Radiation Protection after Nuclear Accident at the Nuclear Power Plant Fukushima Daiichi

Presentation for DIHK Japan

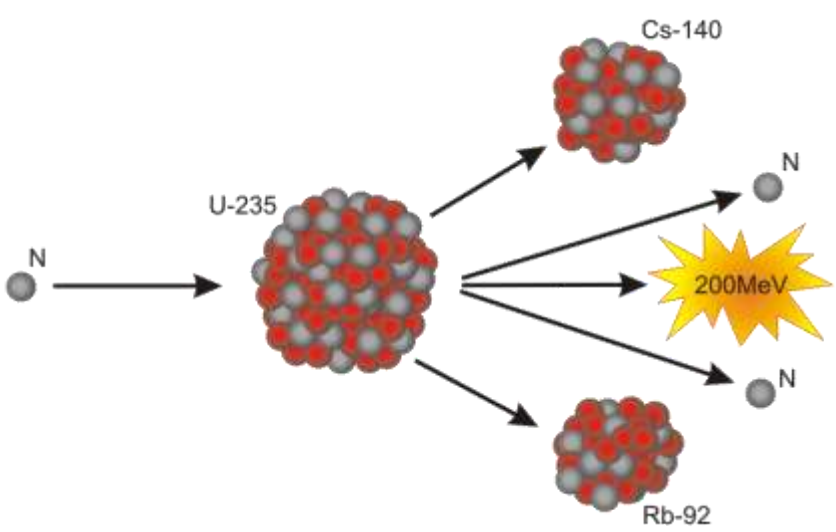
Basic Radiological Definitions

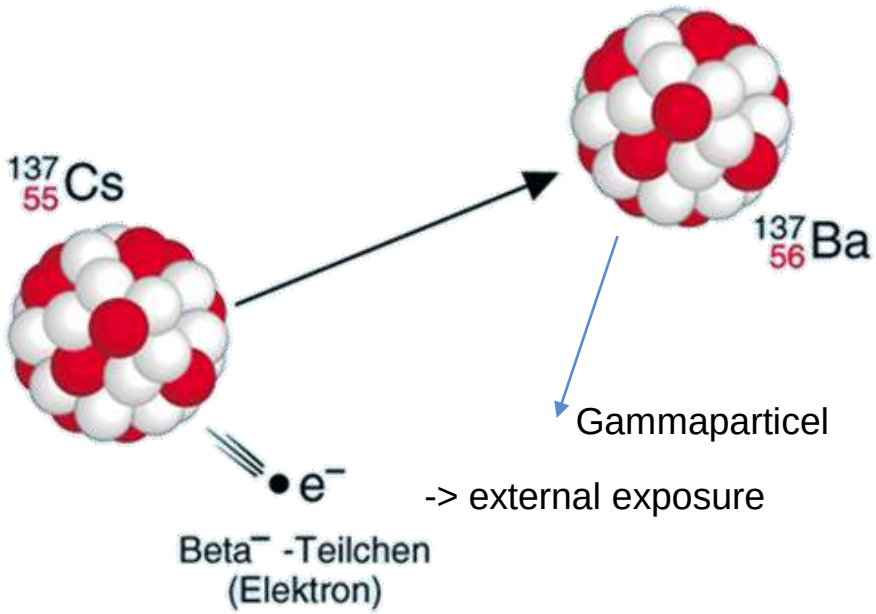
- Equivalent-Dose: Sievert (Sv), typical units mSv, µSv
- **Dose-rate**: dose per unit time, typical **µSv/h**, mSv/h, nSv/h
- Activity: Becquerel (Bq) = 1 per second, typical Bq, kBq, GBq
- **Surface contamination**: activity per area, typical Bq/m², **Bq/cm²**, kBq/km²

Activity

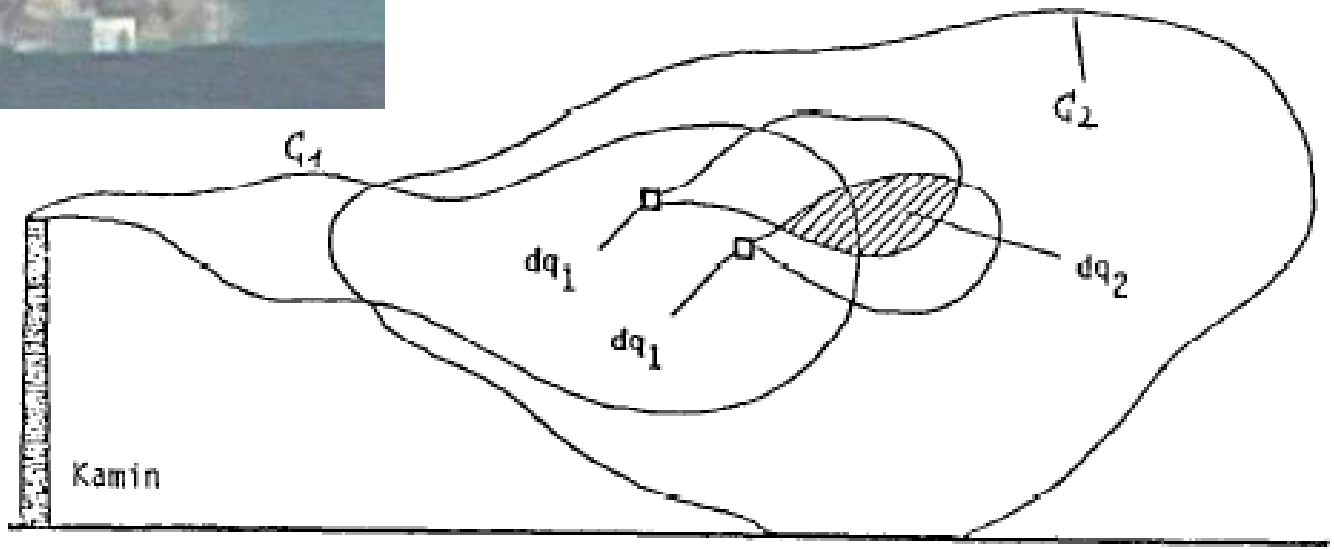
- Activity = number of decays per second

