

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

**Presentation for DIHK Japan**

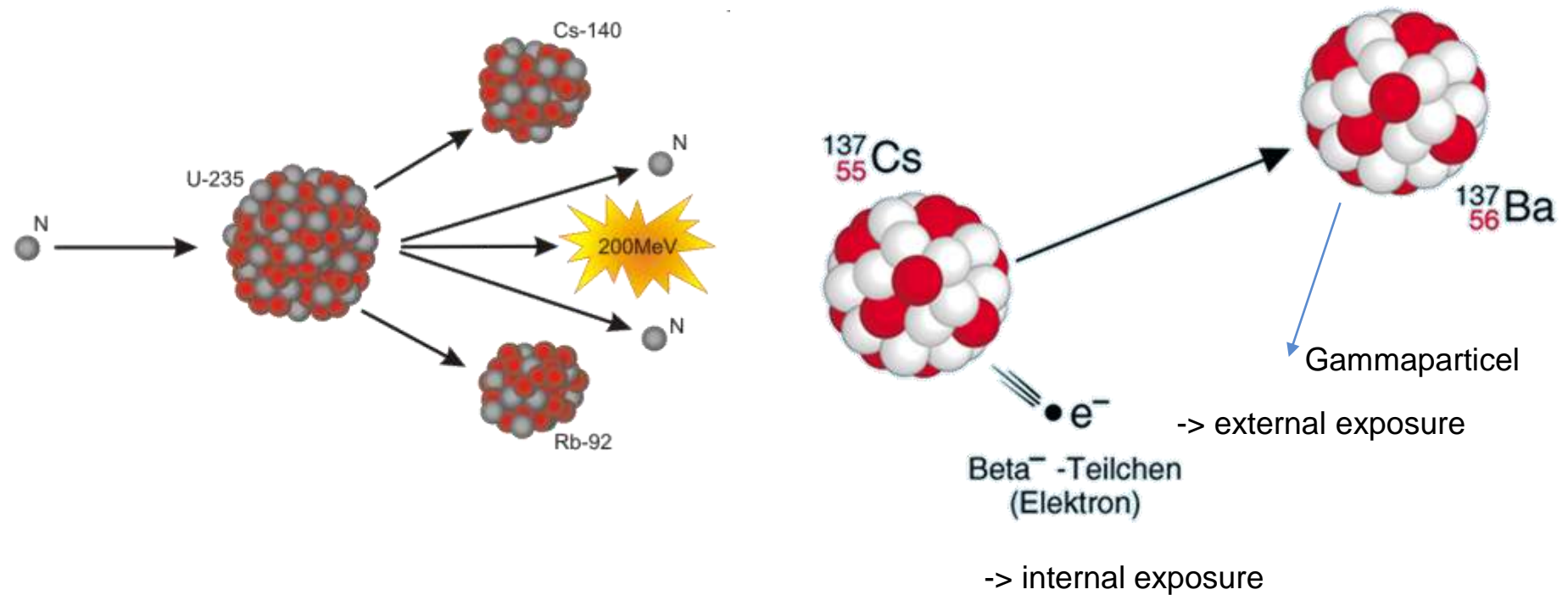
# Basic Radiological Definitions

- Equivalent-Dose: Sievert (Sv), typical units mSv,  $\mu$ Sv
- **Dose-rate**: dose per unit time, typical  $\mu$ Sv/h, mSv/h, nSv/h
- Activity: Becquerel (Bq) = 1 per second, typical Bq, kBq, GBq
- **Surface contamination**: activity per area, typical Bq/m<sup>2</sup>, **Bq/cm<sup>2</sup>**, kBq/km<sup>2</sup>

