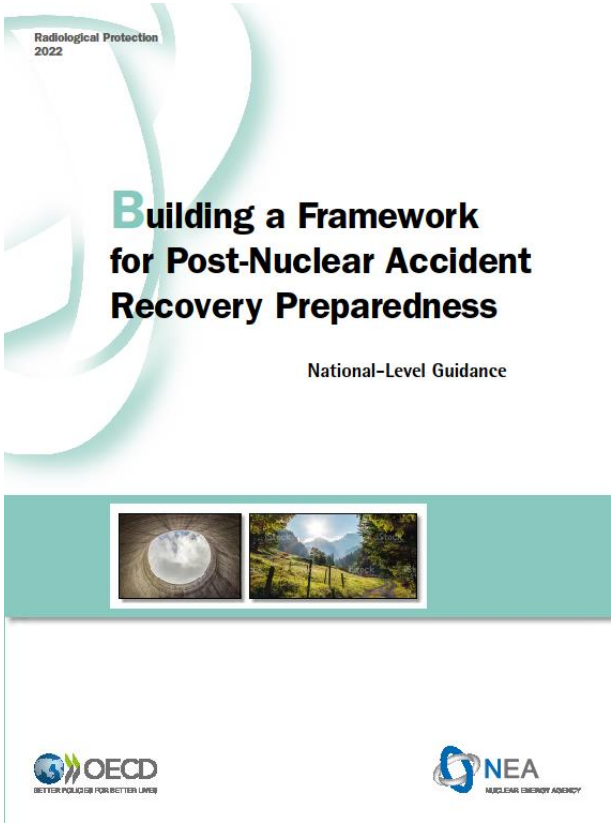
NEA Workshop on Preparedness for Post-Nuclear Accident Recovery



Environmental monitoring and human dose assessment

National example – Germany

Florian Gering
Head of Division "Radiological Emergency Response"
BfS, Germany

27-28 October 2022, hosted by IRSN in Fontenay-aux-Roses, France

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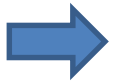
Building a Framework for Post-Nuclear Accident Recovery Preparedness

“Following a nuclear accident, a **comprehensive environmental monitoring programme** will confirm details about the radioactive contamination, its spatial distribution, its nuclide composition, physical and chemical properties, heterogeneity, and mobility of contamination.”



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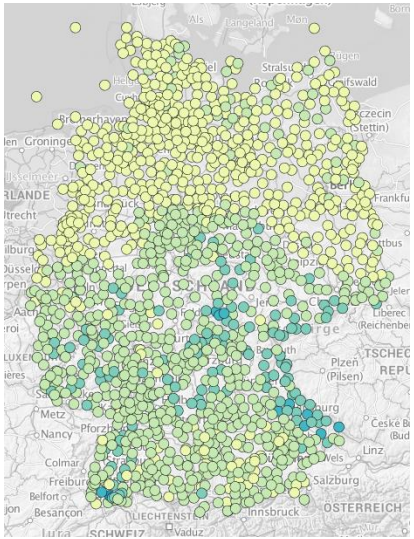
Environmental monitoring in Germany

BfS office locations
“Measurements”

~ 1800 + 300 GDR
observation sites



Mobile measurements
(4 helicopters, 12+ cars)

40 nuclide specific
observation sites
operated by DWD
(German Meteorological
Service)

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IMIS system in Germany

50 specialized laboratories:

- Monitoring of drinking water, food, feed, waste, other environmental samples
- Routine monitoring program:
  about 11.500 samples/a
  with routine 14.000 measurements/a
- Intensive monitoring program: up to 2000 samples/d