  1 Becquerel = 1 Bq = 1 decay per second



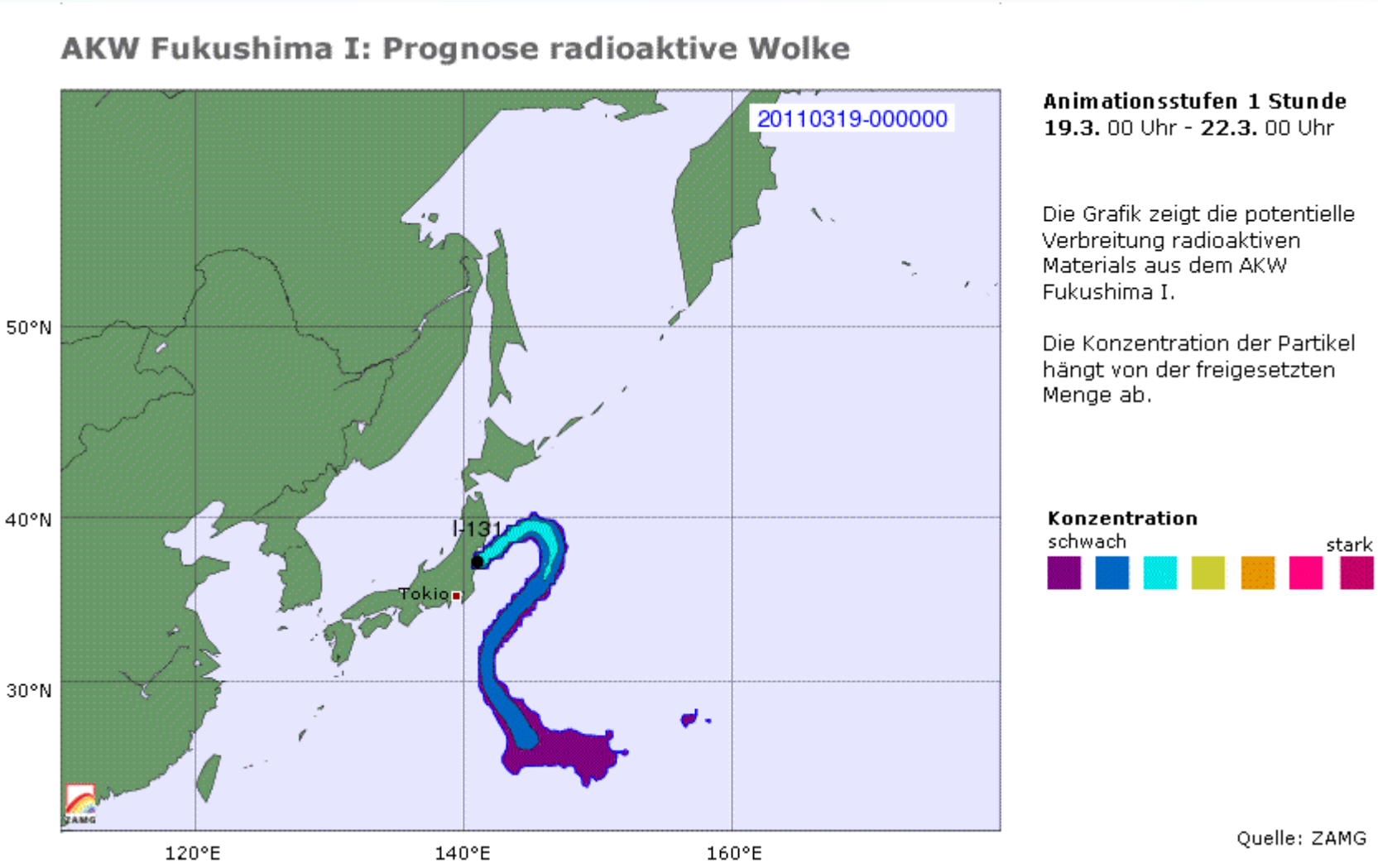


Atmospheric Dispersion



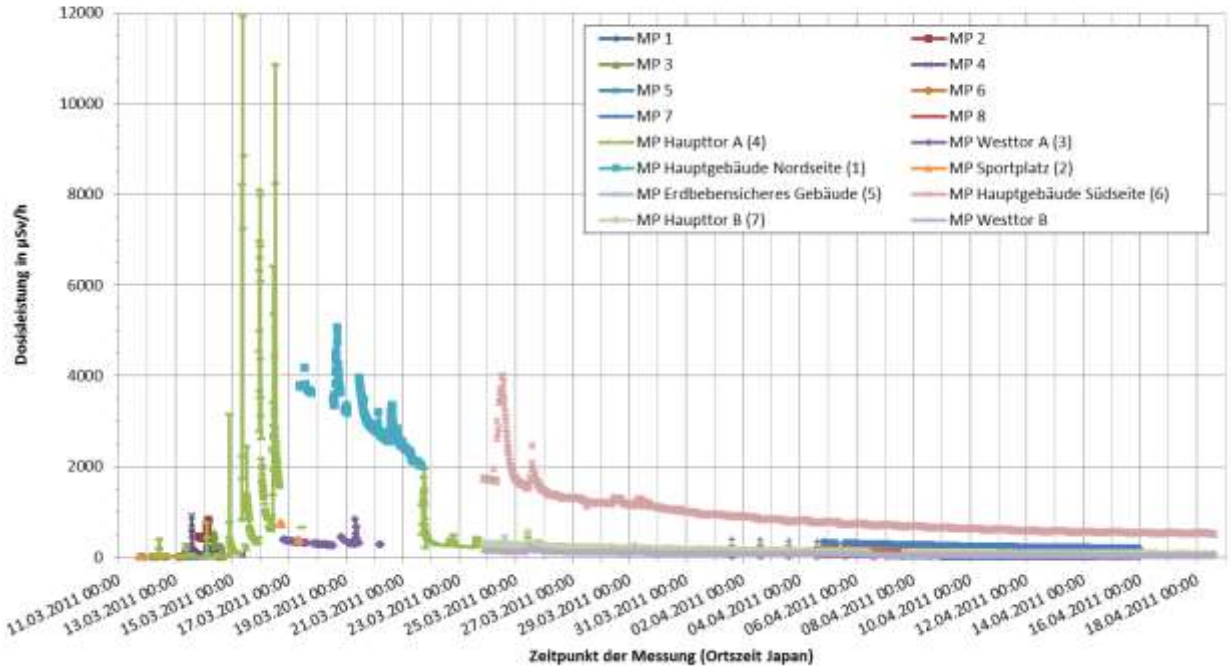
Release height is important

Atmospheric Dispersion



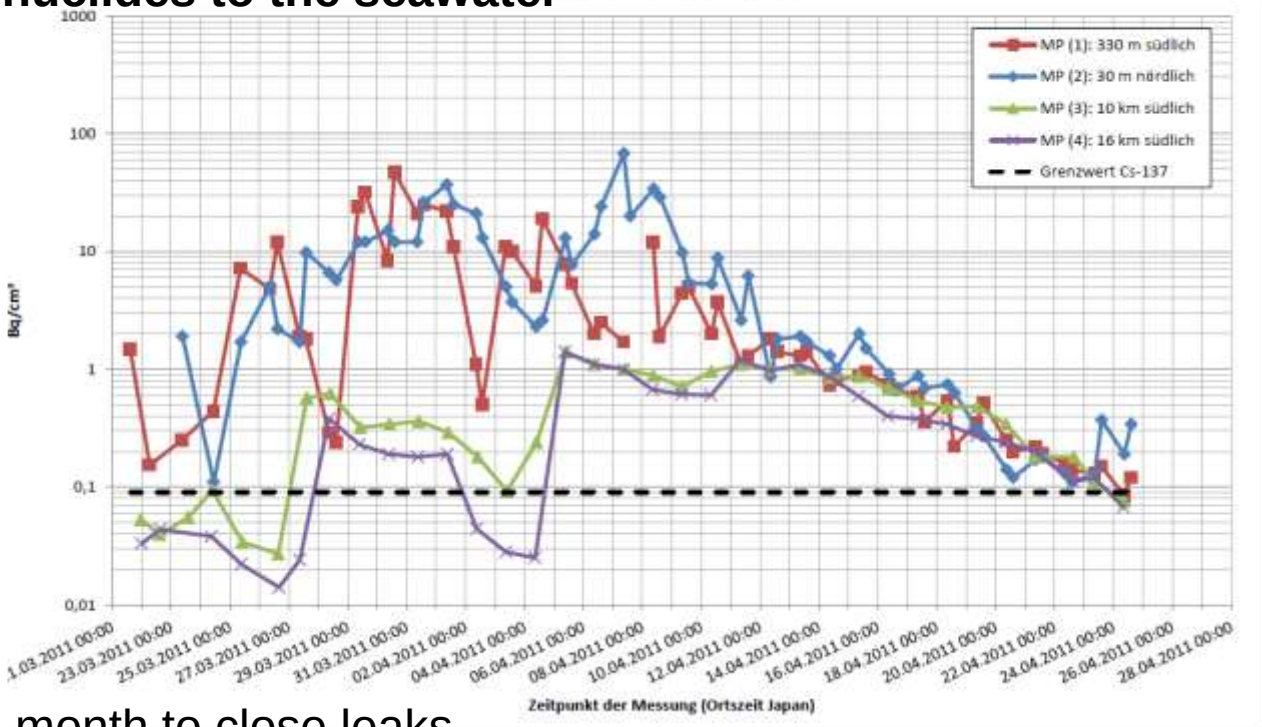
Current Status – Fukushima Daiichi

