# Contingency Plans for Monitoring People Returning to the UK after the Accident at the Fukushima Nuclear Power Plants

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## Introduction

Soon after it became known that the tsunami on 11 March 2011 had caused significant damage to the Fukushima Daiichi nuclear power plants, it became apparent that a large number of people might return to the UK from Japan as a result of concerns about radiation exposure.

HPA, in consultation with UK government departments, recommended that no systematic programme for monitoring returning travellers would be needed unless further significant releases took place. This recommendation was consistent with IAEA advice.

HPA further advised that monitoring of people should be considered if a major release occurred such that predicted doses[a] outside the 80 km radius exclusion zone[b] exceeded 6 mSv.

[a] *(effective dose from external irradiation) + (committed effective dose, E(70), inhalation, 10 year-old child)*

[b] *specified by the UK Government for UK citizens*

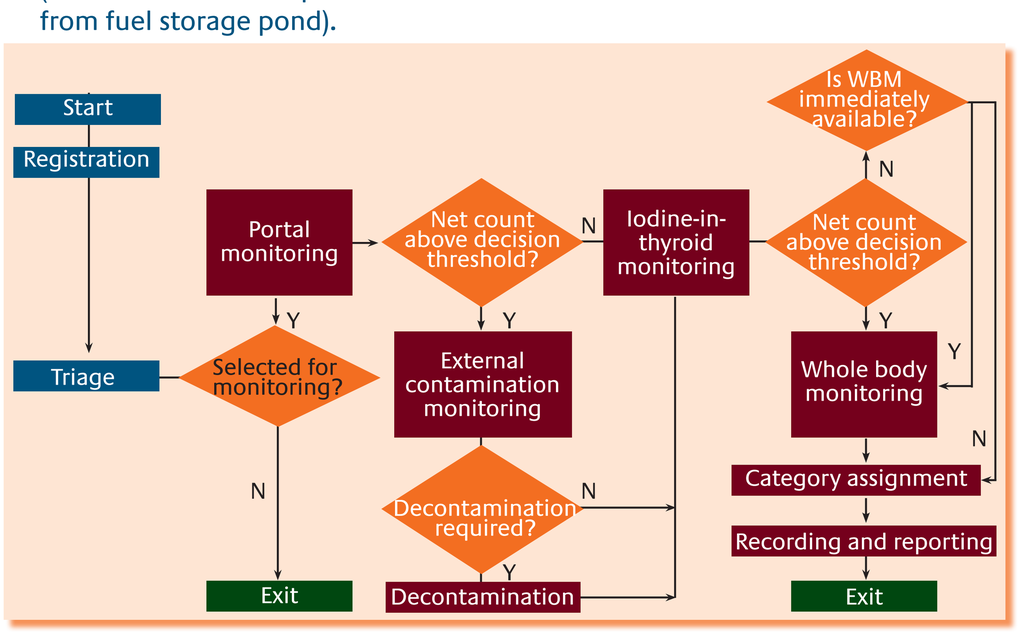
## Main Objectives if People Returning from Japan had Needed Monitoring

- To quantify absorbed doses to organs (for intakes large enough to cause deterministic effects) - very unlikely in this case.
- To quantify committed effective doses (for intakes that could result in an elevated risk of stochastic effects).
- To provide data on internal contamination to aid decisions on dose reduction treatments - unlikely in this case.
- To identify those people who were exposed to radionuclides at low levels (or not at all), but who were concerned.

## Generic Plan for Monitoring People Returning from Japan

The following issues had to be considered:

- numbers requesting to be monitored could be in excess of 1000 per day.
- unclear whether external contamination could be present (although unlikely).
- identity of radionuclides and relative amounts in a future release was unclear (because of different possible release scenarios – reactor release or release from fuel storage pond).




## Triage

The use of simple procedures for rapidly sorting people into groups based on actual or potential effects on health, and the allocation of follow-up measures (eg, medical, radiation monitoring, advice, provision of information) in a way that maximises effective use of resources[1].

Two alternative triage systems, to be selected according to circumstances.

- Those arriving from Japan travel on to final destination in UK. Invited to contact NHS Direct (UK health advice and information service). Triage conducted by telephone questionnaire. Subsequent monitoring at Radiation Monitoring Units (RMUs) set up by the NHS and HPA[2].
- Triage conducted on planes in flight, or on arrival at the airport. Subsequent monitoring at the airport.

### Examples of Triage Questions

Q: Were you within the 20 km exclusion (evacuation) zone near Fukushima Daiichi NPP at any time since 00:01 Japanese Standard Time (JST) on 12 March 2011?

Q: Have you been monitored for radiation by the Japanese authorities since 00:01 JST on 12 March 2011?

Q: Have you been provided with iodine tablets at any time since 00:01 JST on 12 March 2011 by the Japanese authorities?