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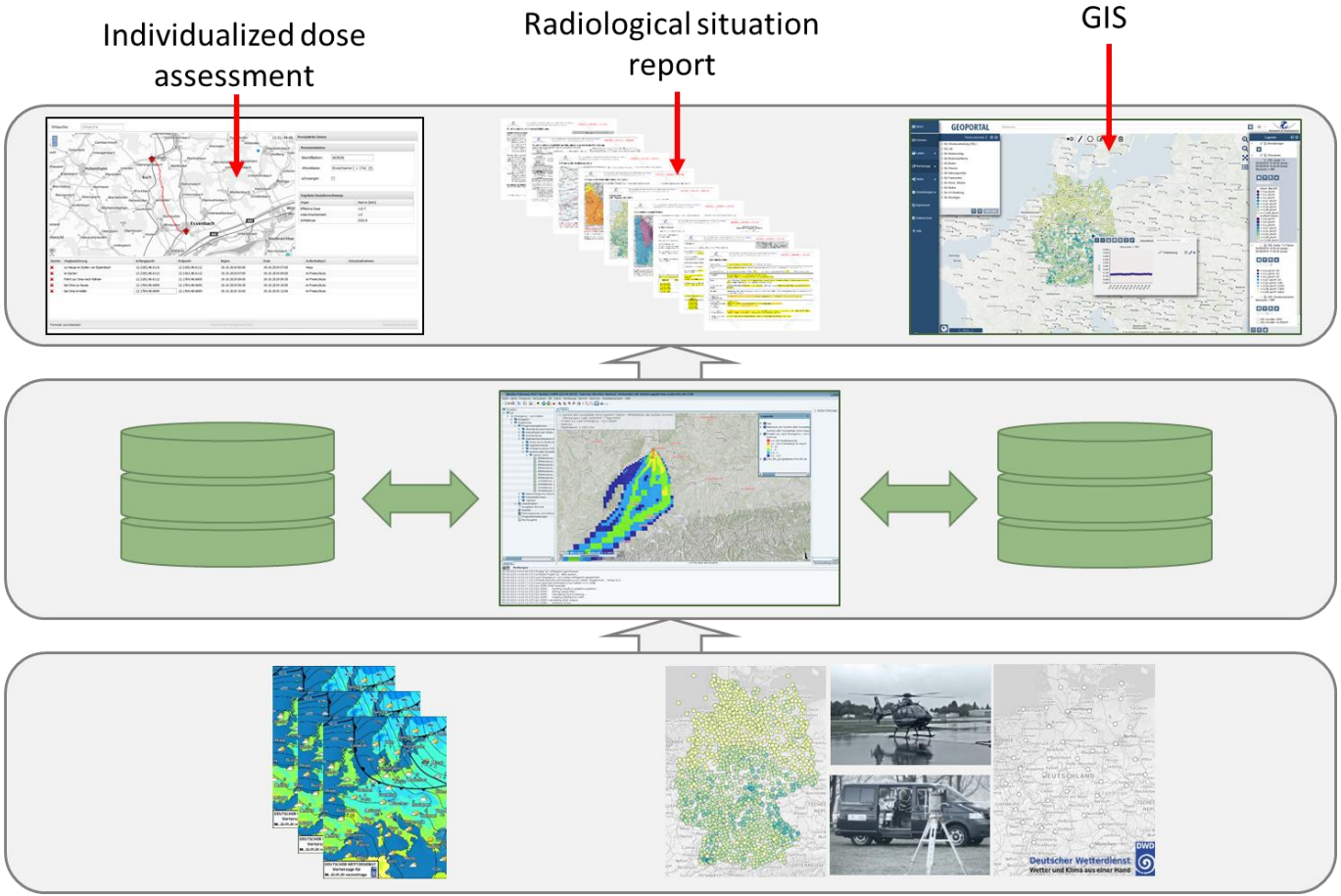
IMIS system in Germany

Data handling
and processing

Output, analysis and
dissemination (IMIS)

Modelling, data
processing and data
storage (IMIS)

Measurement data
(and other data)



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Building a Framework for Post-Nuclear Accident Recovery Preparedness

Monitoring programme according to AVV IMIS – response phase (after release has ended)

„A well-considered environmental monitoring programme, with clearly defined objectives, is a key part …“

„Scope of monitoring programme“

„• Definition of measurement objectives, rationale, and priorities“

Monitoring	Purpose	Prio
Monitoring networks	▪ Identify areas (roughly) where OILs are exceeded (especially OIL2 = 100 µSv/h) ▪ …	1
Mobile monitoring	▪ Identify areas (in detail) where OILs are exceeded (especially OIL2 = 100 µSv/h, also α/β), including finding of hot spots ▪ Decide about termination of protective actions ▪ Identification of nuclide vector	1
Monitoring of food samples	Identify areas where food OILs are exceeded	2
Dose and contamination monitoring of population	Individual dose assessment, need for decontamination	1
…		

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Building a Framework for Post-Nuclear Accident Recovery Preparedness

Monitoring programme according to AVV IMIS – transition phase

„A well-considered environmental monitoring programme, with clearly defined objectives, is a key part …“