- **Release of radio nuclides to the atmosphere**
- Ongoing, but decreasing amounts
- On-site dose rates decreasing



Current Status – Fukushima Daiichi

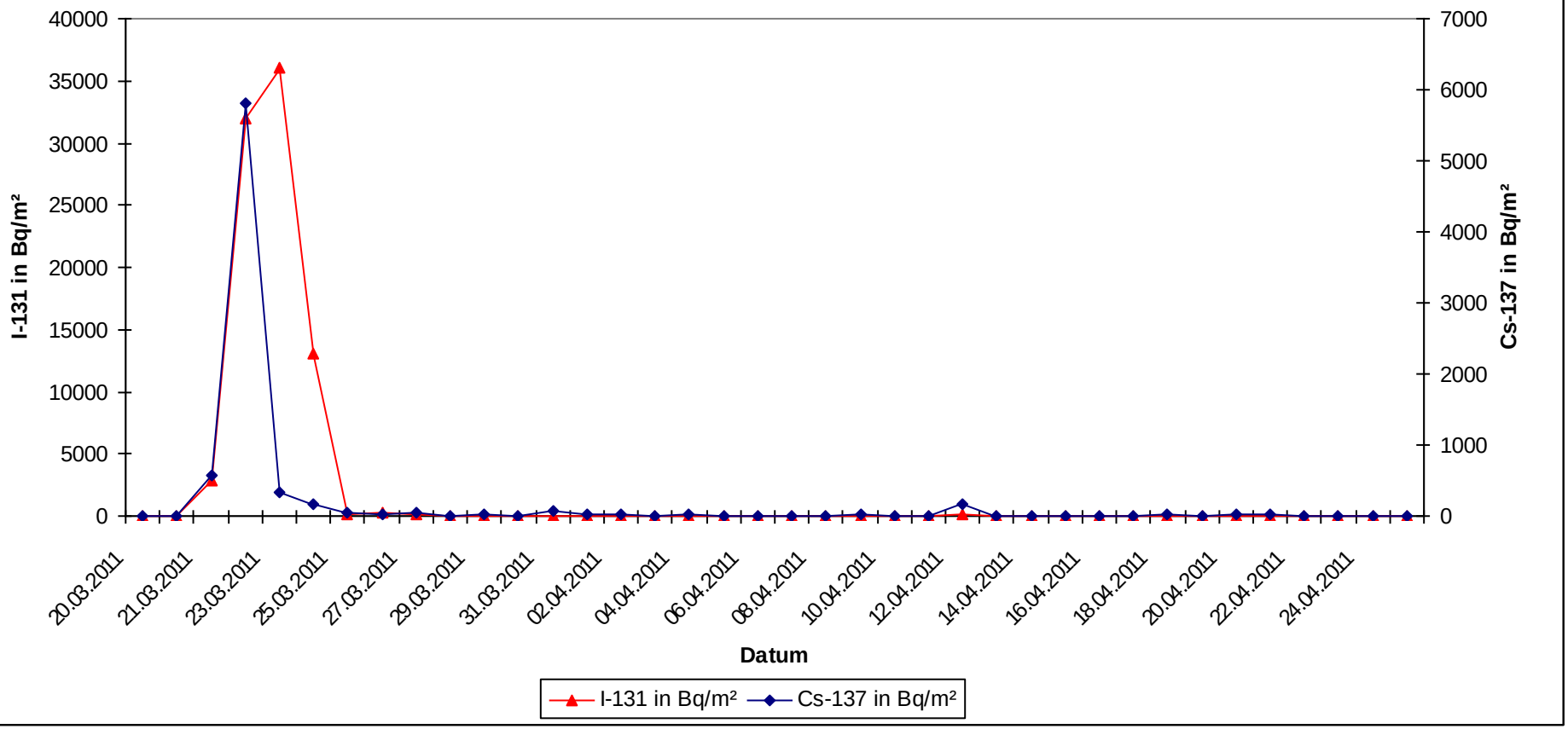
- **Release of radio nuclides to the seawater**
- Reduced, but ongoing
- Stable levels in the seawater