### Approximate Throughput

| Monitoring method | People per hour |
|---|---|
| Portal monitor (walk-through mode) | 300 |
| Portal monitor (standing still) | 300 |
| External contamination (rapid scan, hand-held monitor) | 25 |
| Iodine-in-thyroid screening | 50 |
| Body monitor with 'detective' radionuclide identifier | 10 |

Note - Values are for a single 2-person team for each monitoring method

### Action Levels

Dual action level system, upper ($AL_U$) and variable lower action level ($AL_L$). The approach recommended in the Triage, Monitoring and Treatment (TMT) Handbook[1] was followed.

| | Dose range, E(70), mSv | Actions following body monitoring |
|---|---|---|
| Below $AL_L$ | < x<br>1 ≤ x ≤ 20 | Provide report form, information leaflet |
| Between $AL_L$ and $AL_U$ | Up to 200 | + Carry out more accurate whole body monitoring (WBM) in priority order (eg, using HPA transportable body monitor) |
| Above $AL_U$ | > 200 | Refer immediately for medical assessment (complete blood count + biodosimetry)<br>Perform accurate WBM urgently |

**Example - Action Levels on Net Count Rate, c $s^{-1}$, for Iodine-in-thyroid Screening Measurements in Adults for $^{131}I$ (Type 44A probe)**

| Dose range, $E_I(70)$, mSv | Action level, mSv | Action levels, c $s^{-1}$ for specified elapsed times between intake and measurement, d | | | | | | |
|---|---|---|---|---|---|---|---|---|
| | | 1 | 3 | 7 | 14 | 21 | 28 | 35 |
| 40 | Upper (200) | 1000 | 900 | 600 | 400 | 200 | 100 | 60 |
| 0.2 | Lower (1) | 5 | 5 | ND | ND | ND | ND | ND |

Detector positioned 1 cm from front of neck

$E_I(70)$ - contribution to effective dose from $^{131}I$ intakes at the upper and lower action levels.

In the absence of specific information on the source term of a potential release, the working assumption was made that $^{131}I$, $^{132}Te$, $^{106}Ru$, $^{134}Cs$, $^{140}Ba$ each contribute 20% of the total E(70)

Action levels for children initially set at 10% of the adult values

ND – not detectable, < 5 c $s^{-1}$

## Portal Monitoring

*Rapid, walk-through possible.*

*Detects external and internal contamination.*

*Not radionuclide-specific.*

*Suitable for rapid screening of large numbers of people.*

## External Contamination Monitoring

*Body scan with hand-held monitor.*

*Rapid scan possible: head, hands, shoes.*

*Determines location of contamination.*

*Not radionuclide-specific.*

## Iodine-in-thyroid Monitoring

*NaI(Tl) hand-held probe.*

*Not radionuclide-specific (although thyroid measurement is effectively specific to radioiodine).*

*Calibration and conversion factors determined to estimate intake, committed dose to thyroid, $H_{Th}(70)$ and committed effective dose E(70), for assumed mix of radionuclides in the intake.*

*Effective method for rapid screening for intakes*

## Body Monitoring

*'Detective' radionuclide identifier measures activity in the torso[3].*

*Radionuclide-specific (Ge semiconductor detector).*

*Calibration and conversion factors determined to estimate intakes and E(70) for $^{131}I$, $^{132}Te$, $^{103}Ru$, $^{106}Ru$, $^{134}Cs$, $^{137}Cs$, $^{140}Ba$.*

*Provides data required for assessment of effective dose.*

## Activation Arrangements

Monitoring on arrival only possible at a maximum of two UK airports, for people returning directly from Japan. Plan specified to allow monitoring to commence at London Heathrow (LHR) airport within an agreed timescale, covering:

- Required staff numbers and roles.
- Alerting procedures for HPA and airport staff.
- Despatch of liaison teams to LHR.
- Security arrangements
- Translation services
- Health and Safety
- Information management

## Standard Operating Procedures (SOPs)

SOPs were specified for all of the procedures and included a registry form, triage questionnaires, report forms and draft information leaflets.

## Results

No systematic programme of monitoring people was brought into operation because the dose criterion specified in the Introduction was not met. The few measurements that were made supported the decision not to deploy the resources required for a large-scale monitoring programme of people returning to the UK.

### Results - Fukushima Daiichi

| No. of people | Occupation | Approx. distance from Fukushima Daiichi, km | Result | Estimated E(70) |
|---|---|---|---|---|
| 6 | Journalists | 60 | Activity not detected | - |
| <5* | Journalists | 20 - 80 | Activity not detected | - |
| <5* | Aid workers | 30 - 40 | Activity not detected | - |
| <5* | Journalists | 30 - 40 | Radioiodine detected in thyroid of 1 person<br>No other radionuclide detected | 19 μSv |

Total = 10

* Precise numbers not given to ensure anonymity

## Conclusions and Lessons Learned

- Arrangements were put in place for a large scale programme for monitoring returning travellers to the UK.
- Effective triage procedures are an essential part of such a programme.
- In the absence of detailed information on the 'source term' for any potential exposures, the monitoring programme had to be able to respond to a number of possible scenarios. Once under way, it would have been possible to simplify the programme.
- The level of effort required to devise such a monitoring programme, and to implement it if necessary, should not be underestimated.

## References

(1) TMT Handbook. Triage, Monitoring and Treatment of People exposed to Ionising Radiation following a Malevolent Act. Rojas-Palma C, Liland A, Jerstad AN, Etherington G, del Rosario Pérez m, Rahola T and Smith K (editors). (2009). Published by NRPA, Osteras, Norway. Download from http://www.tmthandbook.org.

(2) Thompson NJ, Youngman MJ, Moody J, McColl NP, Cox DR, Astbury J, Webb S and Prosser SL (2011). Radiation Monitoring Units: Planning and Operational Guidance. HPA-CRCE-017. Download from http://www.hpa.org.uk/Publications/Radiation/CRCEScientificAndTechnicalReportSeries.

(3) Kramer GH, Hauck BM, Capello K. The HML's new field deployable high resolution whole body counter. Health Phys. 89(Supplement 5):S60-S68; 2005.



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