</sup>I in Thyroid



(3) NaI(Tl) + HPGe detectors:  
shielded room, Total Body



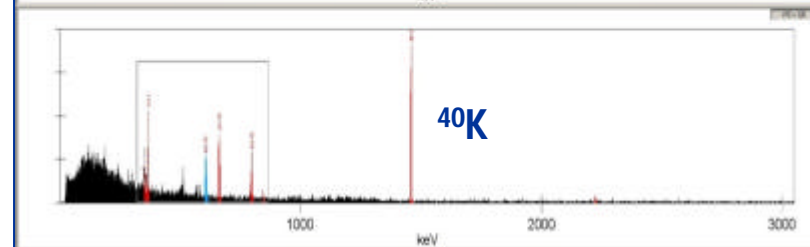
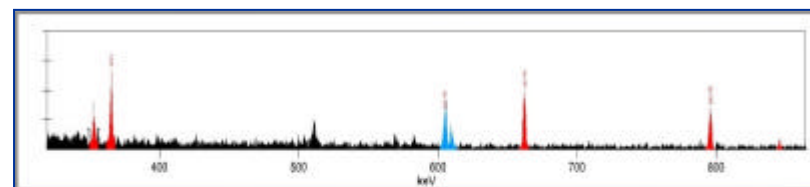
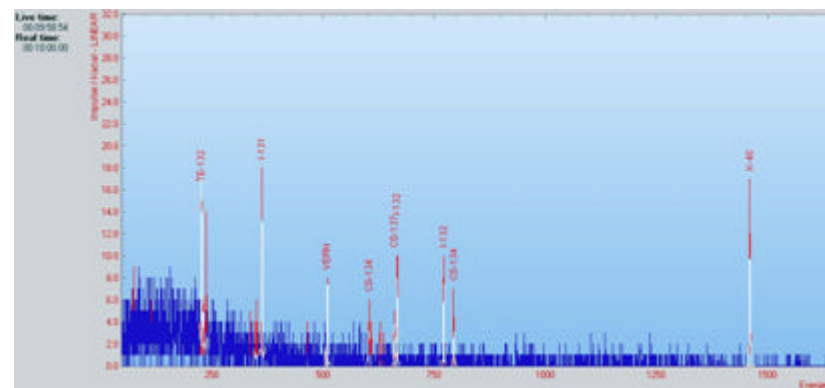
# EURADOS SURVEY:

## IN-VIVO MONITORING of gamma emitters in total body and radioiodine in thyroid

Quantification in terms of **Activity (Bq)** retained in total body or in thyroid at a **time t (days)** after the intake by gamma spectrometry

Radionuclide	T <sub>1/2</sub>	E (keV)	Yield (%)
<b>I-131</b>	8.02 days	80.19	2.6
		284.30	6.1
		364.49	81.7
		636.99	7.17
<b>I-132</b>	2.30 h	667.70	98.7
		772.60	75.6
		1399.0	7.0
<b>Te-132</b>	3.20 days	49.72	15.1
		228.33	88.1
<b>Cs-134</b>	2.07 years	569.33	15.4
		604.72	97.2
		795.86	85.5
<b>Cs-137</b>	30.17 years	661.66	85.1

