RADIATION EDUCATION - NEW CHALLENGES

Naoki Matsuda
Department of Radiation Biology and Protection
Atomic Bomb Disease Institute, Nagasaki University

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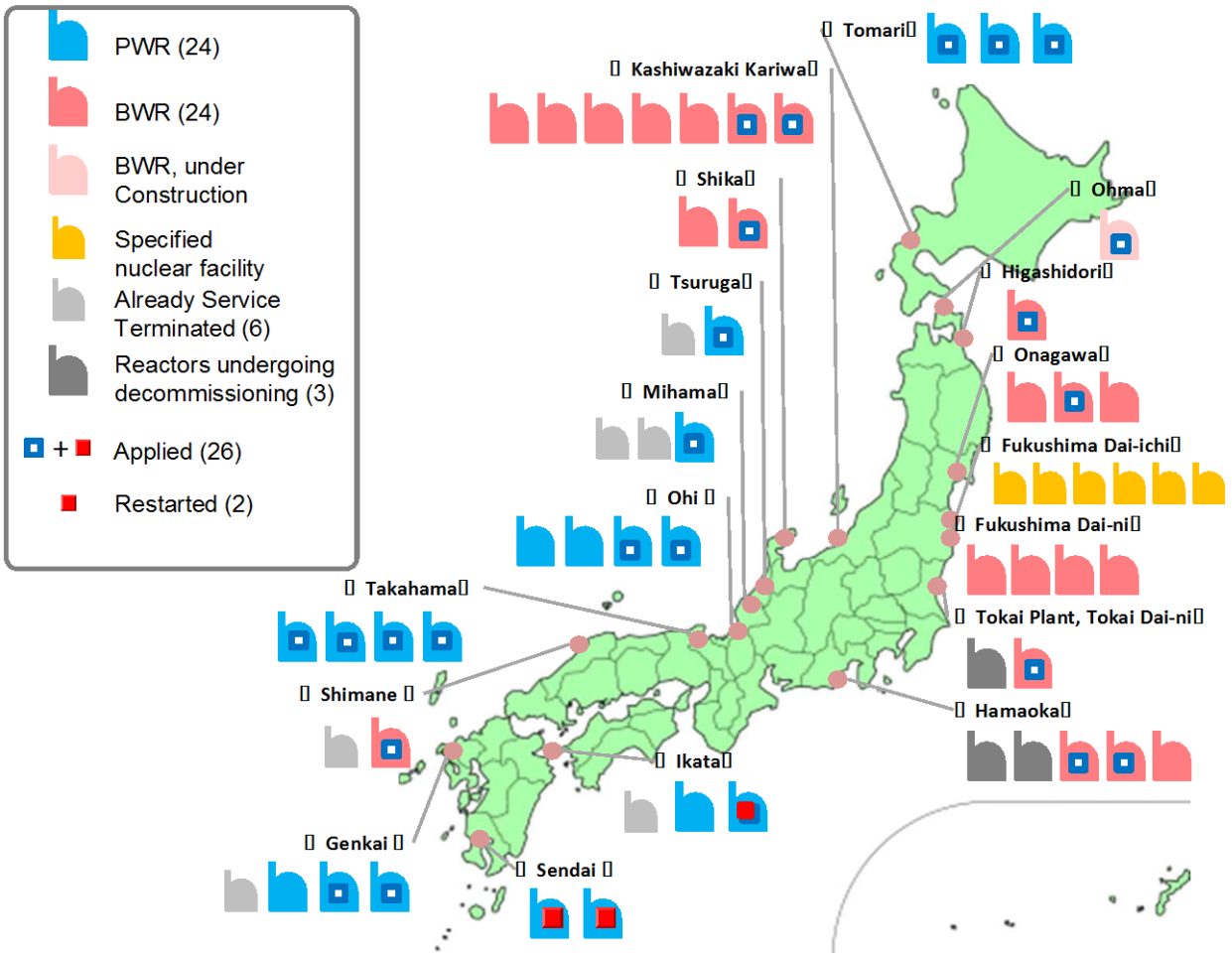
Radiation Education - New Challenges