# Activity

- Activity = number of decays per second

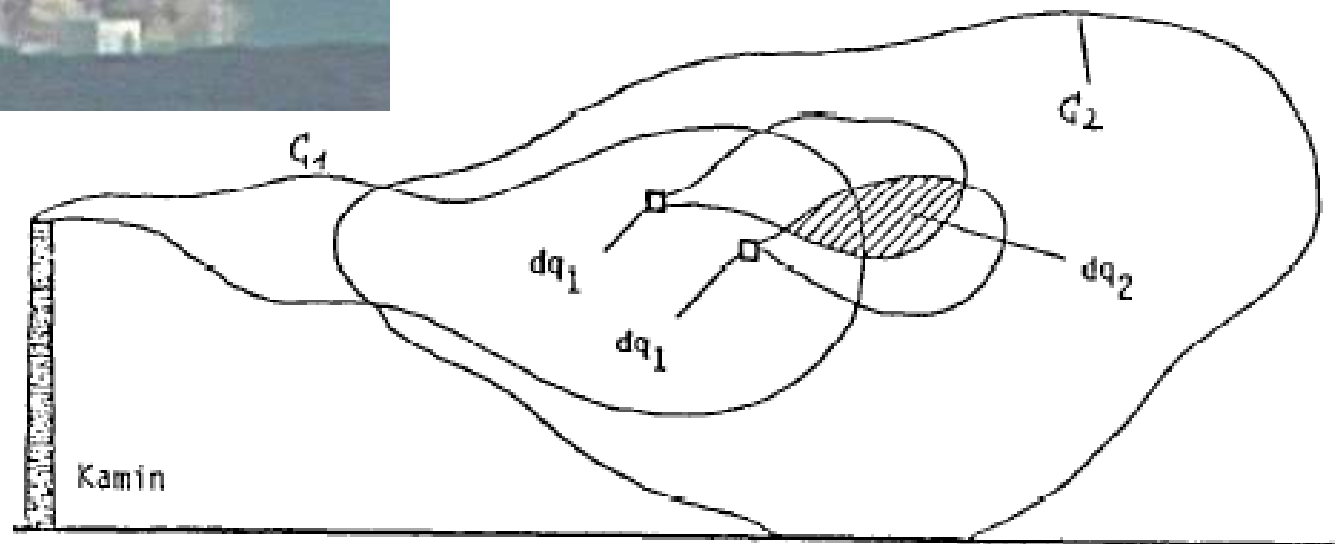
1 Becquerel = 1 Bq = 1 decay per second



# Atmospheric Dispersion



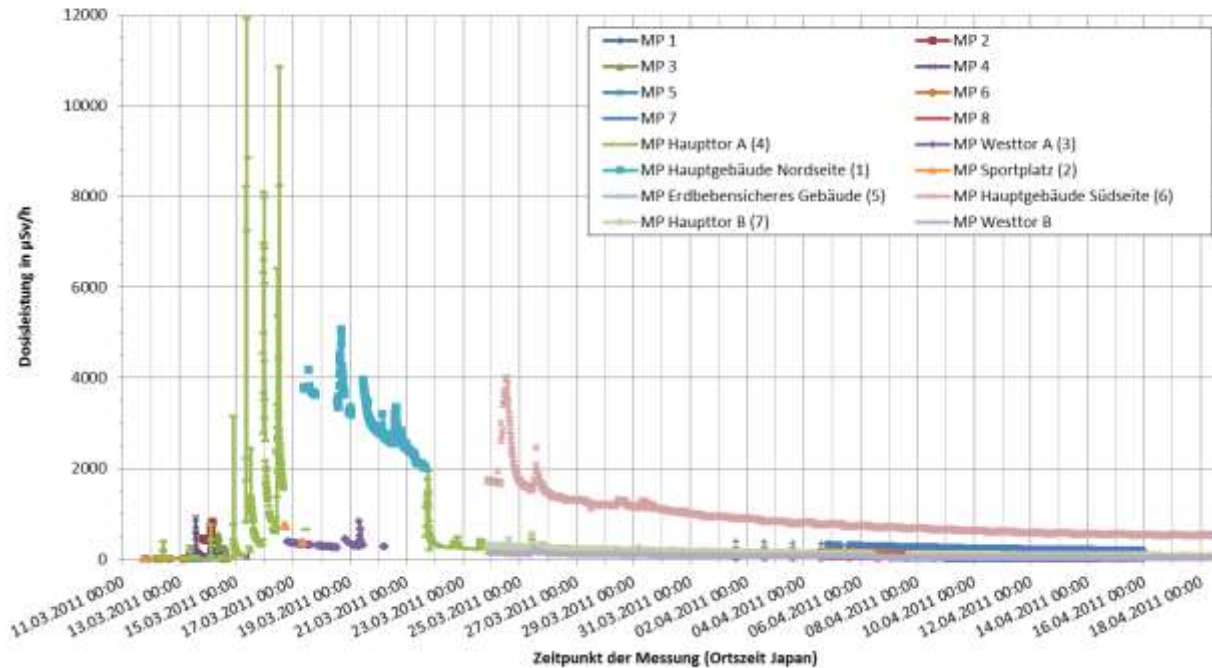
Release height is important





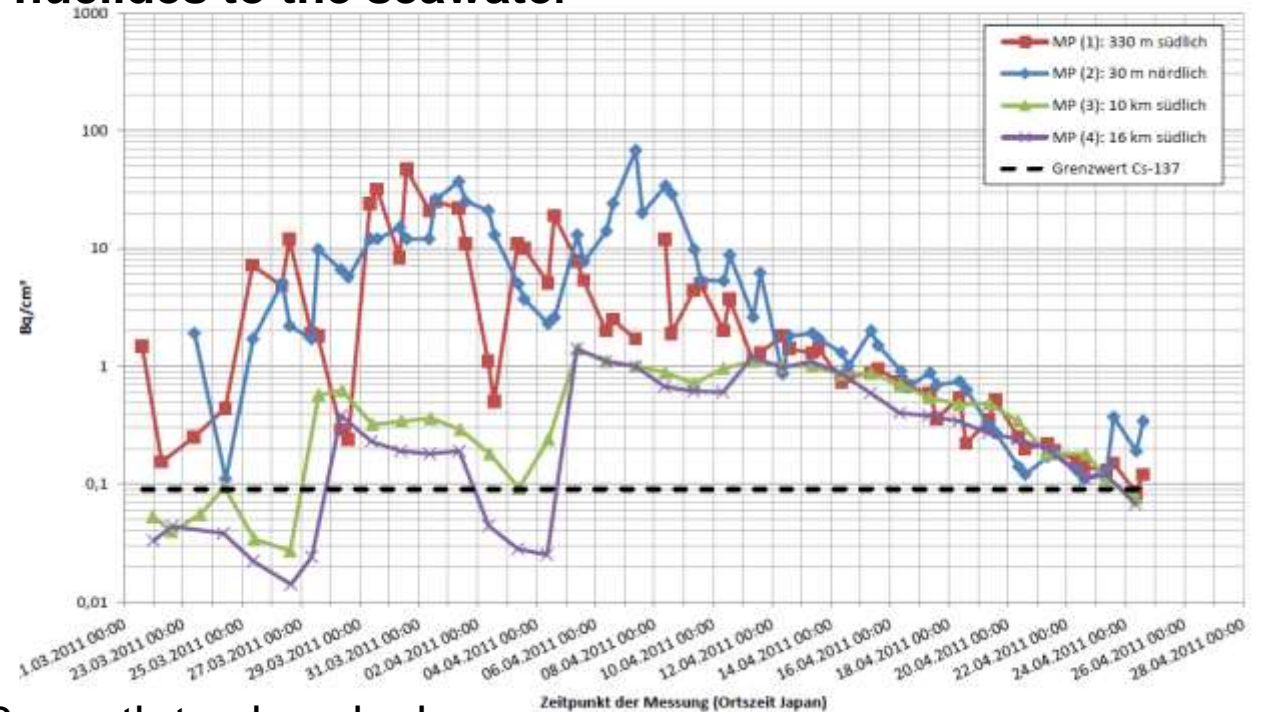