„Scope of monitoring programme“

„• Definition of measurement objectives, rationale, and priorities“

Monitoring	Purpose	Prio
Mobile monitoring	▪ Improve contamination mapping ▪ Improve data base for dose assessment ▪ Identify areas where decontamination is necessary (and feasible) ▪ Monitor effectiveness of decontamination work	1
Monitoring devices in public transport	▪ Improve contamination mapping ▪ Improve data base for dose assessment	2
Monitoring of food samples	▪ Identify areas where food OILs are exceeded ▪ Confirm food safety outside contaminated areas	1
…		

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Monitoring programme according to AVV IMIS

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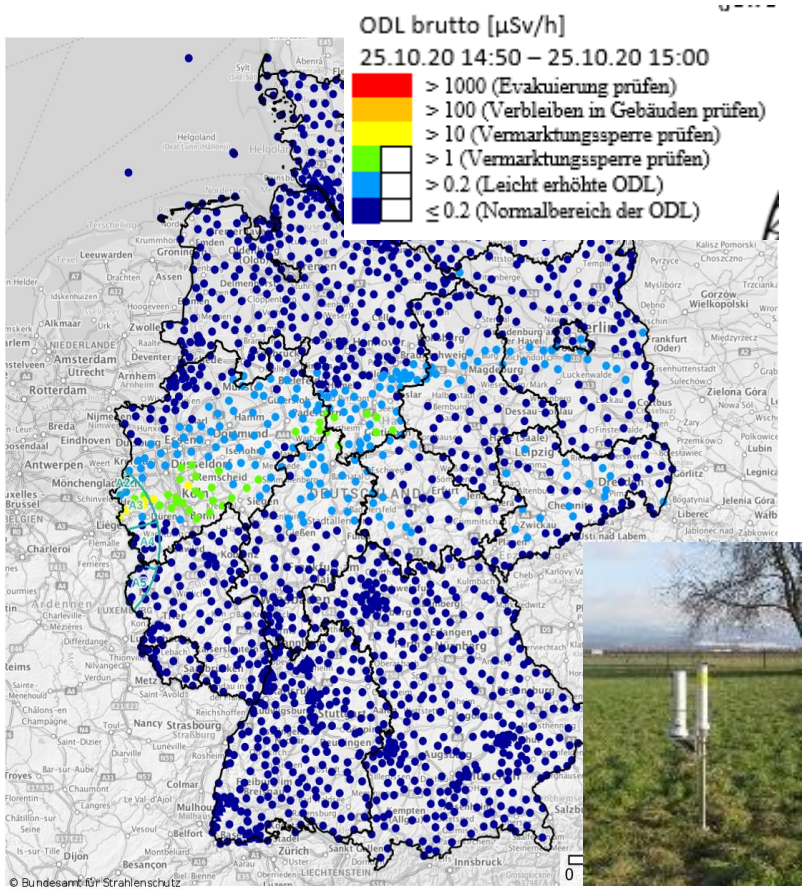
„Scope of monitoring programme“

„• Continuous representative mapping of the whole area “

„• Identification of small-scale inhomogeneity (hot spots) “

„• Area-wide nuclide-specific ground contamination measurements“



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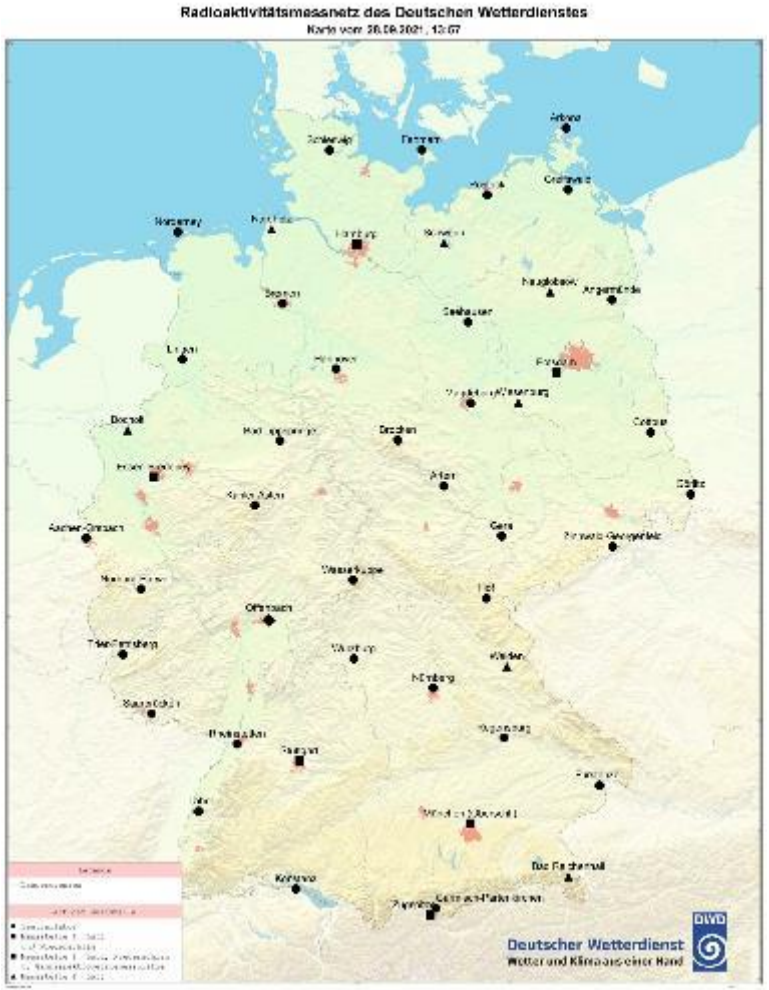
„Scope of monitoring programme“