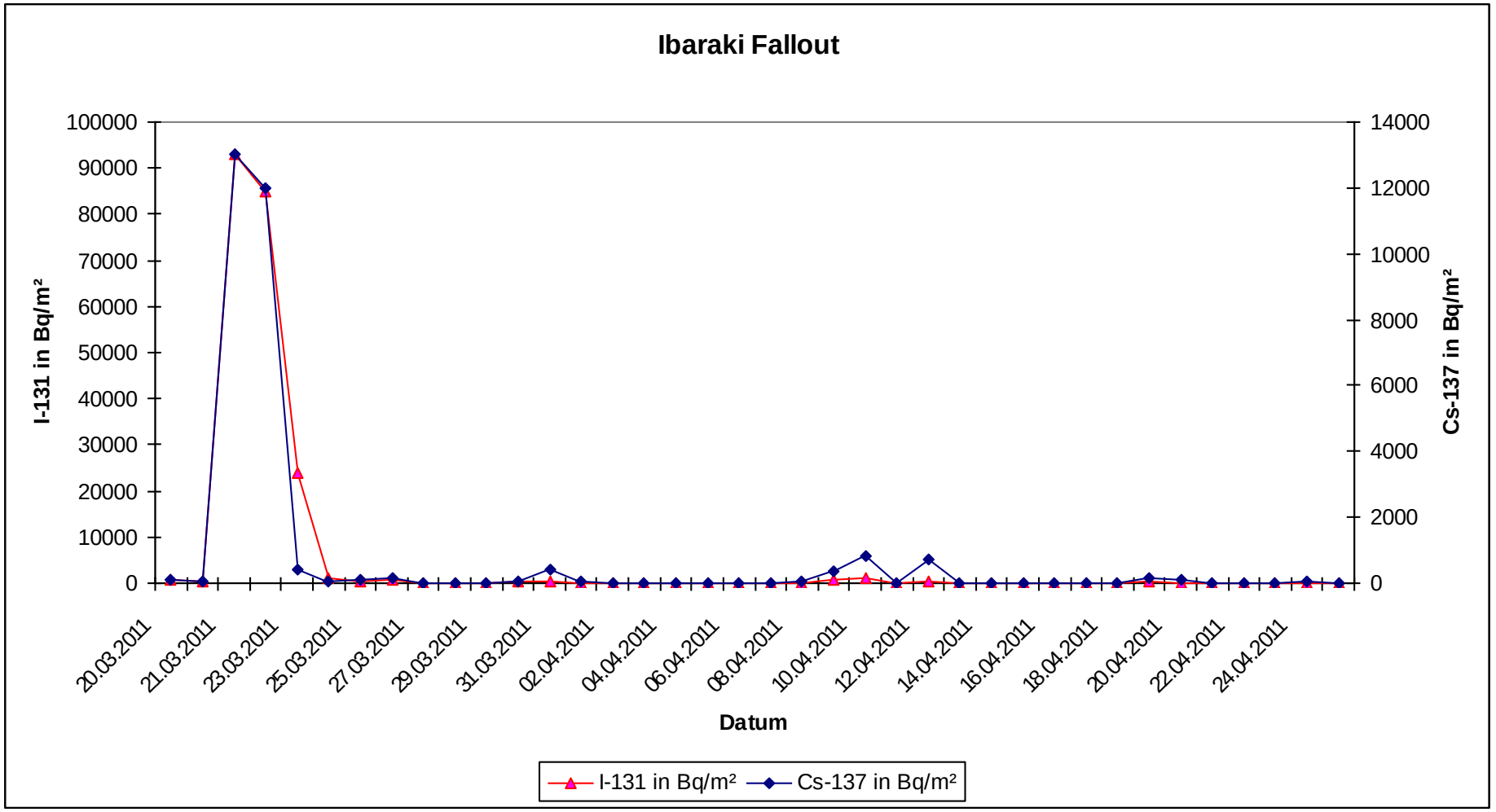
- **Prospect**
- TEPCO expects 3 month to close leaks
- Further 3 – 6 month to stabilize reactors
- One year expected

Fallout

Hinweis: Nullwerte für Cs-137 am 20.03. bedeuten, dass der Wert unter der Nachweisgrenze lag