# Current Status – Fukushima Daiichi

- **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

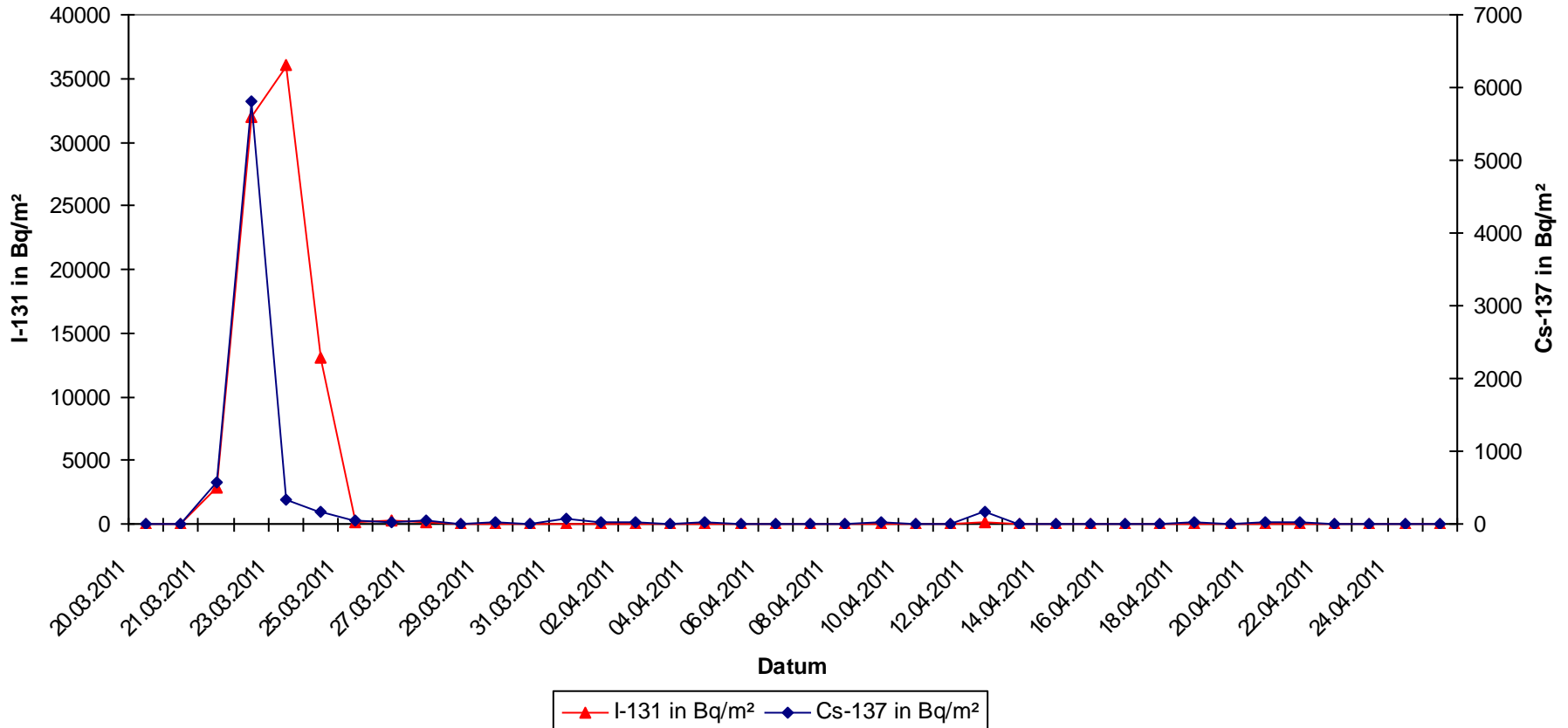


- **Prospect**
- TEPCO expects 3 month to close leaks
- Further 3 – 6 month to stabilize reactors
- One year expected