**HPGe detectors:** best identification of peaks in the gamma spectrum



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident



**Results of EURADOS SURVEY:  
In-vivo monitoring data  
Activity > DL, only adults**

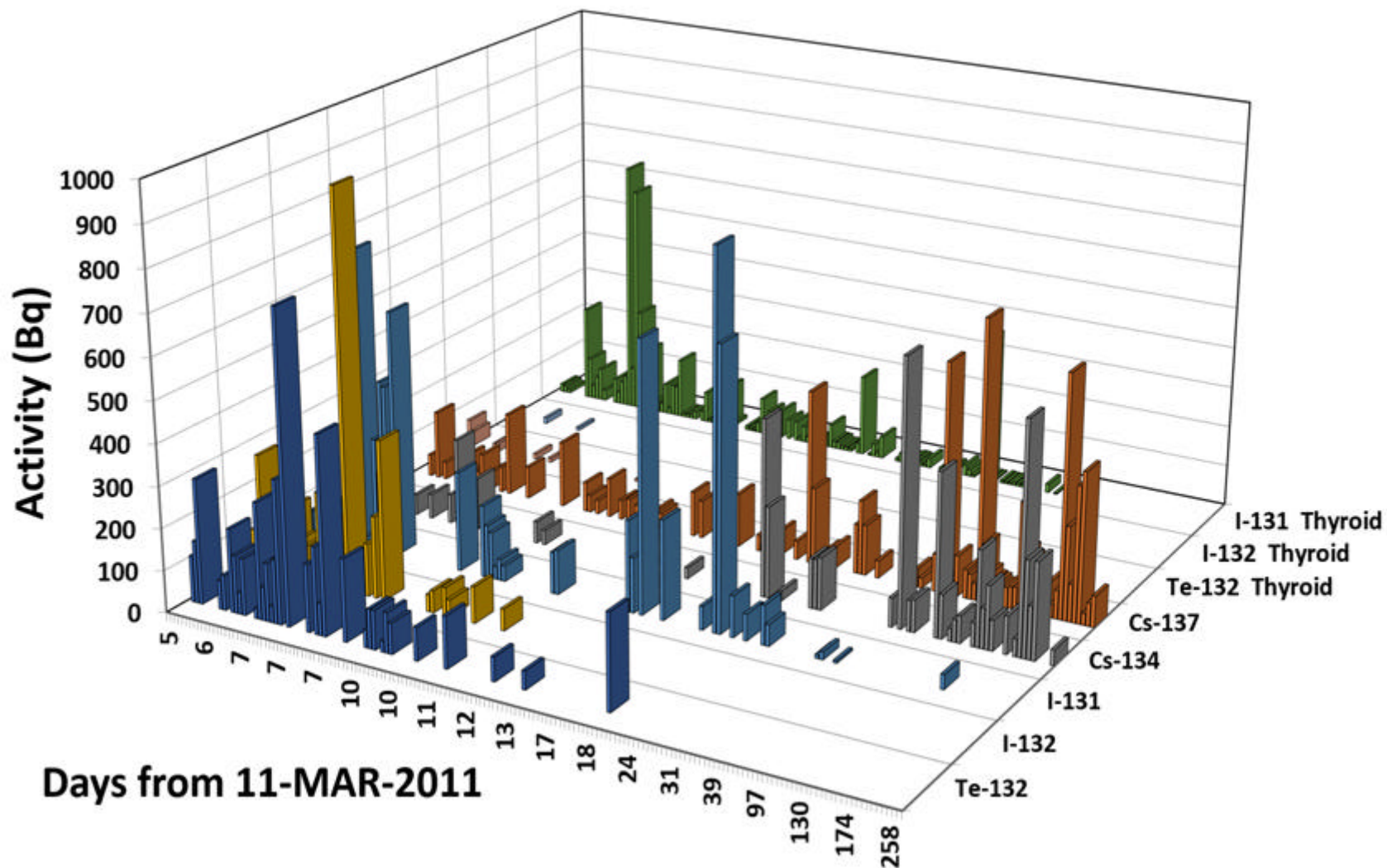
## Thyroid Monitoring

Radionuclide	No. of cases	Activity (Bq)
$^{131}\text{I}$	100	Max: 644
		Min: 9
$^{132}\text{I}$	2	Max: 86
		Min: 3

## WBC - Total body Monitoring

Radionuclide	No. of cases	Activity (Bq)
$^{137}\text{Cs}$	77	Max: 670
		Min: 18
$^{134}\text{Cs}$	40	Max: 637
		Min: 24
$^{131}\text{I}$	45	Max: 890
		Min: 6
$^{132}\text{I}$	26	Max: 953
		Min: 41
$^{132}\text{Te}$	26	Max: 744
		Min: 24

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident



## Assessment of doses due to internal exposures

1. Determination of **amount of radioactive material in the human body** by direct measurements from Whole/partial Body Counting (WBC) and/or indirect methods like excretion analysis or air monitoring  
=> **Monitoring data M (Bq, Bq/d or Bq/m<sup>3</sup>)**
2. The **interpretation of the monitoring data M(Bq)**, in terms of **Intake I (Bq) and Committed Effective Dose E(50) mSv**, requires to know:
  - the physical (e.g. particle size: AMAD) and chemical (absorption type) characteristics of the radioactive substances inside the body,
  - their biokinetics,
  - the time of intake
  - The type of intake (acute, chronic) and
  - the pathway (inhalation, ingestion,...).