„• Regular air activity measurements “



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Monitoring programme according to AVV IMIS

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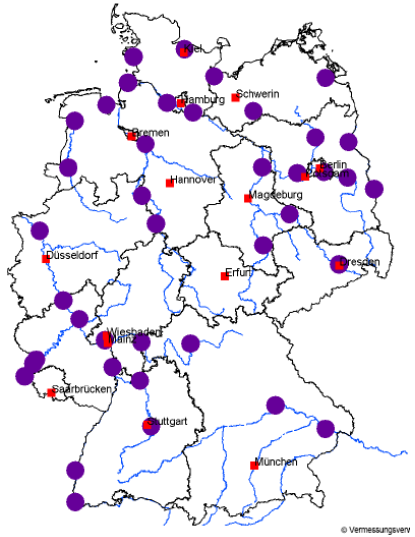
„Scope of monitoring programme“

„• Monitoring of the aquatic environment “




Warnstelle Ketzin

40 automatic monitoring stations along rivers

Monitoring (in labs) of
- Drinking water
- Ground water
- Aquatic food chain

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Monitoring programme according to AVV IMIS

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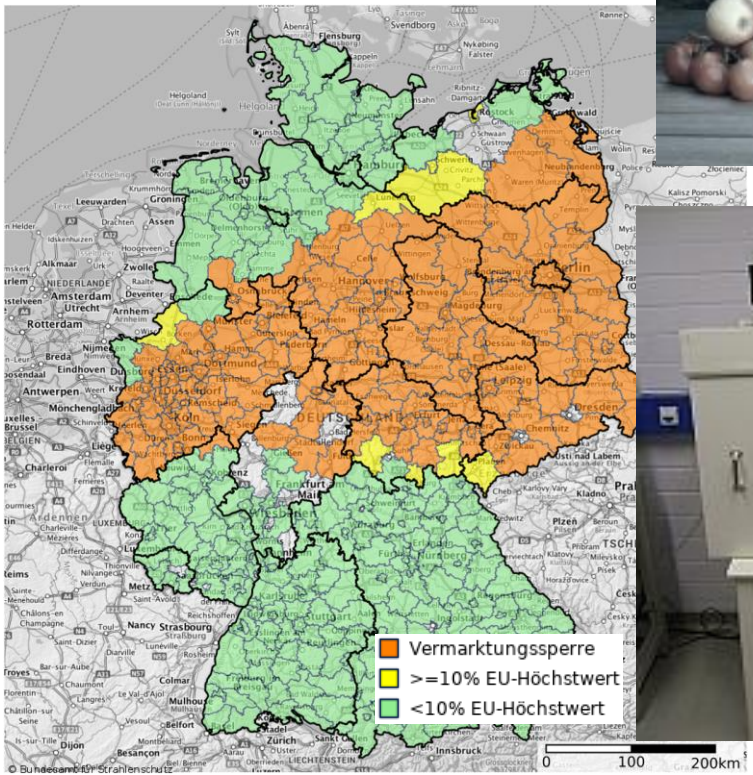
> 50 specialized laboratories for the surveillance of environmental radioactivity

„Scope of monitoring programme“

„• Sampling of lands outside the contaminated area “



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Monitoring programme for contaminated areas

Building a Framework for Post-Nuclear Accident Recovery Preparedness

„Scope of monitoring programme“

„• Detailed, higher-resolution characterisation of the contamination in priority areas “

„• Monitoring the need for and effectiveness of decontamination“

Monitoring protocol

General informationen			
Location			
Monitoring device (z.B. NaI-Szintillator + Herstellerinfos)		Quantity (z.B. ODL)	