Topics

- Research and Education Program for Organized Emergency Monitoring Platform by Radiation Facilities
  - *Human resource development project for nuclear regulation (NRA)*
- Development of Professionals on Radiation Health Risk Science
  - *Problem-solving development program for high-level medical professionals (MEXT)*

PROGRAM FOR ORGANIZED EMERGENCY MONITORING PLATFORM BY RADIATION FACILITIES

Nuclear power plants in Japan, May 2017

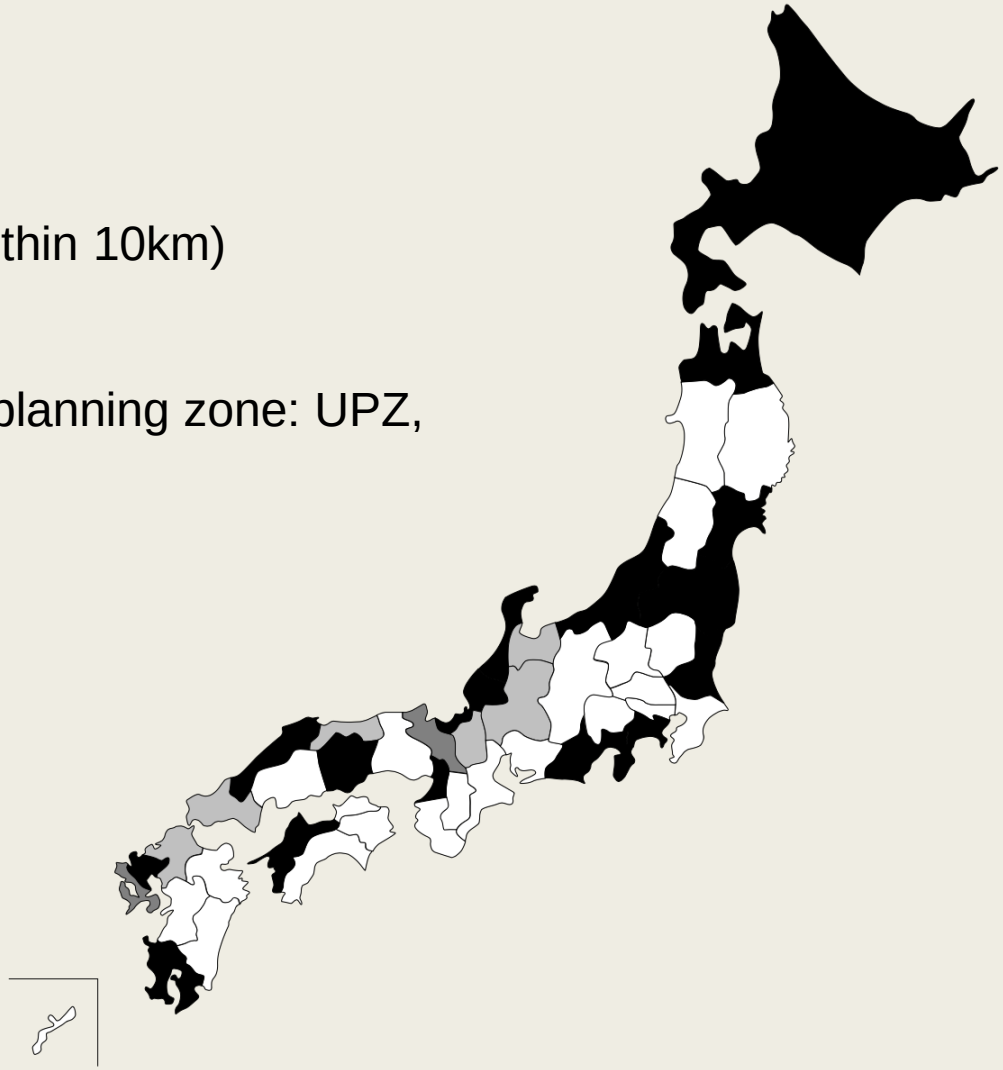


Nuclear emergency preparedness

16 NPP siting prefectures

2 adjacent prefectures (within 10km)