# INTERPRETATION OF MONITORING DATA FOR THE ASSESSMENT OF INTAKE I(Bq) AND DOSE E(50) mSv

## Internal Dose Assessments from a single monitoring data

- Date/Time of Intake  $T_0$  (dd/mm/yyyy)
- Date/Time of Monitoring: t (days) post Intake
- Result of *In-vivo monitoring*:  $M(\text{Bq})$  Activity (from WBC) or *In-vitro monitoring*:  $M(\text{Bq}/\text{d})$  Activity rate in excreta
- Assessment of *Intake I (Bq) from a single monitoring data  $M(\text{Bq})$* :

$$I = \frac{M}{m(t)}$$

$M(\text{Bq})$  = monitoring data (WBC or excreta)

$m(t)$  = retention function (whole body or organ) or excretion function (excreta) at t (days) post intake (ICRP) = fraction of retained/excreted activity when Intake is 1 Bq

- Assessment of the *Committed Effective Dose E(50) mSv*:

$$E(50) \text{ mSv} = I(\text{Bq}) * e(50)(\text{mSv}/\text{Bq})$$

where  $e(50) \text{ mSv}/\text{Bq}$  is the dose coefficient (ICRP) = committed effective dose when Intake is 1 Bq

**EURADOS SURVEY ON IN-VIVO  
MONITORING DATA OF EXPOSED  
FOREIGNERS AT EARLY STAGE  
AFTER Fukushima Daiichi NPP  
Accident:**

## **CASE STUDIES**

- Intakes of radionuclides detected in 176 exposed persons from
  - ✓ Belgium (9),
  - ✓ Canada (1),
  - ✓ Czech Republic (8),
  - ✓ Finland (1),
  - ✓ France (76),
  - ✓ Germany (58),
  - ✓ Greece (5),
  - ✓ Hungary (2),
  - ✓ Norway (3),
  - ✓ Poland (7),
  - ✓ Sweden (1),
  - ✓ UK (1)
  - ✓ Ukraine (4)



## FRANCE:

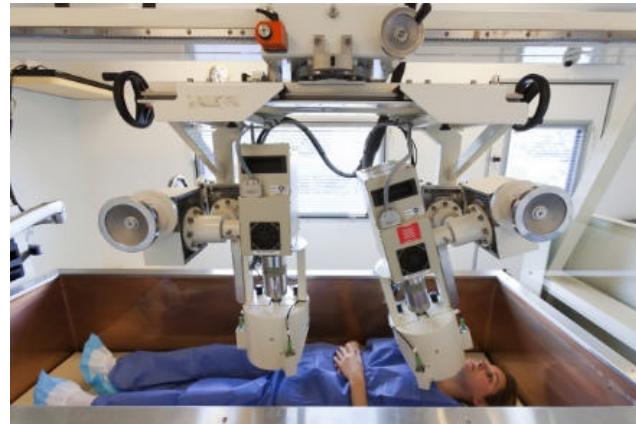
**IRSN: in-vivo monitoring at Le Vésinet WBC (near Paris) and mobile units**

**Contact-person: Didier Franck**

- 62 company employees returning from Japan (business trips)
- 36 Air crew members
- 95 Journalists
- 75 private individuals (expatriates and students)
  
- **End of 2011: 280 in-vivo measurements**  
**268 French citizens (some people monitored several times)**
  
- **Whole body counting:** measurement of gamma emitters in total body (tm= 20 min)
- **Thyroid counting:** determination of radioiodine ( $^{131}\text{I}$ ,  $^{132}\text{I}$ ) in the thyroid (tm= 15 min)
  
- **84 measurements: Activity (Bq) > DL (Detection Limit) – 30% positive results**

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

- **France-IRSN:** Collection of a questionnaire from French citizens at their arrival, with information in the locations in Japan during and after the Fukushima Daiichi NPP accident and the places they visited at that time before their leaving.
- **IRSN Capabilities:**
  - Fleet of 10 Mobile units for Accident Monitoring of internal contamination
  - HPGe detector systems



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident



## - France-IRSN:

- Group 1: 77% of monitored persons during the first 3 weeks after Fukushima Daiichi NPP accident (mainly journalists)
- Group 2: monitored persons on July-September 2011 (summer holidays)

## - In-vivo monitoring results:

- Activity in the **thyroid**:  $^{131}\text{I}$  most frequently detected; also  $^{132}\text{I}$  /  $^{132}\text{Te}$
- Activity in **total-body** :  $^{137}\text{Cs}$ ; and  $^{134}\text{Cs}$  detected in few cases