Information about conduct of monitoring		
	Bevor decontamination	After decontamination
Date		
Time		
Name of person		
Remarks		

Monitoring results

	Bevor decontamination			After decontamination		
Site	Value	Unit	Height	Value	Unit	Height
A						
B						
C						
D						
E						
F						
G						

Sketch of location with monitoring sites
(grober Grundriss der Fläche mit Gebäuden, Bäumen oder anderen Strukturen, die als Orientierung verwendet werden können; Eintragen der Messpunkte A, B, ... am jeweiligen Messort)

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Building a Framework
for Post-Nuclear Accident
Recovery Preparedness

Exit strategy

„Ongoing re-evaluation and exit strategy“

„When transitioning from the emergency phase into an existing exposure situation, the generic monitoring programme is transferred into a situation-specific monitoring programme“ (AVV IMIS)

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Building a Framework for Post-Nuclear Accident Recovery Preparedness

Individual dose monitoring

„Scope of monitoring programme“

„• Individual dose monitoring “

„Dose assessment of the affected population must begin early …“

Thyroid monitoring

Body surface contamination monitoring (handheld device)

Body surface contamination monitoring (portal monitor)

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Dose assessment based on modelling and monitoring

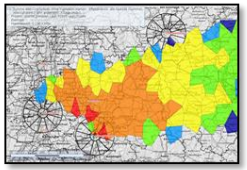
Building a Framework for Post-Nuclear Accident Recovery Preparedness

„Dose assessment based on modelling using environmental monitoring data “

Release of radioactivity into the environment

Radiological **Monitoring data**

Area-wide dose assessment (based on monitoring data)



Individual dose assessment (based on monitoring data)

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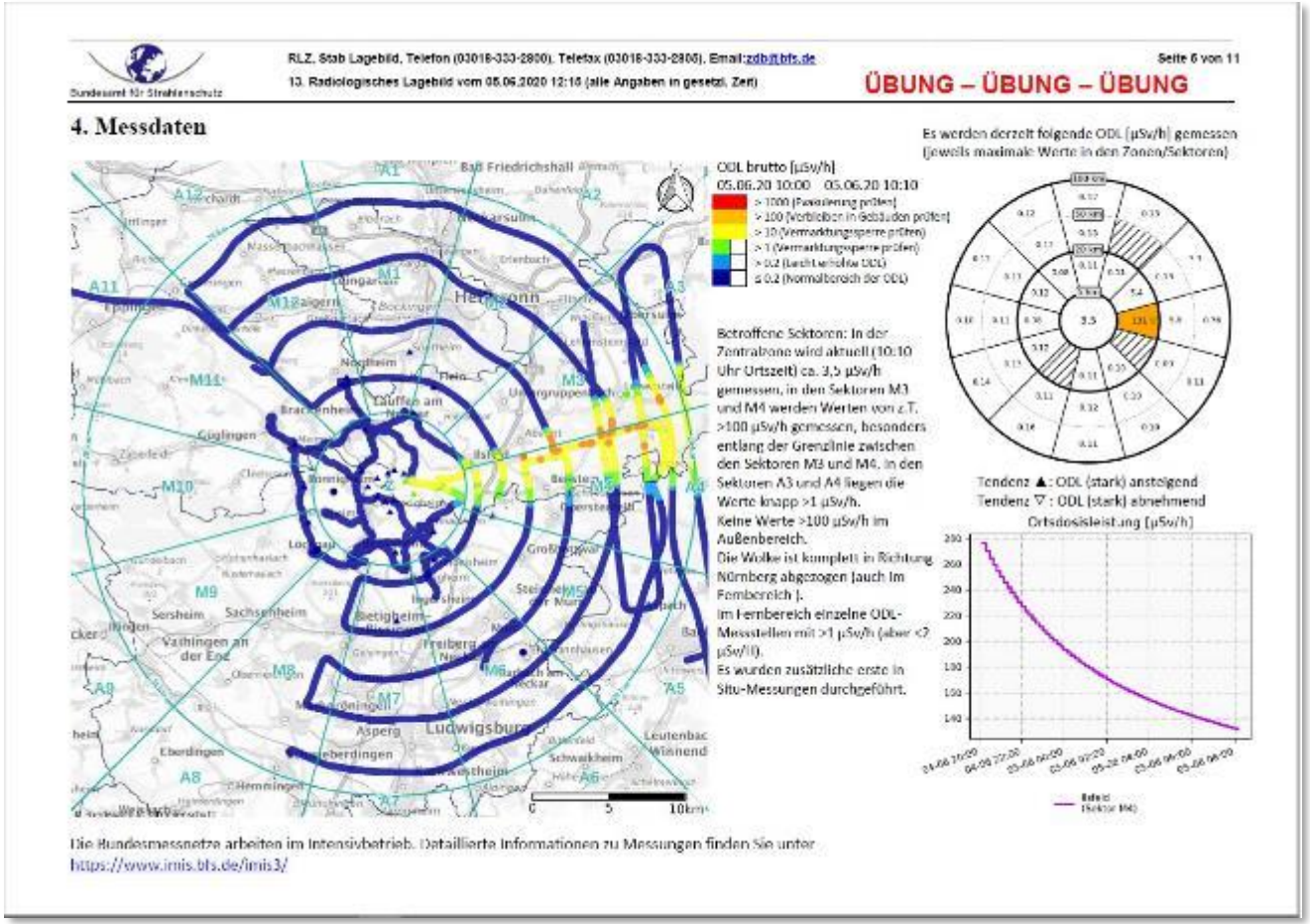
Summary of monitoring data (situation report)