# Fallout

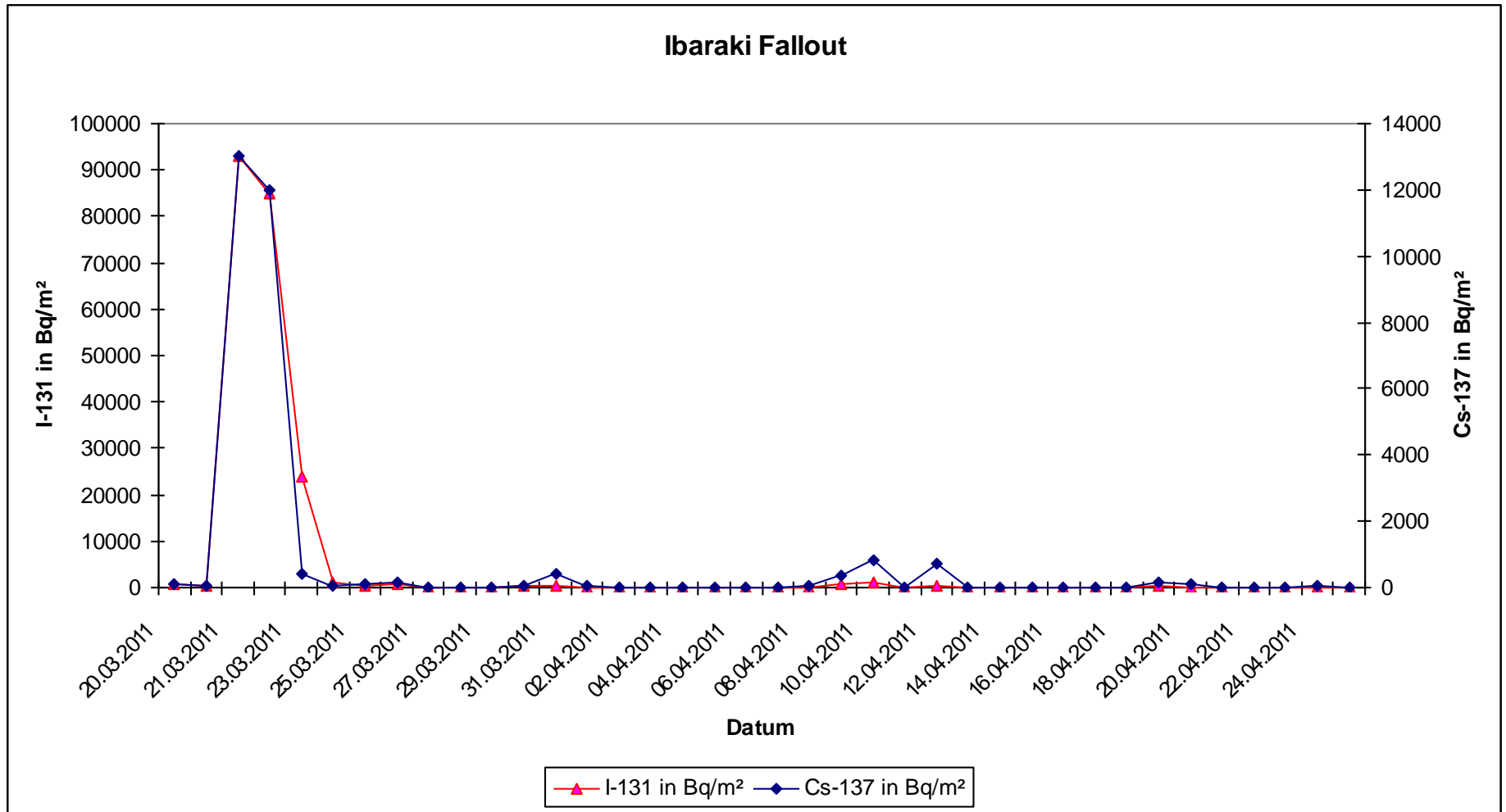
Hinweis: Nullwerte für Cs-137 am 20.03. bedeuten, dass der Wert unter der Nachweisgrenze lag