## - Interpretation of monitoring data for Dose assessments:

- Assumptions: **time of intake on 12 March 2011, Acute Inhalation, particle size: AMAD= 1  $\mu\text{m}$**
- Estimation of the **Committed Effective Dose E(50) mSv**
- **Annual Dose Limit (public exposures):  $E = H_p(10) + E(50) = 1 \text{ mSv/year}$**
- **$H_{\text{THYROID}}$  that triggers the process of administering stable iodine in France is 50 mSv**

- **France-IRSN. Most exposed person:**
  - **Date of measurement: 18/3/2011**
  - Location of exposure: **Iwaki**
  - In-vivo monitoring results (**IRSN Mobile Unit**):
    - **Thyroid counting** (DL= 5 Bq)  
161 ± 16 Bq of  $^{131}\text{I}$
    - **Whole Body Counting** (DL= 40 Bq)  
744 ± 112 Bq of  $^{132}\text{Te}$   
953 ± 143 Bq of  $^{132}\text{I}$   
204 ± 31 Bq of  $^{137}\text{Cs}$
  - **Dose evaluation:**
    - **Total E(50)= 0.09 mSv, < 0.1 mSv**
    - **H<sub>THYROID</sub> < 1.4 mSv**

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

Germany in 2011: 19 in-vivo monitoring laboratories,  
358 measurements reported,  
Most of results < DL, only 75 cases (21%) > DL

## EURADOS Survey:

- **BfS – Contact person: U. Gerstmann**
    - **22 cases reported** (dates of measurements: **18/3–28/4/2011 + 20/10/2011**)
      - Only WBC, no thyroid counting
  - **KIT- Karlsruhe Institute of Technology – Contact person: B. Breustedt**
    - **1 case reported** (date of measurement: **18/3/2011**)
      - WBC results: detection of  $^{131}\text{I}$ ,  $^{137}\text{Cs}$ ,  $^{134}\text{Cs}$ ,  $^{132}\text{I}$ ,  $^{132}\text{Te}$  in total-body (>LD)
  - **LIA.NRW- Contact person: C. Scholl**
    - **35 cases reported** (dates of measurements: **16/3/2011 – 24/11/2011**)
      - WBC and Thyroid counting results reported
- The Fukushima accident and travel medicine. Analysis and recommendations.  
C. Scholl, W. Lieberz, P. Jansing, T. Küpper.  
Travel Medicine and Infectious Disease (2013) 11, 139-145.*

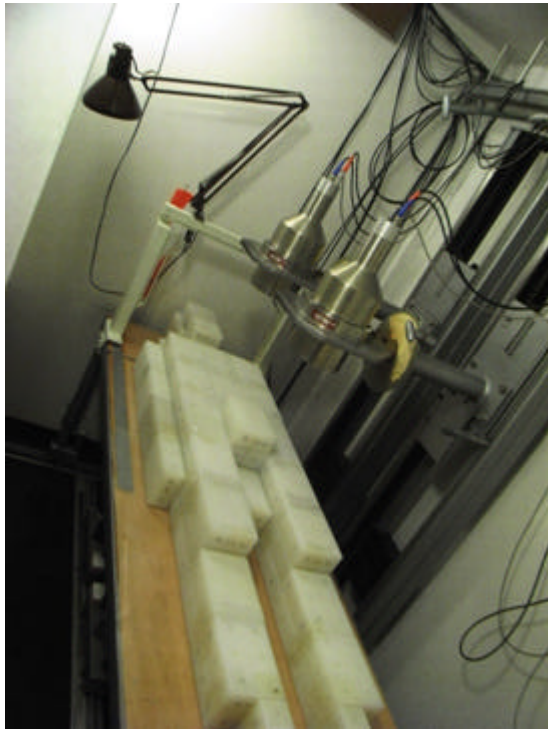
# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

## Germany - Summary:

- **Radionuclides detected:**
  - **Thyroid counting (up to 29/3/2011)**
    - $^{131}\text{I}$  : 20 cases, maximum activity  $644 \pm 74$  Bq in thyroid (18/3/2011)
    - $^{132}\text{I}$  : 2 cases, 8 and 15 Bq (17-18/3/2011)
  - **WBC:**
    - $^{137}\text{Cs}$  detected in 44 cases, range of 18 – 581 Bq in total body
    - $^{134}\text{Cs}$  detected in 22 persons, range of 24 – 637 Bq in total body
    - $^{132}\text{Te}$  detected in 22 persons, range of 42 – 344 Bq in total body, **up to 24/3/2011**
- **Most of cases  $E(50) < 0.1$  mSv**
- **$E(50)_{\text{MAX}} = 0.5$  mSv**
  - External dose to be received in a flight from Europe to Japan and return = 0.13 mSv (calculated with EPCARD).
  - Average annual effective dose in Germany: 2.1 mSv
  - Intakes due to Fukushima Daiichi NPP accident: no radiological threat