Building a Framework for Post-Nuclear Accident Recovery Preparedness

„Dose assessment based on modelling using environmental monitoring data “



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RLZ, Stab Lagebild, Telefon (03018-333-2800), Telefax (03018-333-2805), Email:zdb@bfs.de

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13. Radiologisches Lagebild vom 05.06.2020 12:16 (alle Angaben in gesetzl. Zeit)

ÜBUNG – ÜBUNG – ÜBUNG

4. Messdaten

Es werden derzeit folgende ODL (µSv/h) gemessen (jeweils maximale Werte in den Zonen/Sektoren)

ODL brutto [µSv/h]
05.06.20 10:00 – 05.06.20 10:10
> 1000 (Evakuierung prüfen)
> 100 (Verbleiben in Gebäuden prüfen)
> 10 (Vermarktungssperre prüfen)
> 1 (Vermarktungssperre prüfen)
> 0,2 (Leicht erhöhte ODL)
≤ 0,2 (Normalbereich der ODL)

Betroffene Sektoren: In der Zentralzone wird aktuell (10:10 Uhr Ortszeit) ca. 3,5 µSv/h gemessen, in den Sektoren M3 und M4 werden Werten von z.T. >100 µSv/h gemessen, besonders entlang der Grenzlinie zwischen den Sektoren M3 und M4. In den Sektoren A3 und A4 liegen die Werte knapp >1 µSv/h.
Keine Werte >100 µSv/h im Außenbereich.
Die Wolke ist komplett in Richtung Nürnberg abgezogen (auch im Fernbereich).
Im Fernbereich einzelne ODL-Messstellen mit >1 µSv/h (aber <2 µSv/h).
Es wurden zusätzliche erste in Situ-Messungen durchgeführt.

Tendenz ▲: ODL (stark) ansteigend
Tendenz ▽: ODL (stark) abnehmend

Ortsdosisleistung [µSv/h]

Die Bundesmessnetze arbeiten im Intensivbetrieb. Detaillierte Informationen zu Messungen finden Sie unter https://www.imis.bfs.de/imis3/