## Tokyo Fallout



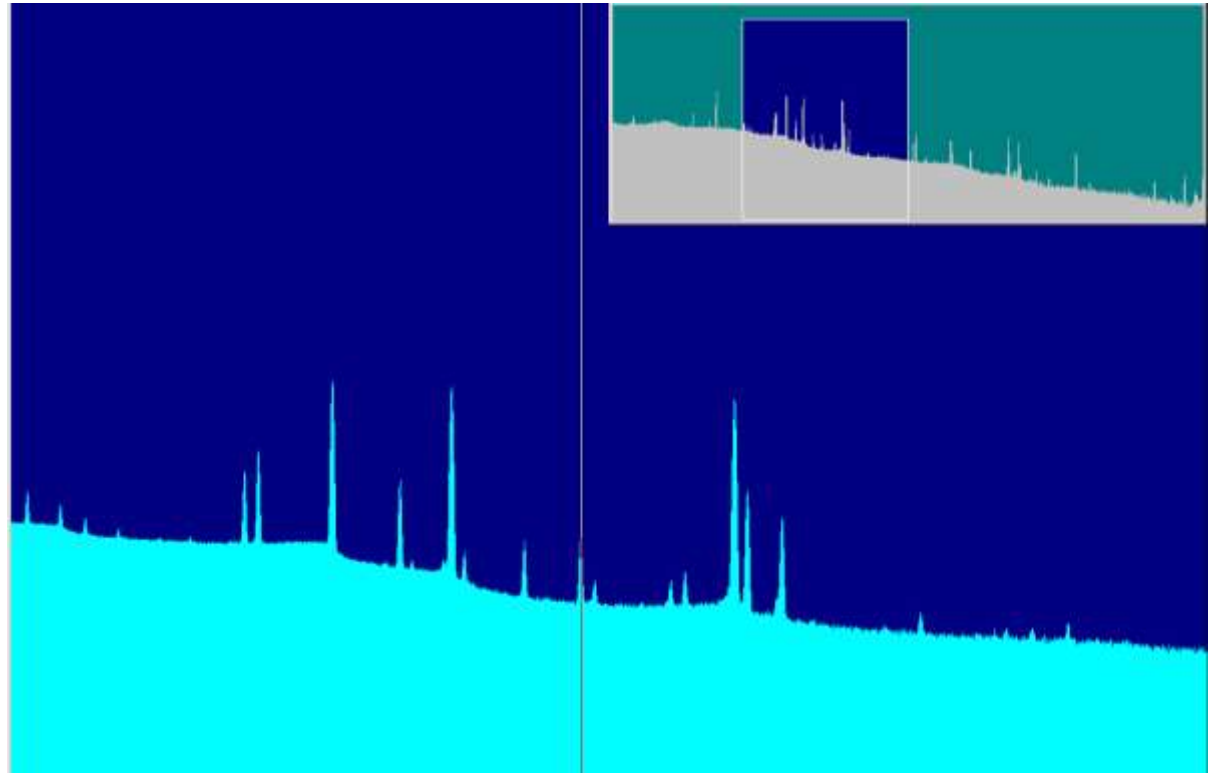
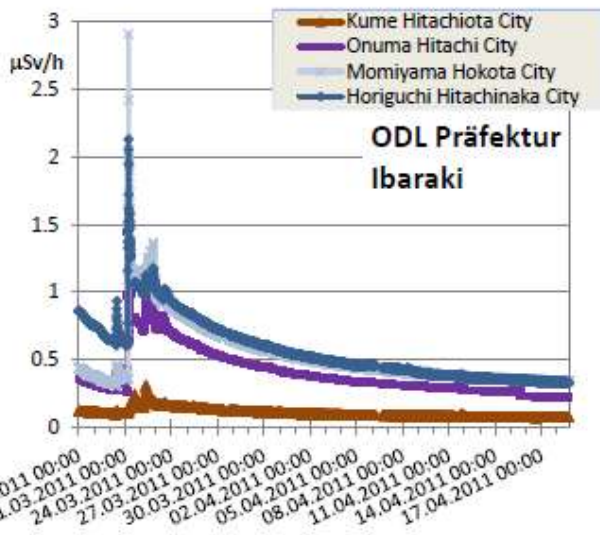