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

## Germany - Summary:



## BfS WBC Berlin. HP Ge detector



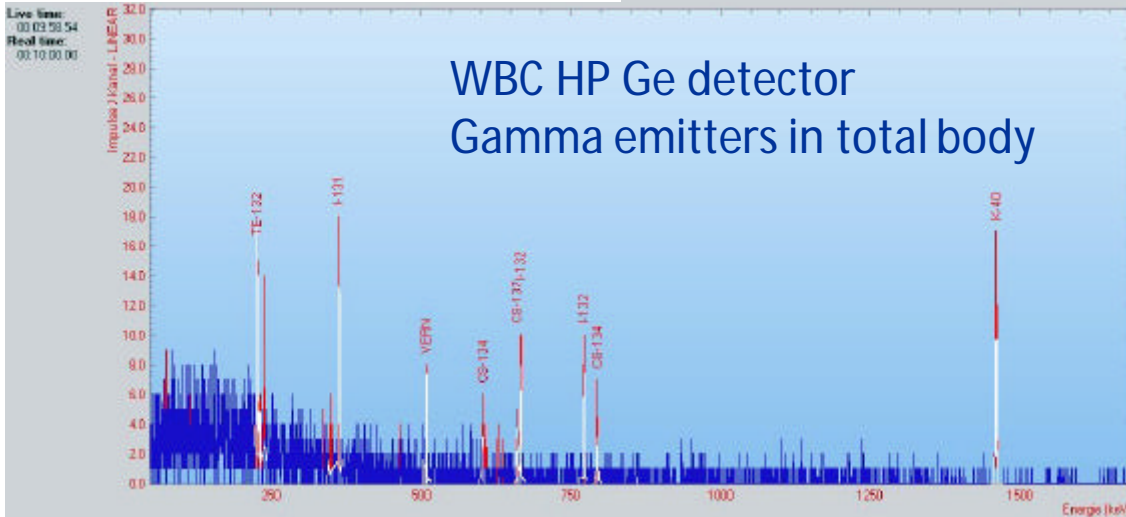
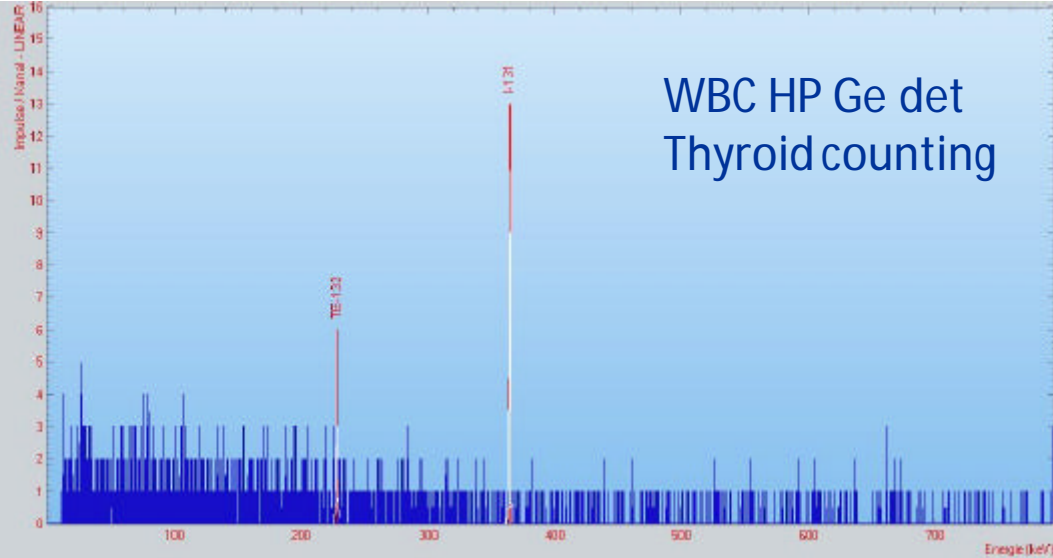
**BfS WBC Neuherberg:** 4 big NaI-detectors and a small HPGe-detector under the stretcher. The detectors have been replaced with four big HPGe-detectors with electric cooling in March 2013. Brick calibration phantom – Standard Man – gamma emitters in total body.