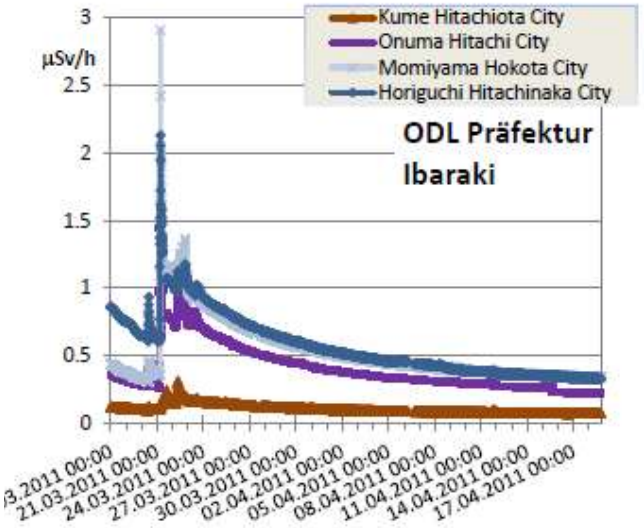


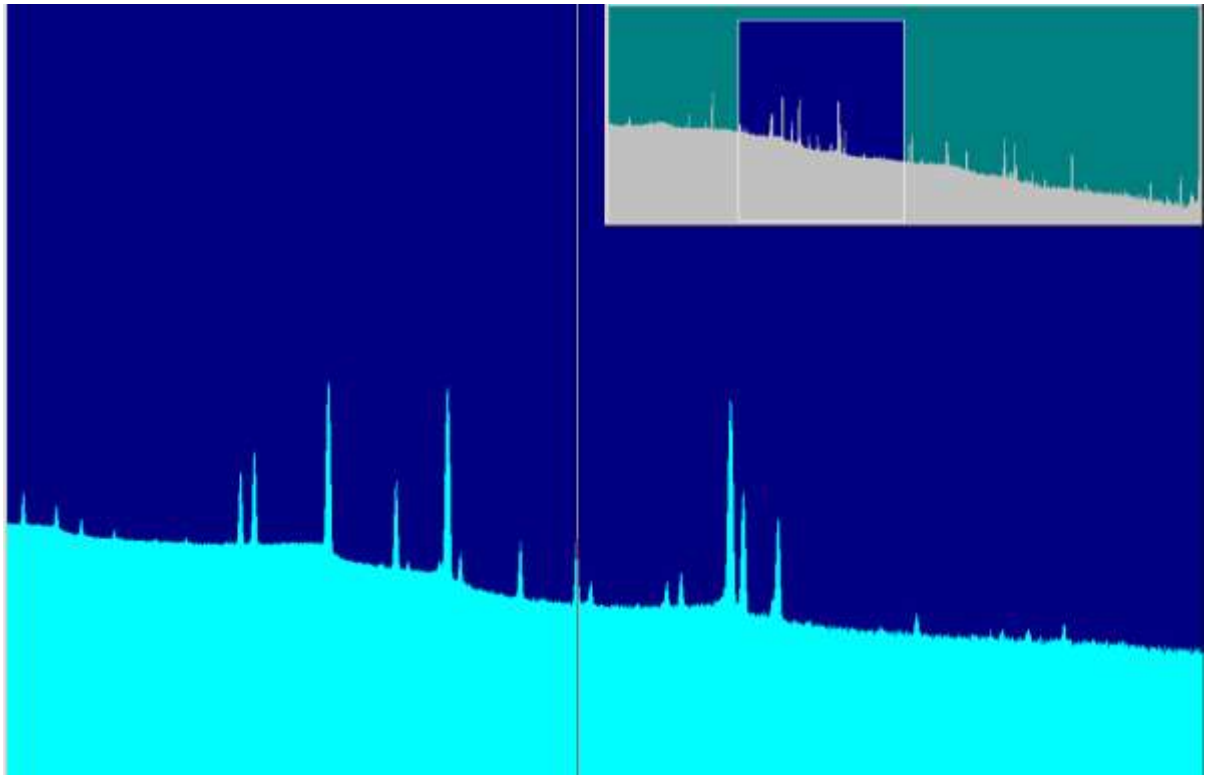
Fallout



Current Status – Radiological Situation

- **Dose rate and contamination**
- Decreasing levels
- Relevant part of Cs-134, Cs-137
- Long term impact expected





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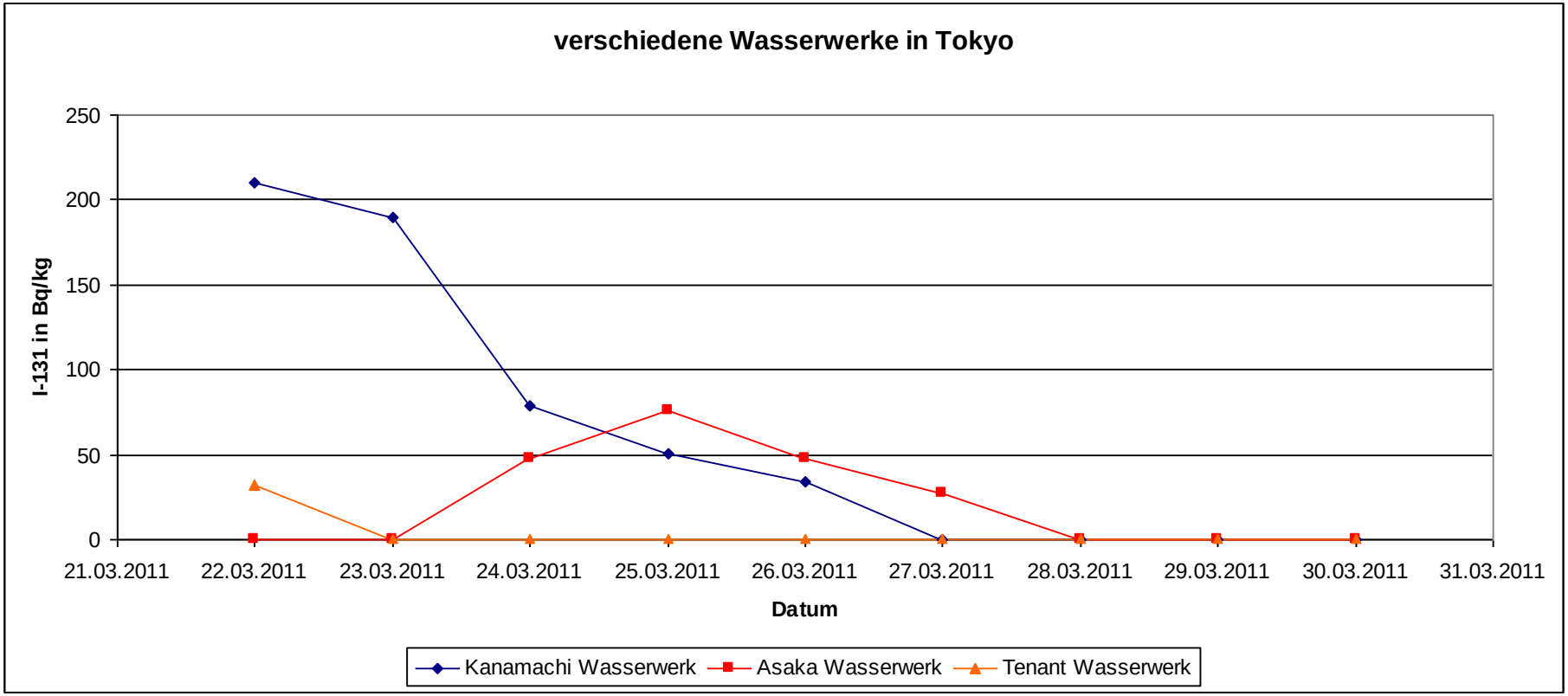
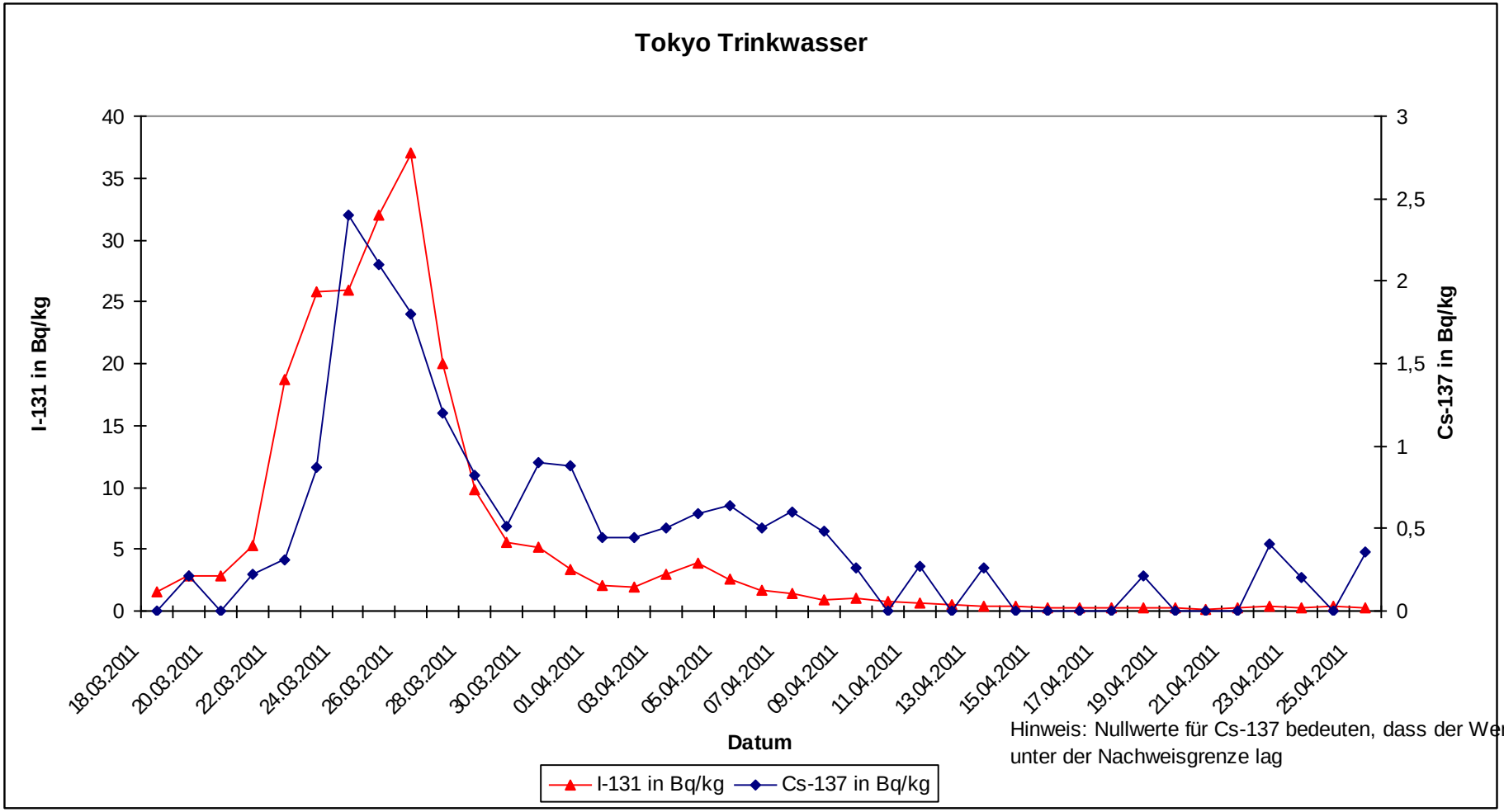
Contamination of Drinking Water