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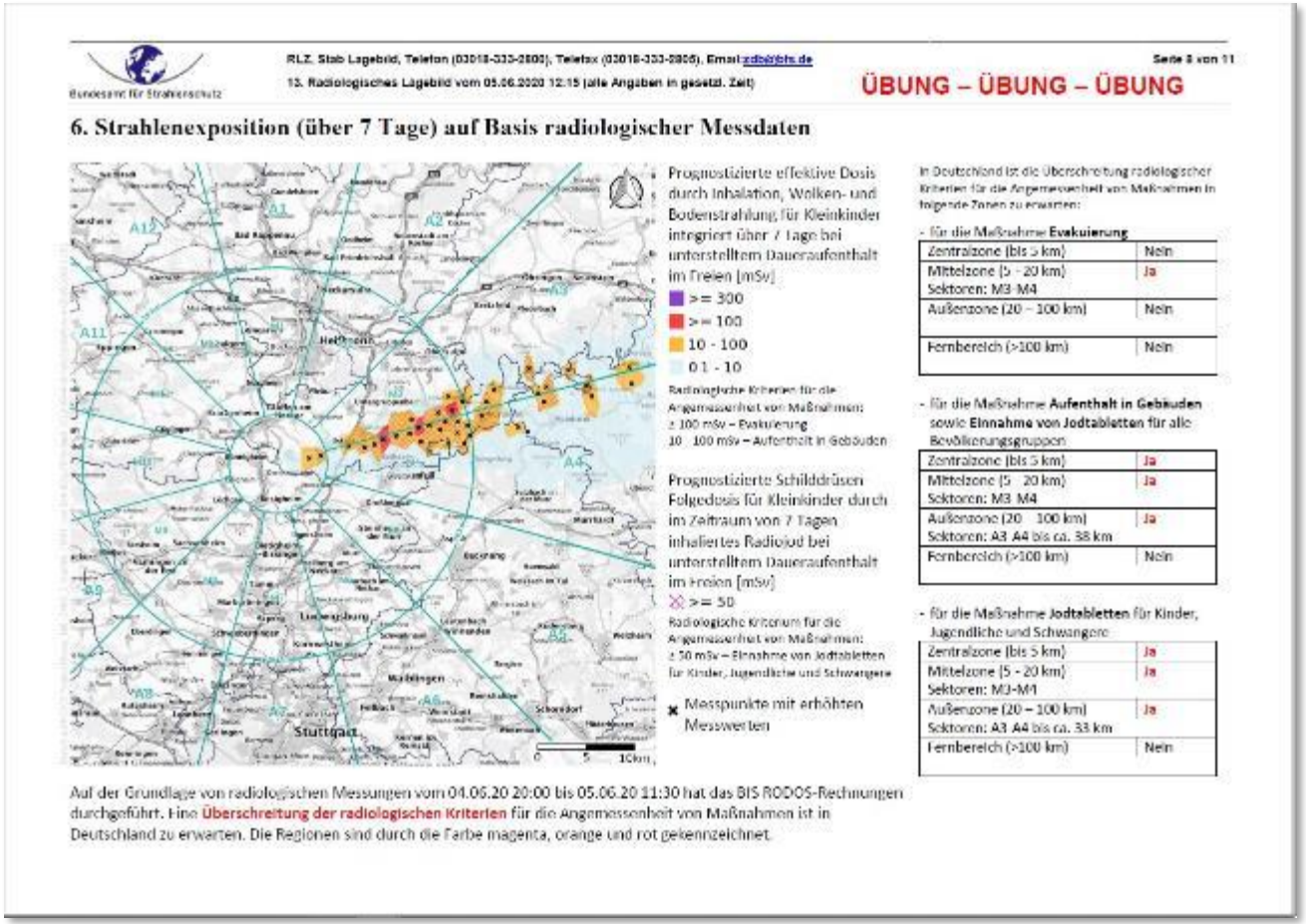
Building a Framework for Post-Nuclear Accident Recovery Preparedness

„Dose assessment based on modelling using environmental monitoring data “

Dose assessment based on monitoring data



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13. Radiologisches Lagebild vom 05.06.2020 12:15 (alle Angaben in gesetzl. Zeit)

ÜBUNG – ÜBUNG – ÜBUNG

6. Strahlenexposition (über 7 Tage) auf Basis radiologischer Messdaten

Prognostizierte effektive Dosis durch Inhalation, Wolken- und Bodenstrahlung für Kleinkinder integriert über 7 Tage bei unterstelltem Daueraufenthalt im Freien [mSv]

- >= 300
- >= 100
- 10 - 100
- 0.1 - 10

Radiologische Kriterien für die Angemessenheit von Maßnahmen:
± 100 mSv – Evakuierung
10 - 100 mSv – Aufenthalt in Gebäuden

Prognostizierte Schilddrüsen Folgedosis für Kleinkinder durch im Zeitraum von 7 Tagen inhaliertes Radiojod bei unterstelltem Daueraufenthalt im Freien [mSv]

- >= 50

Radiologische Kriterium für die Angemessenheit von Maßnahmen:
± 50 mSv – Einnahme von Jodtabletten für Kinder, Jugendliche und Schwangere

✖ Messpunkte mit erhöhten Messwerten

In Deutschland ist die Überschreitung radiologischer Kriterien für die Angemessenheit von Maßnahmen in folgende Zonen zu erwarten:

- für die Maßnahme **Evakuierung**

Zentralzone (bis 5 km)	Nein
Mittelzone (5 - 20 km) Sektoren: M3 M4	Ja
Außenzone (20 – 100 km)	Nein
Fernbereich (>100 km)	Nein

- für die Maßnahme **Aufenthalt in Gebäuden** sowie **Einnahme von Jodtabletten** für alle Bevölkerungsgruppen