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

## Germany - Summary: LIA.NRW



Live time:  
00:03:55,72  
Real time:  
00:10:00,00



In-vivo monitoring LIA.NRW  
HP Ge detectors

- WBC
- Thyroid counting
  
- Identification/quantification of the radionuclides in complex gamma spectra



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident



**UK** – Contact persons: July Scott, George Etherington (PHE, UK)  
1 case reported: Male journalist.

- **Internal exposure in Japan:**

- 12-13 March 35 km from Fukushima Daiichi NPP
- 13-16 March 80 km from NPP

Open air most of the time

Iodine Tablet administration on 25 March 2011

**Time of intake: assumed 12 March 2011**

- **Measurements at PHE, Chilton, UK**

- 4 April 2011, 23 days post intake
- In-vivo monitoring:
  - WBC: gamma emitters in total-body
  - Thyroid counting: Radioiodine
- In-vitro monitoring: gamma emitters in urine (gamma spectrometry)



Top small HP Ge detector used for **thyroid counting**

- **Intake and dose evaluation:**
  - **Time of intake: assumed 12 March 2011**
  - **Monitoring data:** 4 April 2011, 23 days post intake
    - WBC: 5 NaI(Tl) detectors
      - Result of  $^{131}\text{I}$ :  $64 \pm 35$  Bq in total-body
      - $^{137}\text{Cs}$ ,  $^{134}\text{Cs}$  < MDA (Minimum Detectable Activity = 40 Bq)
    - Thyroid counting: 1 small HP Ge detector
      - Result of  $^{131}\text{I}$ :  $27 \pm 14$  Bq in thyroid
    - In-vitro monitoring:
      - Result of  $^{131}\text{I}$ :  $0.39 \pm 0.18$  Bq in 24h urine simple
- **Interpretation of Monitoring data:** Calculation of Intake I(Bq), E(50) and  $H_{\text{THYROID}}$ 
  - Acute Intake – Inhalation on 12 March 2011
  - $^{131}\text{I}$ : type F (aerosol, absorption type F “FAST”, rapid absorption to the blood)
  - ICRP default values (particle size AMAD= 1  $\mu\text{m}$ )
  - Calculation (IMBA software):
    - **Intake = 2536 Bq of  $^{131}\text{I}$**
    - **E(50) = 1.87E-2 mSv , <1 mSv**
    - **$H_{\text{THYROID}} = 3.72\text{E-1 mSv}$**

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

**Sweden** – Contact person: Lilian del Risco (SSM)

6 cases reported.

Measurements performed:

**SSM Stockholm (in-vivo monitoring)**

**Linköping Univ. Hospital (in-vitro monitoring)**

**1. Case A.** Male, construction worker in Tsukuba

- **Internal exposure in Japan:**

12 March 2011: travel from Tsukuba to Tokyo

Arrival at Stockholm Airport **on 14 March 2011**

- **Measurement performed at SSM WBC, on 14 March 2011 !!!!**

- WBC. NaI(Tl) detector:  **$195 \pm 22 \text{ Bq } ^{137}\text{Cs}$**

**$170 \pm 20 \text{ Bq } ^{134}\text{Cs}$**

- Thyroid counting:  $^{131}\text{I} < \text{Detection Limit (DL= 10 Bq)}$

- **Interpretation of Monitoring data:** Calculation of I(Bq) and E(50):

- Acute Intake – Inhalation of Cs type F. Particle size: AMAD= 1  $\mu\text{m}$

- **Total Intake = 540 Bq;**

- **E(50) = 9E-3 mSv < 1 mSv**



↓  
**SSM WBC,  
Stockholm**

Sweden –cont.

## 2. Case C.

- **Internal exposure in Japan:**
  - Female living in Tokyo
- Measurements performed on **16 April 2011** at Linköping Univ. Hospital, Sweden  
**In-vitro monitoring.** Spot urine samples Vol= 1L. Gamma spectrometry.
  - **$21.4 \pm 0.5$  Bq/l  $^{131}\text{I}$  in urine**
  - **$0.93 \pm 0.01$  Bq/l  $^{137}\text{Cs}$  in urine**
- **Interpretation of Monitoring data:** Calculation of Intake I(Bq) and E(50)
  - Acute Intake – Inhalation Particle size: AMAD=  $1\mu\text{m}$  ???
  - **Intake  $^{131}\text{I}$ : 25390 Bq**
  - **Intake  $^{137}\text{Cs}$ : 74 Bq**
    - **Total Intake = 25464 Bq;**
    - **Total E(50) = 0.18 mSv <1 mSv**
    - **Hthyroid= 0.14 mSv**