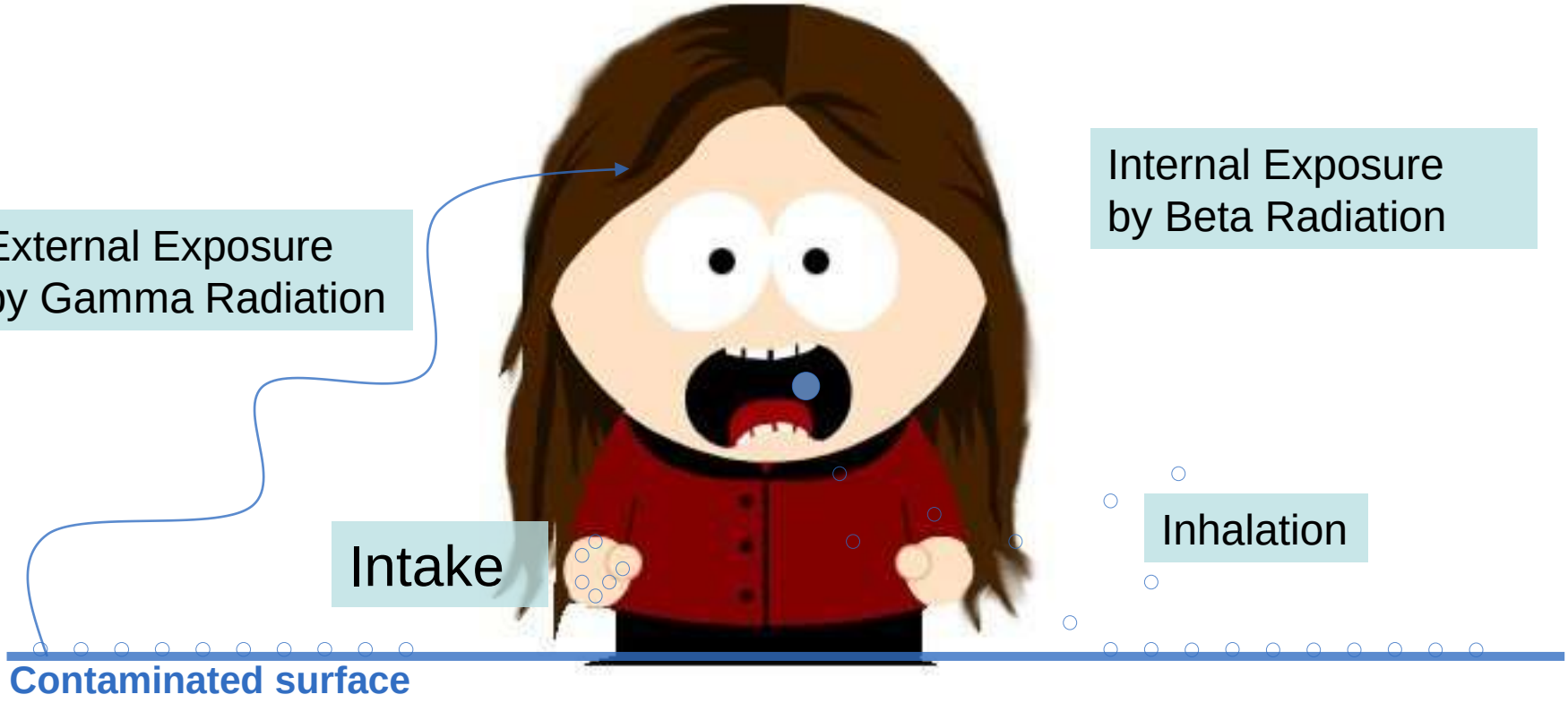


Contamination of Drinking Water



Hinweis: Nullwerte für Cs-137 bedeuten, dass der Wer unter der Nachweisgrenze lag

Pathways of Radiation Exposure



- External exposure: dose [mSv] = **dose rate [mSv/h]** x duration [h]

- Internal exposure: dose [mSv] = intake of activity [Bq] x dose conversion factor [mSv/Bq]