Zentralzone (bis 5 km)	Ja
Mittelzone (5 - 20 km) Sektoren: M3 M4	Ja
Außenzone (20 - 100 km) Sektoren: A3 A4 bis ca. 38 km	Ja
Fernbereich (>100 km)	Nein

- für die Maßnahme **Jodtabletten** für Kinder, Jugendliche und Schwangere

Zentralzone (bis 5 km)	Ja
Mittelzone (5 - 20 km) Sektoren: M3-M1	Ja
Außenzone (20 – 100 km) Sektoren: A3 A4 bis ca. 33 km	Ja
Fernbereich (>100 km)	Nein

Auf der Grundlage von radiologischen Messungen vom 04.06.20 20:00 bis 05.06.20 11:30 hat das BIS RODOS-Rechnungen durchgeführt. Eine **Überschreitung der radiologischen Kriterien** für die Angemessenheit von Maßnahmen ist in Deutschland zu erwarten. Die Regionen sind durch die Farbe magenta, orange und rot gekennzeichnet.

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für Strahlenschutz

Dose assessment based on modelling and monitoring

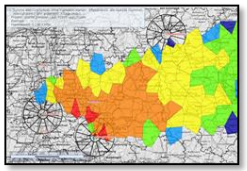
Building a Framework for Post-Nuclear Accident Recovery Preparedness

„Dose assessment based on modelling using environmental monitoring data “

Release of radioactivity into the environment

Radiological **Monitoring data**

Area-wide dose assessment (based on monitoring data)



Individual dose assessment (based on monitoring data)

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Dose assessment based on monitoring and modelling

Building a Framework for Post-Nuclear Accident Recovery Preparedness

„Dose assessment based on modelling using environmental monitoring data “

- **Individualized dose calculations** are performed in emergency centres during and after a radiological or nuclear incident.
- The dose assessment is based on **movement profiles of individuals** (from affected or potentially affected areas) combined with measurement data.

Dose assessment based on modelling

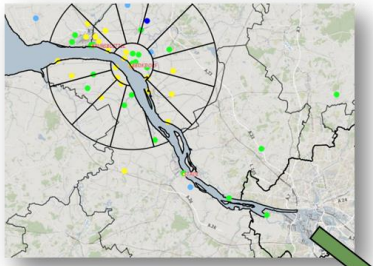
Bundesamt für Strahlenschutz

Building a Framework for Post-Nuclear Accident Recovery Preparedness

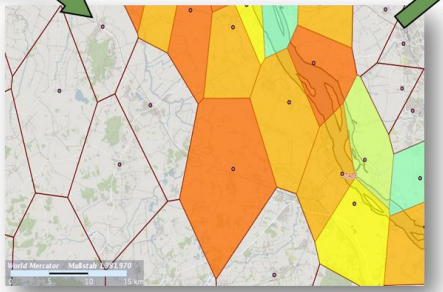
„Dose assessment based on modelling using environmental monitoring data “

Individualized dose assessment - methodology

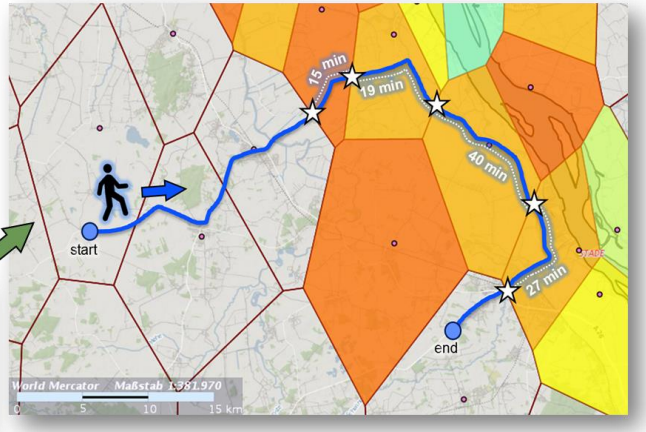
Measurement data



Dose rates and doses estimated from measurements



Dose calculation for an individual movement profile



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Dose assessment based on modelling

Building a Framework for Post-Nuclear Accident Recovery Preparedness

„Dose assessment based on modelling using environmental monitoring data “

Individualized dose assessment – user interface (via web browser)

Open Street Map: Click to define locations and paths of people

Personal data: ID number, age

Results of dose calculation: effective dose, dose to thyroid, dose to RBM

List of paths and locations and protective measures (e.g. sheltering, ITB, face mask)