# Fallout

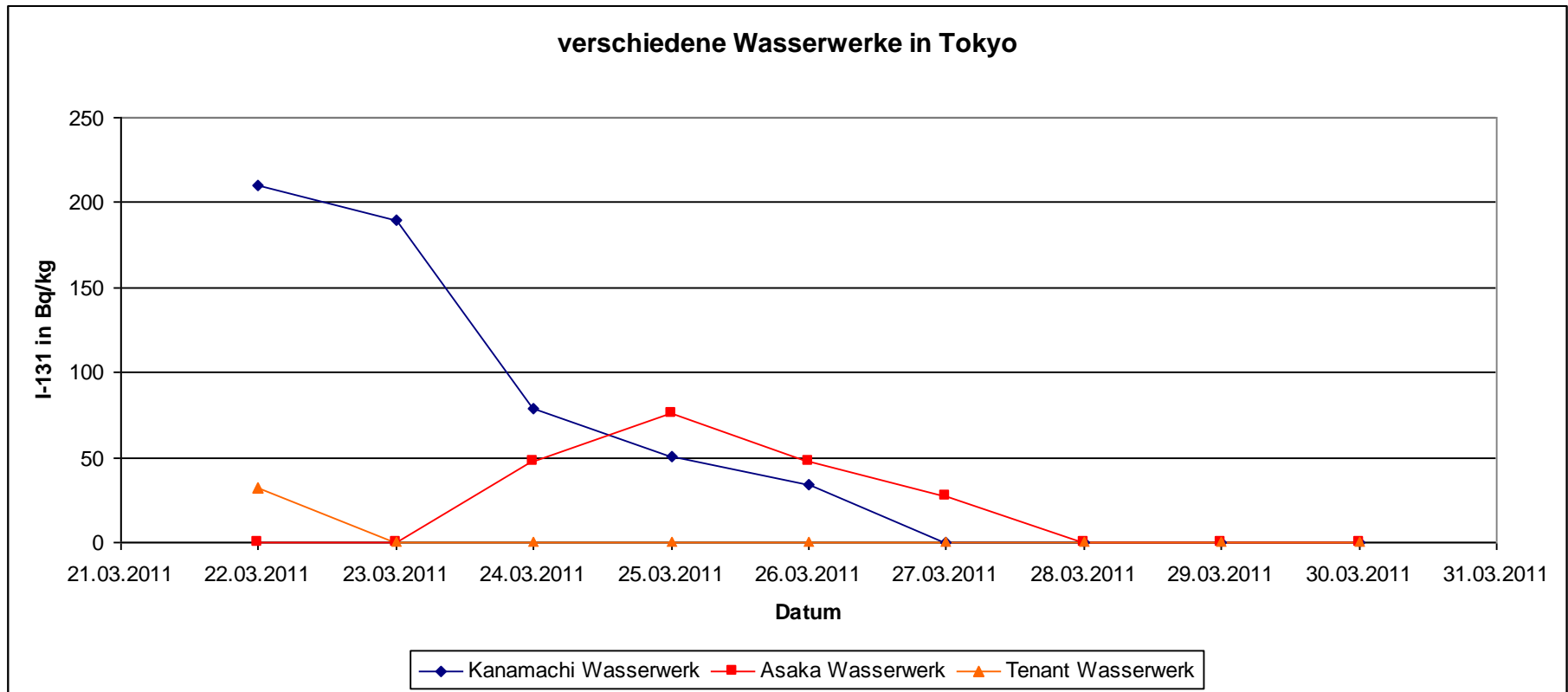


# Current Status – Radiological Situation

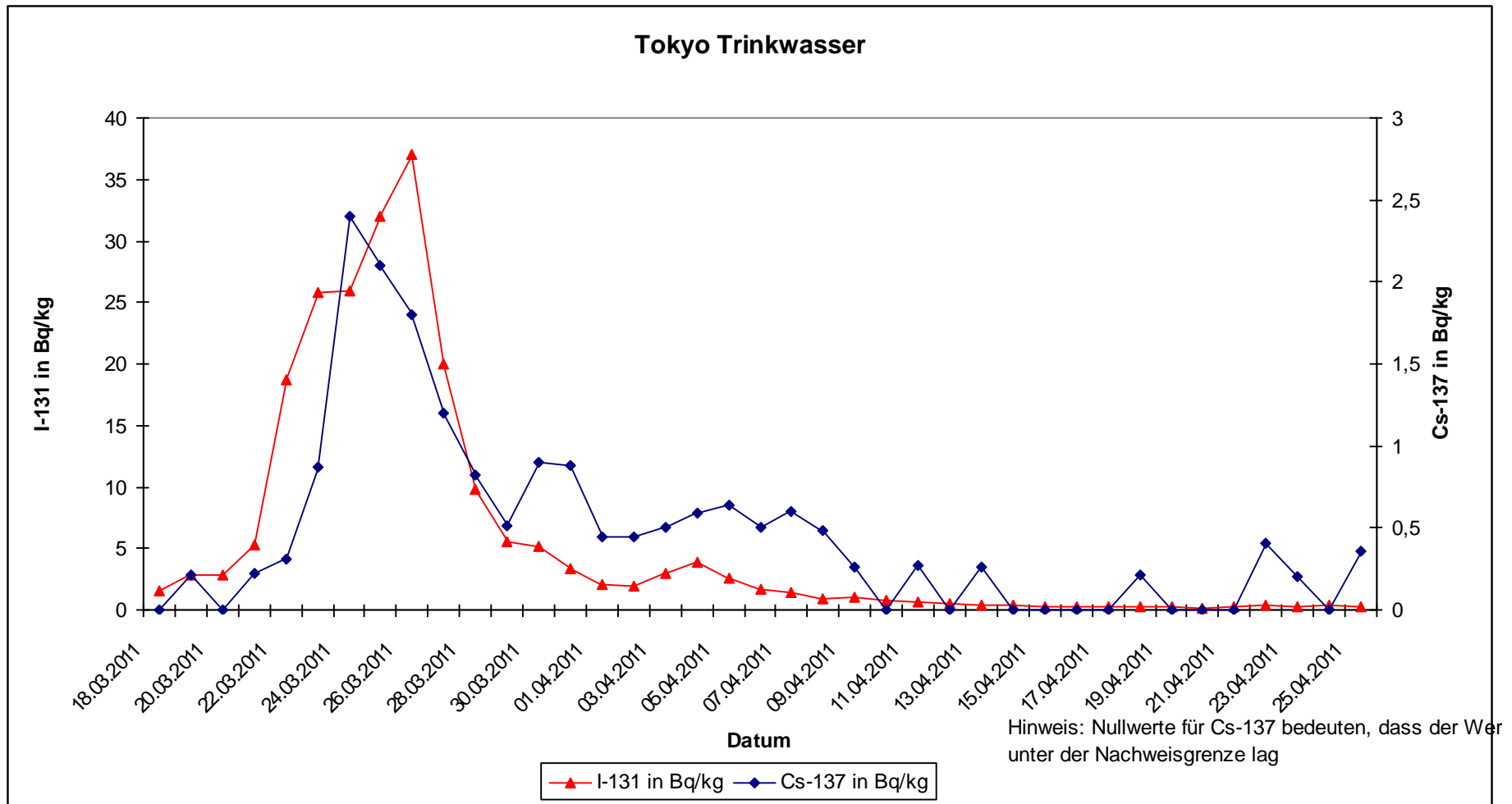
- **Dose rate and contamination**
- Decreasing levels
- Relevant part of Cs-134, Cs-137
- Long term impact expected



