EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS IN JAPAN, OBTAINED IN THEIR RESPECTIVE COUNTRIES AT EARLY STAGE AFTER THE NUCLEAR ACCIDENT OF FUKUSHIMA DAIICHI NUCLEAR POWER PLANT

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EURADOS Survey: > 300 foreigners in Japan when Fukushima, in-vivo monitored in their countries. 176 contaminated persons were evaluated from Belgium, Canada, Czech Rep., Finland, France, Germany, Greece, Hungary, Norway, Poland, Sweden, UK and Ukraine.

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

IRSN Mobile Unit:  

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

Nal(Tl) detector: $^{131}$I, $^{132}$I in Thyroid

(3) NaI(Tl) + HPGe detectors: shielded room, Total Body
**In-vivo monitoring** of radionuclides incorporated into the body mainly by inhalation, emitting X-ray and \(\gamma\) radiation: Activity (Bq) retained in **Total Body & Thyroid**

<table>
<thead>
<tr>
<th>Radionuclide</th>
<th>(T_{1/2})</th>
<th>(E) (keV)</th>
<th>Yield (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>I-131</td>
<td>8.02 days</td>
<td>364.49</td>
<td>81.7</td>
</tr>
<tr>
<td>I-132</td>
<td>2.30 h</td>
<td>49.72, 228.83, 667.70, 772.6</td>
<td>15.10, 88.12, 98.7, 75.6</td>
</tr>
<tr>
<td>Te-132</td>
<td>3.20 days</td>
<td>228.3</td>
<td>88.1</td>
</tr>
<tr>
<td>Cs-134</td>
<td>2.07 years</td>
<td>604.72, 795.86, 569.33</td>
<td>97.6, 85.53, 15.38</td>
</tr>
<tr>
<td>Cs-137</td>
<td>30.17 years</td>
<td>661.66</td>
<td>85.1</td>
</tr>
</tbody>
</table>

**Gamma Spectrum with HP Ge detectors:**
Accurate identification/quantification of contaminants, excellent discrimination of contributions from all radionuclides.
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  

LATE MEASUREMENTS (≥ MAY 2011)  | No. of cases  
--- | ---  
Miyagi Pref. | 1  
Sendai | 1  
Fukushima City | 5  
Koriyama | 1  
Tamura | 1  
NPP | 4  
Utsunomiya | 1  
Hitachi | 3  
Tsukuba | 1  
Ushiku | 1  
Tokyo | 5  
Chiba | 2  
Yokohama | 2  

Places of contamination:

(4) Setagaya (TMITRI)

H. Tsuruta 2012, 1st NIRS Symposium
Reconstruction of Early Internal Dose after Fukushima
EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

### Total body Monitoring

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>No. of cases</th>
<th>Activity (Bq)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$^{137}$Cs</strong></td>
<td>77</td>
<td>Max: 670, Min: 18</td>
</tr>
<tr>
<td><strong>$^{134}$Cs</strong></td>
<td>40</td>
<td>Max: 637, Min: 24</td>
</tr>
<tr>
<td><strong>$^{131}$I</strong></td>
<td>45</td>
<td>Max: 890, Min: 6</td>
</tr>
<tr>
<td><strong>$^{132}$I</strong></td>
<td>26</td>
<td>Max: 953, Min: 41</td>
</tr>
<tr>
<td><strong>$^{132}$Te</strong></td>
<td>26</td>
<td>Max: 744, Min: 24</td>
</tr>
</tbody>
</table>

### Thyroid Monitoring

<table>
<thead>
<tr>
<th>Contaminant</th>
<th>No. of cases</th>
<th>Activity (Bq)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>$^{131}$I</strong></td>
<td>100</td>
<td>Max: 644, Min: 9</td>
</tr>
<tr>
<td><strong>$^{132}$I</strong></td>
<td>2</td>
<td>Max: 86, Min: 3</td>
</tr>
<tr>
<td><strong>$^{132}$Te</strong></td>
<td>7</td>
<td>Max: 744, Min: 24</td>
</tr>
</tbody>
</table>

- EURADOS Survey 2013: > 300 foreigners in-vivo monitored from 15 countries
- **176 contaminated 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) and Ukraine (4)

Committed Effective Doses $E(50)$: $< 1$ mSv
EURADOS SURVEY ON IN-VIVO MONITORING DATA OF EXPOSED FOREIGNERS AT EARLY STAGE AFTER Fukushima Daiichi NPP Accident

![Graph showing activity levels over time](image-url)

**Activity Bq**

<table>
<thead>
<tr>
<th>Time days</th>
<th>Activity Bq</th>
</tr>
</thead>
<tbody>
<tr>
<td>5</td>
<td>1000</td>
</tr>
<tr>
<td>6</td>
<td>900</td>
</tr>
<tr>
<td>7</td>
<td>800</td>
</tr>
<tr>
<td>8</td>
<td>700</td>
</tr>
<tr>
<td>9</td>
<td>600</td>
</tr>
<tr>
<td>10</td>
<td>500</td>
</tr>
<tr>
<td>11</td>
<td>400</td>
</tr>
<tr>
<td>12</td>
<td>300</td>
</tr>
<tr>
<td>13</td>
<td>200</td>
</tr>
<tr>
<td>14</td>
<td>100</td>
</tr>
<tr>
<td>15</td>
<td>0</td>
</tr>
</tbody>
</table>

**Time days**

- I-131 WBC
- Cs-137 WBC
- Cs-134 WBC
- I-132 WBC
- Te-132 WBC
- I-131 T
- I-132 T
- Te-132 T

IAEA, 2014