6 adjacent prefectures
(Urgent protective action planning zone: UPZ, within 30km)



For issues related to:

Generic criteria

Ls)

Observables/
indicators

System of generic criteria and operational criteria

(IAEA Pub1467, GSG-2, Fig.1)

Default OILs for Field Survey Measurements by NRA

OIL		Monitoring	OIL value		Response Action
Urgent response	OIL1	Ambient dose	500μSv/h	1m height	Immediately evacuate or provide substantial shelter
	OIL4	Surface contamination	40,000cpm 120Bq/cm^2	Skin surface	Provide for skin decontamination
			13,000cpm 40Bq/cm^2	1 month later	
Early response	OIL2	Ambient dose	20μSv/h	1m height	Stop consumption of local produce within 1 day Temporarily relocate those living in the area in 1 week

OIL: Operational Intervention Level

March 15, 2011 in Fukushima city

17:34 12.48μSv/h（109.3mSv/y）

17:59 16.38μSv/h（143.5mSv/y）

18:13 1.58μSv/h（13.8mSv/y）

March 16, 2011 in Fukushima Medical University

15:56　　5,470cpm

15:56　　8.34μSv/h　(73.1mSv/y)

Default Screening OILs for Food, Milk and Water by NRA

OIL	Monitoring	OIL value		Response action
Screening level	Ambient dose	0.5μSv/h	1m height	Assess using OIL6
OIL6	Radionuclide analysis	Radionuclide specific		Stop consumption

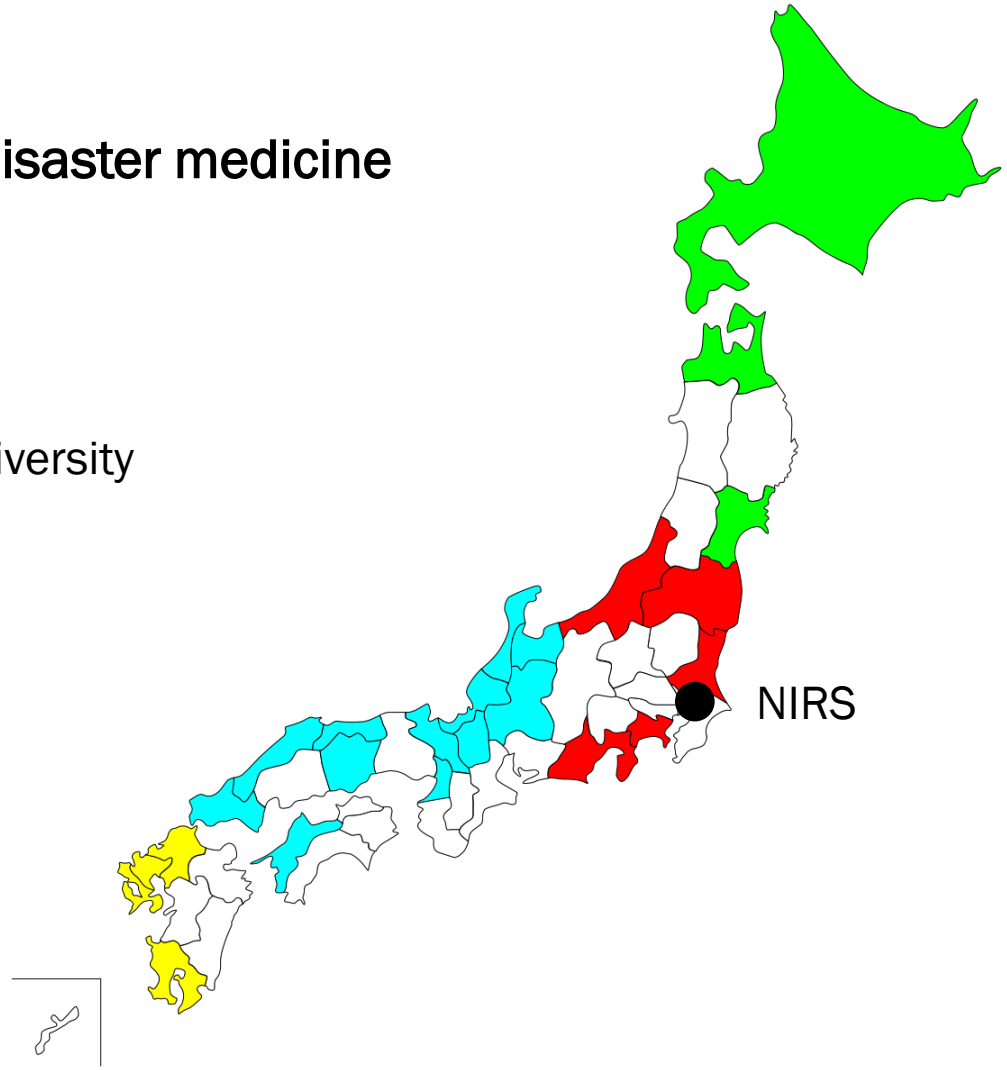
Radionuclide	Milk and water	Food
Iodine	300Bq/kg	2,000Bq/kg
Cesium	200Bq/kg	500Bq/kg
Plutonium and TRU alpha-ray nuclides	1Bq/kg	10Bq/kg
Uranium	20Bq/kg	100Bq/kg