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

Greece – Contact persons: K. Potiriadis, V. Kamenopoulou (GAEC)

5 cases reported: Greek citizens in Tokyo

- **WBC measurements:** 1 NaI(Tl) detector + 1 HP Ge detector
  - $^{137}\text{Cs}$ ,  $^{134}\text{Cs}$  (3 cases): up to 350 Bq
  - Detection of  $^{132}\text{Te}/^{132}\text{I}$  (very small amounts, not quantified)
- **Thyroid counting:** NaI(Tl) detector
  - $^{131}\text{I}$  (5 cases) up to 800 Bq
- **In-vitro monitoring:** HP Ge detector,  $\gamma$  emitters in **urine samples**



Greece – Cont.

- **Interpretation of monitoring data - dose calculation** (IMBA Software):
  - **Time of intake:** the day that the plume arrives in Tokyo (**14/3/2011**)
  - **Acute Inhalation**
  - **Absorption type:** available data from the environmental measurements during the time after the accident were used:
    - In the case of  $^{131}\text{I}$ , a mixture of 30 % F (Fast) and 70% V (vapour) was assumed

**Calculation of E(50)** based on the measurements of Iodine and Caesium isotopes. The **estimated doses were: E(50) = 75, 280, 43, 9, 42  $\mu\text{Sv}$ .**

**E(50)max = 0.28 mSv**

**Finland** – Contact persons: Maarit Muikku, Jussi Hurihari (STUK)

1 case reported

- **Monitoring : 11/9/2011**
- **WBC:**  $^{137}\text{Cs}$ :  $80 \pm 20$  Bq.  
 $^{134}\text{Cs}$ :  $90 \pm 20$  Bq
- **Interpretation of monitoring data:** calculation of Intake I(Bq) and E(50)
  - Intake scenario: **CHRONIC INHALATION during 4 months**
  - ICRP default values, IMBA software
  - **Intake < 2.5 Bq/d**
  - **E(50) < 4E-3 mSv**

# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

**Canada** – Contact person: Chunsheng Li (Health Canada)

1 case reported

- **Monitoring : 04/01/2012**

- **WBC:**  $^{137}\text{Cs}$ :  $37 \pm ?$  Bq.

$^{134}\text{Cs}$ :  $78 \pm ?$  Bq

- **Interpretation of monitoring data (IMBA Software)**

The scenario of Intake :

- Person working in Japan
- Considering that Japanese Government implemented appropriate food/water control after the release of radioactive material in the environment: INHALATION is assumed as main pathway of intake
- Acute Intake (Inhalation) in the week 14-21 March 2011

- **Intake and Dose:**  $^{134}\text{Cs}$ : I= 700 Bq; E(50)= 6.8E-3 mSv

$^{137}\text{Cs}$ : I= 1150 Bq; E(50)= 7.7E-3 mSv

**TOTAL E(50)= 0.014 mSv**



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

**Belgium**– Contact person: Anne Laure Lebacqz (SCK-CEN, Mol)

8 cases reported, **in-vivo monitoring**:

- 17/3/11 – 20/4/11, detection of  $^{131}\text{I}$  in thyroid (6 – 91 Bq), Ge detector
- 10/8/11 and 23/12/11, WBC:  $^{137}\text{Cs}$  detected (~ 55 Bq), NaI(Tl) detector

## Case A.- Female journalist

Tokyo -> Koriyama -> Sendai -> Tokyo  
12/March 13/March 14 March 15/March

- 1st measurement (SCK-CEN): 17/March/2011  
detection of  $^{131}\text{I}$ ,  $^{137}\text{Cs} > \text{DL}$

Tokyo -> Fukushima area -> Tokyo  
5/May 6-10 May 12/May

- 2nd measurement (SCK-CEN): 13/May/2011  
 $^{131}\text{I}$ ,  $^{137}\text{Cs} < \text{DL}$

Acute Inhalation, time of intake: 13/03/2011

Intake:  $I = 535 \text{ Bq } ^{131}\text{I} + 169 \text{ Bq } ^{137}\text{Cs}$

$E(50) = 4\text{E-}3 \text{ mSv } (^{131}\text{I}) + 8\text{E-}4 \text{ mSv } (^{137}\text{Cs}) = \underline{4.8\text{E-}3 \text{ mSv}}$