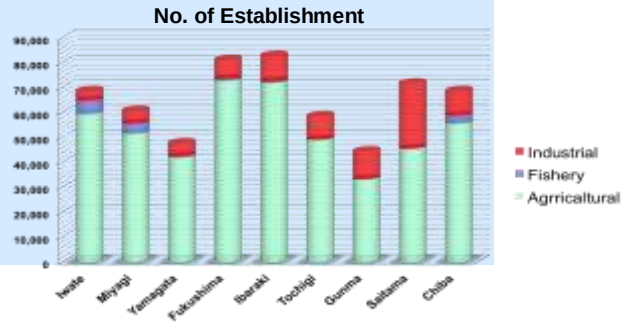
Measurement Methodology

-	Primary Limits effective dose for member of the public	Secondary Limits
▪ Emergency Level	~ 50 mSv	e.g. for Evacuation Sheltering
	Urgent Measuring Methodology	
▪ Normal Operation Level	~ 1 mSv	e.g. **Dose Rate Measurements** 1 mSv/1a = 0,12 µSv/h ECURIE: 0,2 µSv/h
	Preliminary Measuring Methodology	
▪ Trivial Level	~ 10 µSv	IAEA 4Bq/cm² for all RN StrlSchV 1Bq/cm² Cs-137
	Accurate Measuring Methodology	**Surface Contamination Measurements**

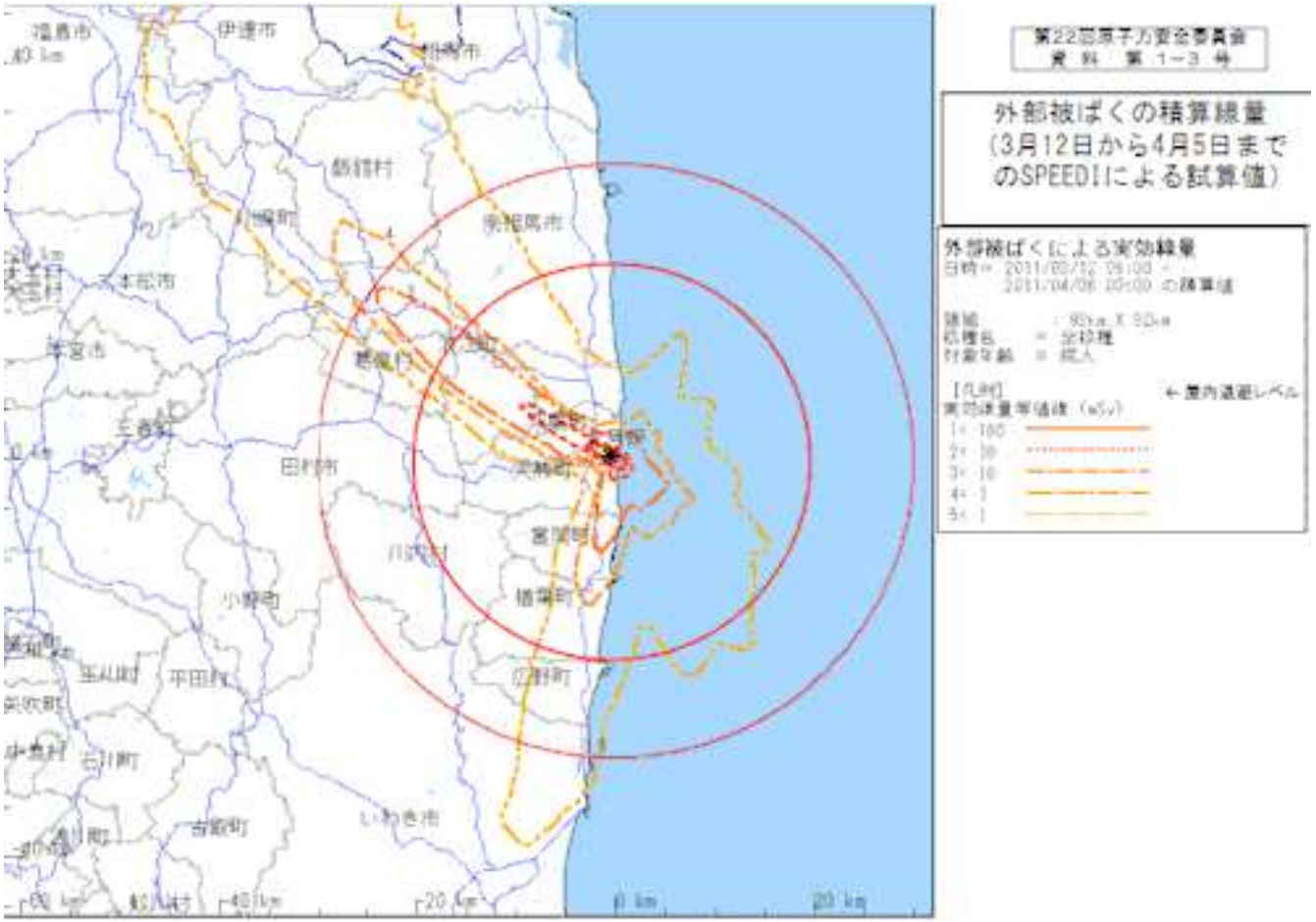
Concerns of the Japanese Population & Industry

- **Population**
  - Understanding the current and future situation in the region
  - food and water safety
  - Short term and long term health impact

- **Industry**
  - Understanding the current and future situation in the region
  - impact on their business continuity
  - Working environment / employee safety
  - Customer and consumer confidence