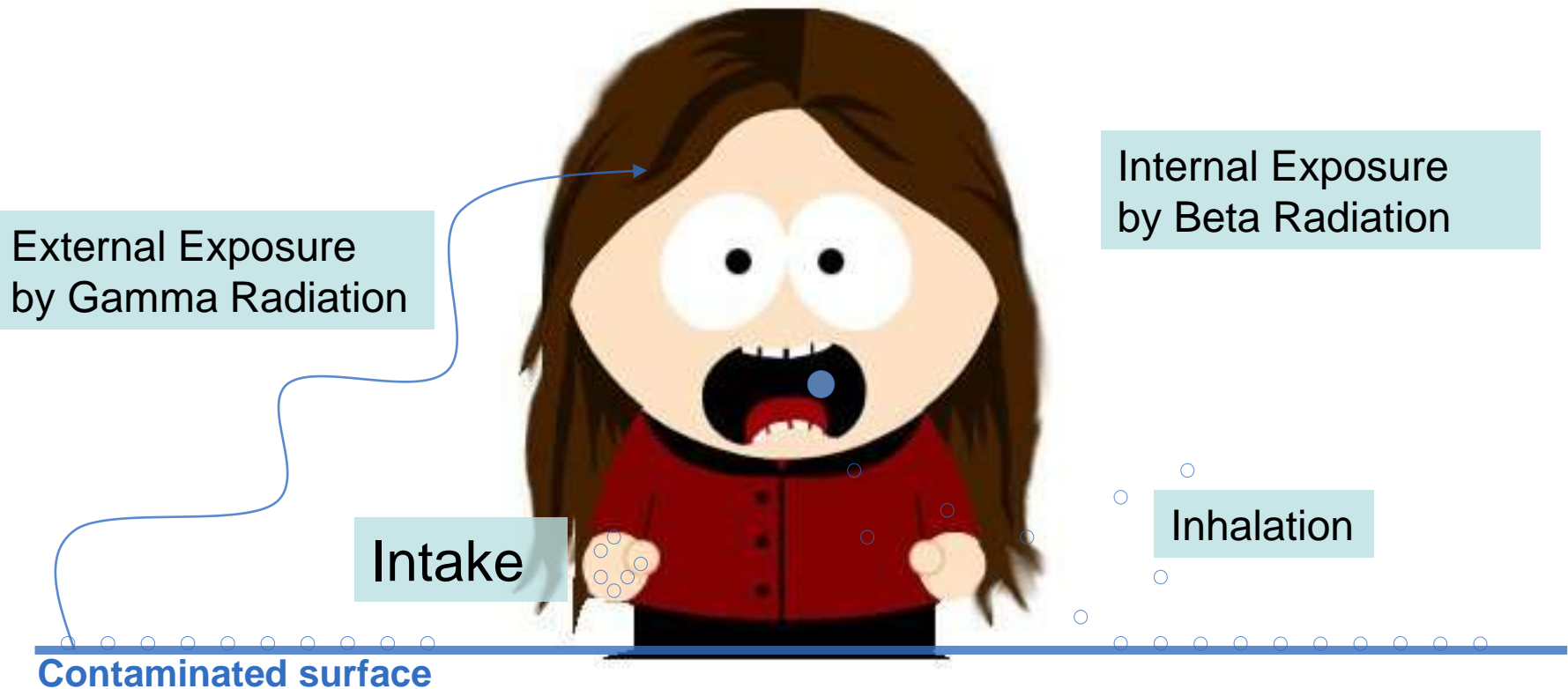
# Contamination of Drinking Water



# Contamination of Drinking Water



# 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
	<b>Urgent Measuring Methodology</b>	
▪ Normal Operation Level	~ 1 mSv	e.g. <b>Dose Rate Measurements</b> 1 mSv/1a = 0,12 $\mu$ Sv/h ECURIE: 0,2 $\mu$ Sv/h
	<b>Preliminary Measuring Methodology</b>	
▪ Trivial Level	~ 10 $\mu$ Sv	IAEA 4Bq/cm <sup>2</sup> for all RN StrISchV 1Bq/cm <sup>2</sup> Cs-137
	<b>Accurate Measuring Methodology</b>	<b>Surface Contamination Measurements</b>