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

**Poland** – Contact person: Jakub Osko (NCBJ)

- **7 cases reported,**

- In-vivo Monitoring on **March-June 2011**
- **NCBJ WBC** and **IFJ PAN WBC**
- **Thyroid counting (Ge detector, shielded room):**
  - $^{131}\text{I}$  detected in 3 persons on **March-April 2011**,  
range of activities: **3 - 367 Bq in thyroid**
- **WBC:**  $^{137}\text{Cs}$  in 7 persons (**25-670 Bq**) ,  
 $^{134}\text{Cs}$  in 3 persons (**27-390 Bq**)
- **Dose evaluation:**  
Case 86: **Chronic ingestion, from 11/03 to 20/06/2011**
  - **$E(50) = 13.8 \mu\text{Sv } ^{137}\text{Cs} + 11.9 \mu\text{Sv } ^{134}\text{Cs} = 25.7 \mu\text{Sv}$**



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

**Czech citizens** – Contact person: Pavel Fojtik (SURO)

8 cases reported, in Japan from March to July 2011

- **WBC monitoring on April-June and September 2011** (WBC in Prague)
  - 6 persons with Activity of  $^{137}\text{Cs}$  > DL, range of **30-200 Bq**.  $^{134}\text{Cs}$ : **70-120 Bq**
  - No dose evaluation
- **Thyroid counting:** detector + collimator, DL = 29 Bq I-131 in thyroid
  - 2 cases with activity of  $^{131}\text{I}$  > DL (monitoring on **6 April**). Volunteer rescue workers
  - **Dose Evaluation:** Acute Inhalation 19/May/2011 (1st day in Japan),  $^{131}\text{I}$  (Type F)
    - Case B: I= 1500 Bq  $^{131}\text{I}$ ; **E(50) = 1.15E-2 mSv**; Hthyroid= 0.2 mSv
    - Case C: I= 2700 Bq  $^{131}\text{I}$ ; **E(50) = 2.1E-2 mSv**; Hthyroid= 0.4 mSv



# EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

## EURADOS Survey: internally exposed persons

### - Hungary:

- Contact person: Imre Balashazy
- 6 Hungarian citizens visited Fukushima NPP after the accident
- Time of intake: 12-13 March 2011, Acute inhalation
- 2 cases reported:
  - Thyroid counting: (1) 22/3/2011 and (2) 07/04/2011. DL= 50 Bq.
    - Case 1: (1)  $424 \pm 27$  Bq  $^{131}\text{I}$ ; (2)  $153 \pm 22$  Bq  $^{131}\text{I}$
    - Case 2: (1)  $470 \pm 26$  Bq  $^{131}\text{I}$ ; (2)  $180 \pm 22$  Bq  $^{131}\text{I}$

### - Ukraine:

- Contact person: Valentyna Vasylenko, Nat Research Centre for Rad Medicine
- 4 cases reported,
- WBC:  $^{137}\text{Cs}$ : 53 – 361 Bq, on 21-23 March, 1 April and 21 November 2011

### - Norway:

- Contact person: Bjorn Lind (NRPA, Norway)
- Thyroid counting, portable NaI(Tl) detector. 3 cases with Activity in thyroid > DL
- DL= 50 Bq I-131

## CONCLUSIONS - EURADOS Survey (intakes detected in 176 persons):

- **EURADOS Survey:** Collection of information on the capabilities for in-vivo monitoring and dose assessment in European Internal Dosimetry Laboratories and services, in case of RN emergency
- **Short-lived radionuclides:**
  - $^{132}\text{I}$  and  $^{132}\text{Te}$  only detectable few days after the accident.
  - $^{131}\text{I}$  detected up to 2 months after the Fukushima Daiichi NPP accident
- **Main gaps** identified and improvements required:
  - Thyroid counting calibration not always available for in-vivo monitoring
  - In most of cases: just calibration for ADULTS not for children
- **Assumptions for dose calculations:**
  - Acute Inhalation. Few cases: chronic inhalation or ingestion,.
  - Time of intake: assumed on 12 March 2011 in many cases
- **European WBC:** similar results of in-vivo monitoring data (WBC and thyroid counting). Same level of Intakes and doses E(50) and Hthyroid
- **All the Doses E(50) < 1 mSv**, no health concern due to intakes of radioiodine and/or radiocaesium

**Thank you very much for your attention!**