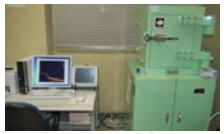
Radioactivity in soil samples collected in FMU on March 19, 2011

site	Radioactivity (kBq/kg)				
	^{131}I	^{134}Cs	^{137}Cs	^{129m}Te	^{40}K
Radiation emergency unit	54.2 ± 0.8	13.4 ± 0.1	13.0 ± 0.2	14.9 ± 1.0	0.4 ± 0.1
Sports field	34.3 ± 0.7	20.8 ± 0.1	20.4 ± 0.1	20. 3 ± 1.1	0.5 ± 0.1
Kindergarten sandbox	18.8 ± 0.4	11.4 ± 0.1	11.2 ± 0.1	10.7 ± 0.7	0.6 ± 0.1

Cover area of radiation disaster medicine

- Hirosaki University
- Fukushima Medical University
- Hiroshima University
- Nagasaki University

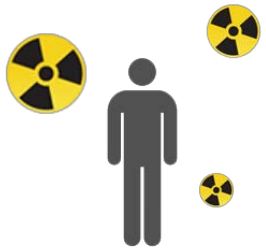




Educational radiation facilities

Safety management of
- Radiological environment
- Radiation sources
- Radiation workers

Radiation monitoring
Communication and education



Radiological Emergency

Dispersion of radioactive materials to environment
Radiation exposure to workers and residents