# Concerns of the Japanese Population & Industry

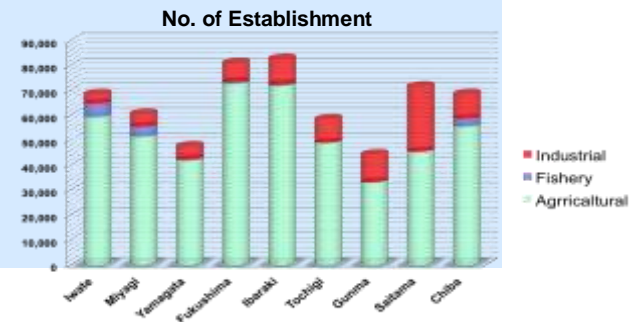
## Population

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

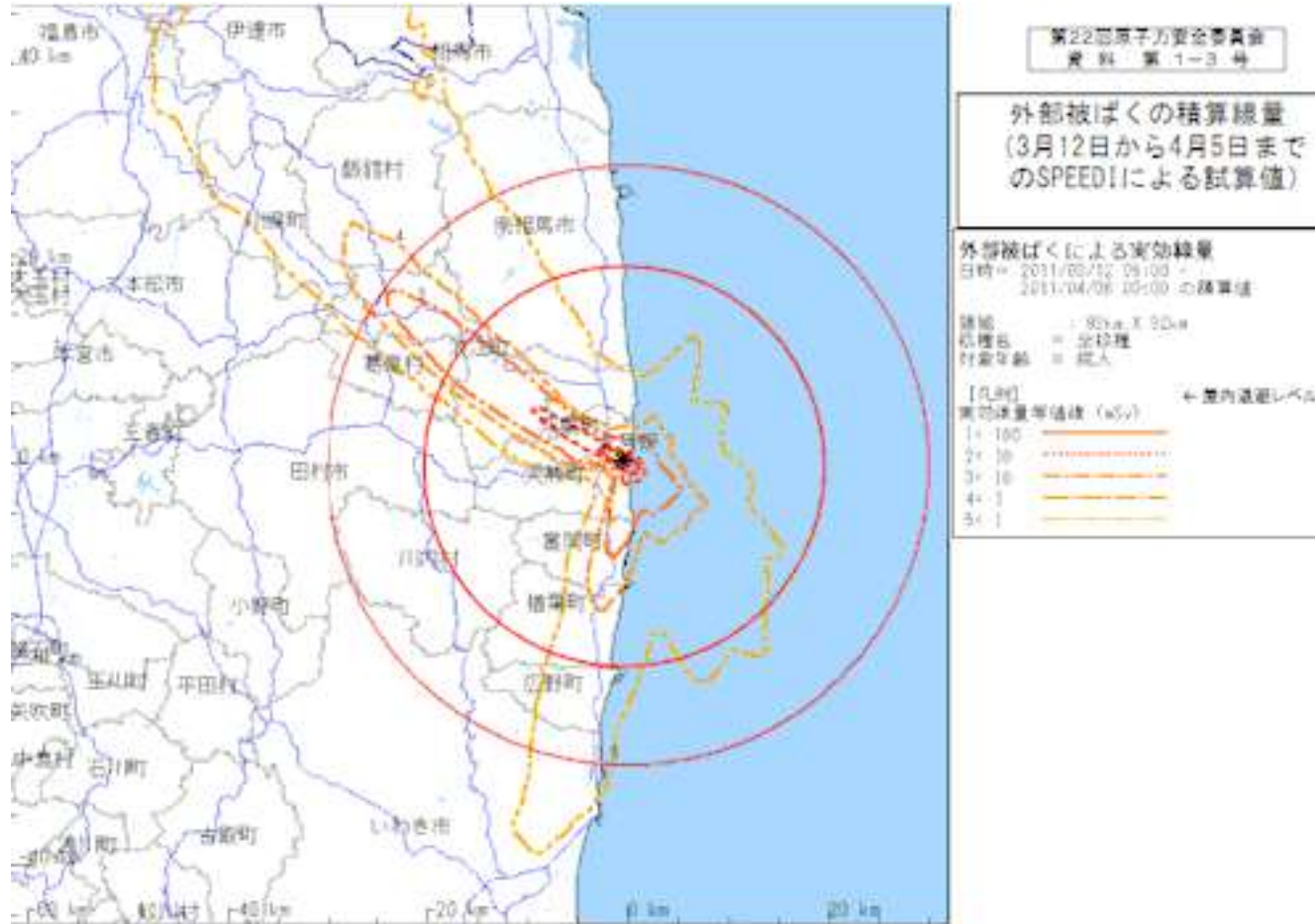


## Industry

- 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







# 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**

# TÜV Rheinland Japan

## Radiation Protection Measurement Process Certification

### Certification

### Surveillance

#### 1. Initial screening

- Initial on-site radiation screening (the site to be decided separately, including product screening)
- Dose rate and surface contamination measurements
- Report

#### Option

- Consultation
- Concept development
- Measurement equipment selection
- Training of personnel
- Basic training introduction to radiation measurement techniques and procedures

#### 2. Review of concept & reporting

- Review of concept (during the review additional documentation might be required to complete the review. Timely submission of the documentation is crucial in order to proceed with the project)
- Issue recommendation report
- Presentation of results

#### Note:

- *The review can be repeatable as needed.*

#### 3. On-site audit / certification

- On-site Audit radiation measurement activities (including product samples)
- Review of measurement process/ procedures and records
- Perform measurement comparison for dose rate and surface contamination
- Calibration/ control of customer's measurement instruments
- Report

#### 4. Issue certificate

- Review of on the on-site audit results
- Issue of certificate

#### Surveillance process to maintain certification

- Monitoring activities (frequency to be discussed)
- Audit radiation measurement activities (including product screening)
- Review of measurement process/ procedures and records
- Perform measurement comparison for dose rate and surface contamination
- Calibration/control of customer's measurement instruments
- Report

# 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