Emergency Level – Local Scale



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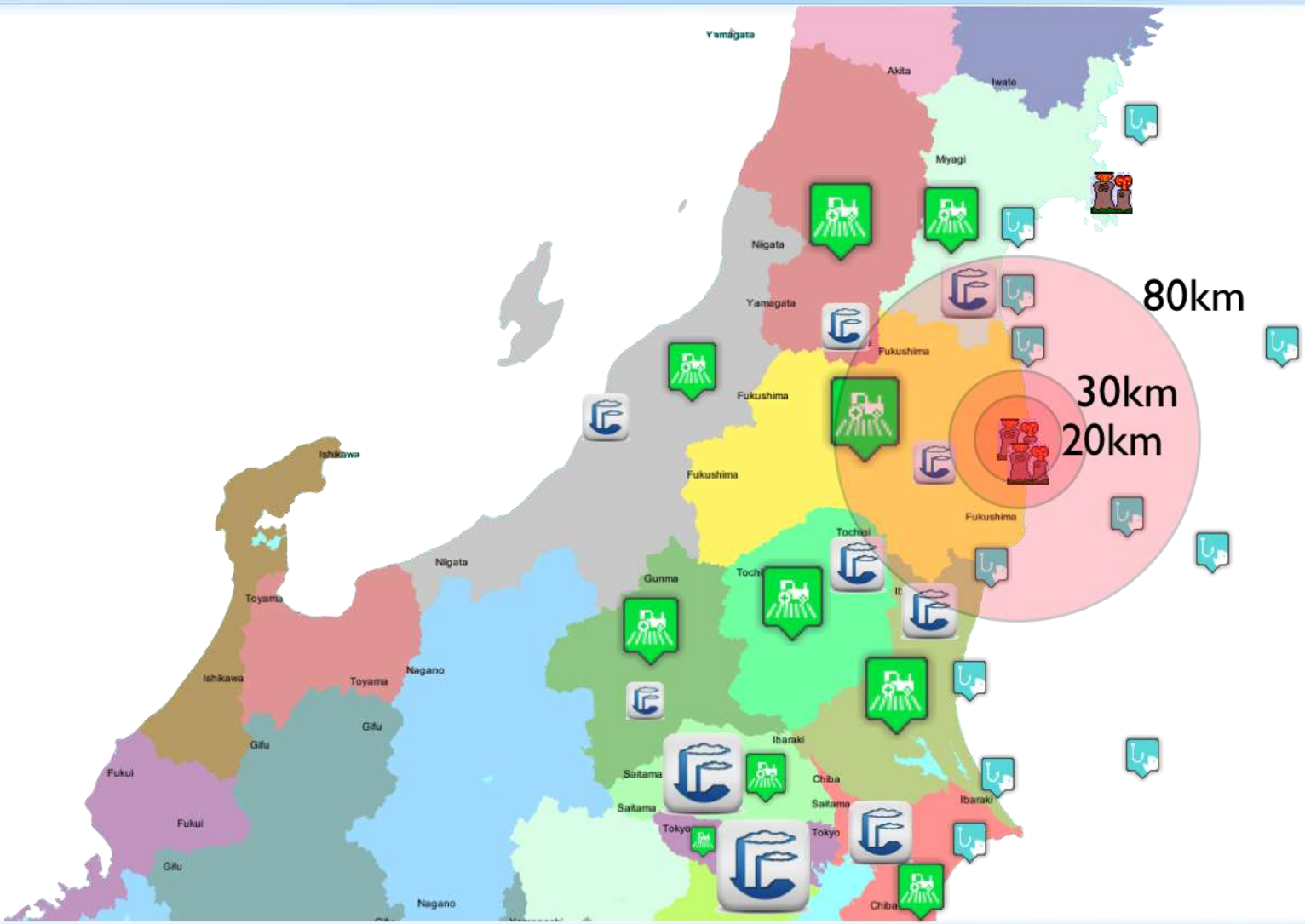
National Scale



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Radiation Protection Services

Established main services

- **Measurements of surface contamination related to alpha and beta emitters**
- **Gamma-ray spectrometry**
- **Dose rate measurements**
- **Development of concepts for evaluation and management of radioactivity in all stages of manufacturing processes and for protection of employees and public**

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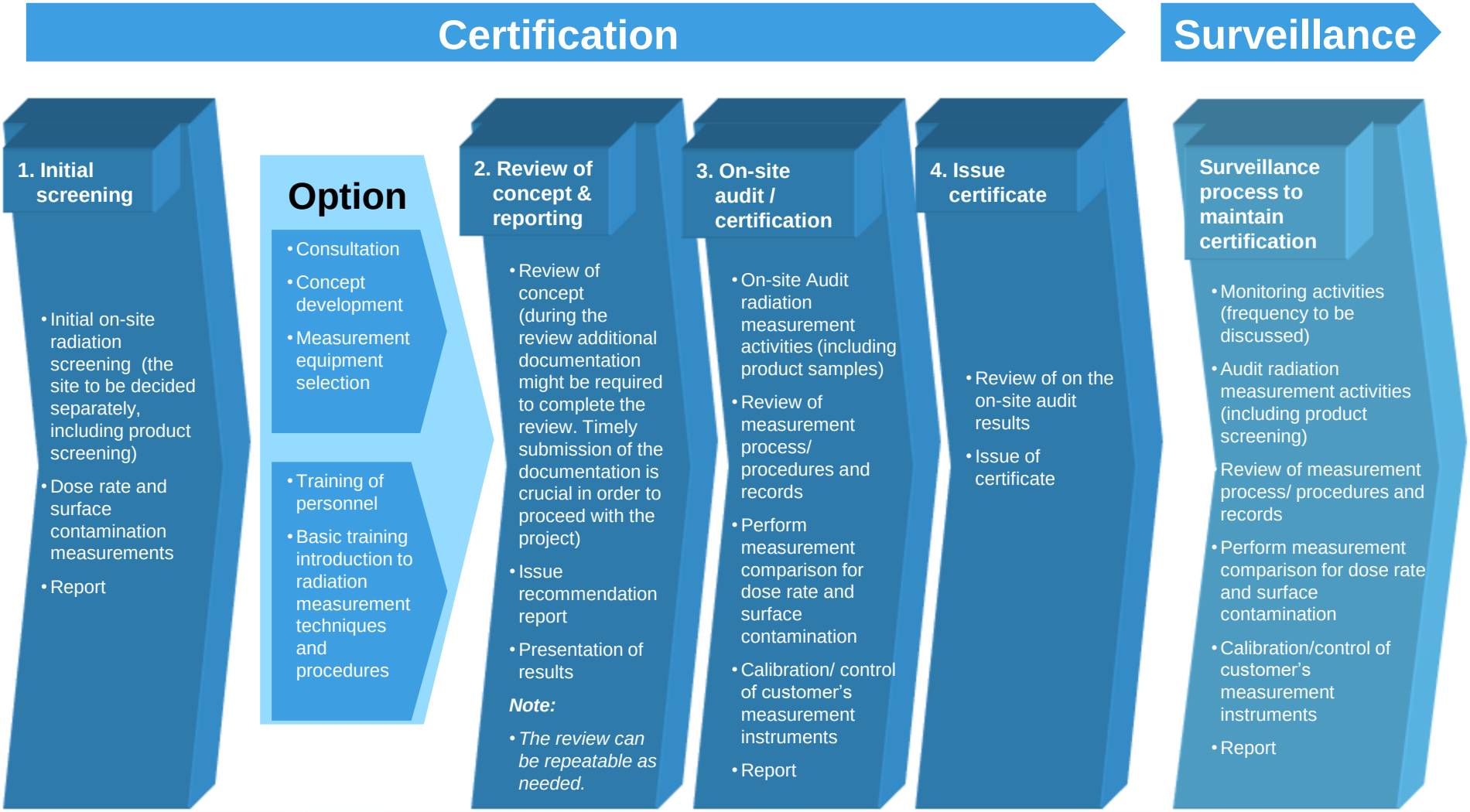
Radiation Protection Measurement Process Certification



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Measurement Equipment

- Dose rate measurements of gamma radiation

- Beta-Counting with surface contamination monitors

Measurement Equipment

- On-site nuclide identification

- Fast identification of artificial radiation by NBR technique

Lab Equipment

- Hp Ge-Gamma Spectrometry