- Ambient dose rate
- Surface contamination
- Exposed dose

On-site

Outreach to
- Public
- Academy
- Government

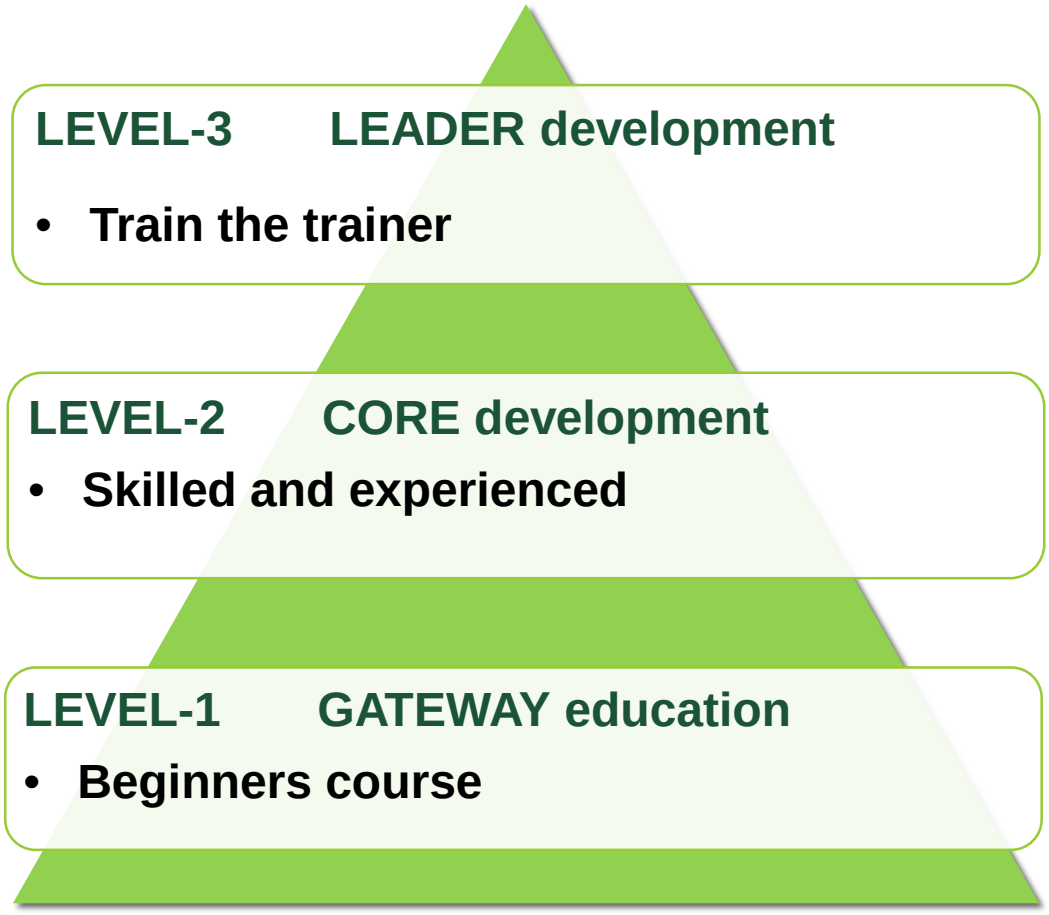
incoming

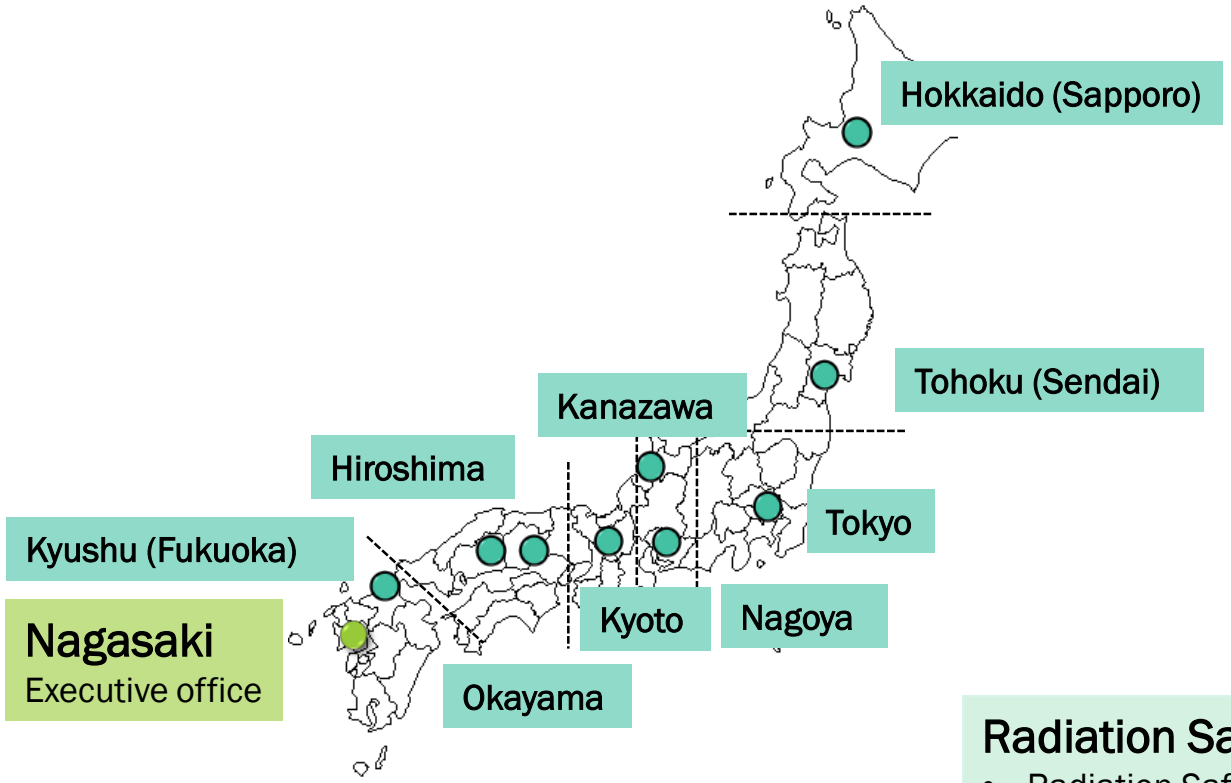
Radiation facilities

Intercollege Monitoring Platform

- Radionuclide analysis
- Ambient dose rate
- Airborne radioactivity
- Body surface contamination
- Evaluation of health risk
- Crisis communication

outgoing


LEVEL-3 LEADER development
• Train the trainer
LEVEL-2 CORE development
• Skilled and experienced
LEVEL-1 GATEWAY education
• Beginners course



Expand to 30 facilities
Cover all prefectures - goal

Radiation Safety Organizations

- Radiation Safety Council of Universities in Japan
- Japan Radioisotope Association
- Japanese Society of Radiation Safety Management
- Japan Health Physics Society

RADIATION RISK ASSESSMENT

The risk we assess here

Dose evaluation

Risk estimation

Scenario

Radionuclides dispersed from the nuclear power plant

Radioactive plume moved wide area around

Fallout of radionuclide by the rain

Question

How much your health risk estimated in this radiological environment?

Step

1. Dose estimation
    1. external dose
    2. internal dose
2. Evaluation of health risk
    1. deterministic effect (acute effect)
    2. stochastic effect (late effect)

1.1 External dose estimation

1.1.1 From ambient dose rate

1.1.2 From ground radioactivity

1.1.3 From body surface contamination

1.1.4 From a point source (hotspot)

1.2 Internal dose estimation

1.2.1 By ingestion

1.2.2 By inhalation

1.2.3 From whole body measurement

1.2.4 From urine measurement

2. Evaluation of health risk

Exposure	Monitoring source	Estimated dose	Health risk
External	From ambient dose	100 mSv/year	
	From ground radioactivity	4.43 mSv/month	
	From body surface contamination	0.45 mGy/year	
	From a point source (hotspot)	0.6 mSv/month	
Internal	By ingestion	Thyroid 15mSv Effective 0.8 mSv	
	By inhalation	Thyroid 2.3mSv Effective <0.01 mSv	
	From whole body measurement	2.29 mSv	
	From urine measurement	0.02mSv	

DEVELOPMENT OF PROFESSIONALS ON RADIATION HEALTH RISK SCIENCE

提言

医学教育における必修化をはじめとする放射線の健康リスク科学教育の充実

平成２６年（２０１４年）９月４日

日　本　学　術　会　議

臨床医学委員会

放射線防護・リスクマネジメント分科会

Policy recommendation to the government

Improvement of radiation health risk education in curriculum for medical-related students

September 4, 2014

The Science Council of Japan
Committee of Clinical Medicine
Subcommittee of radiation protection and risk management

Educate effect, protection and risk of radiation to medical students

Be able to explain radiation risk to the residents as a medical doctor

Subject on radiation health effect and protection should be required to all students

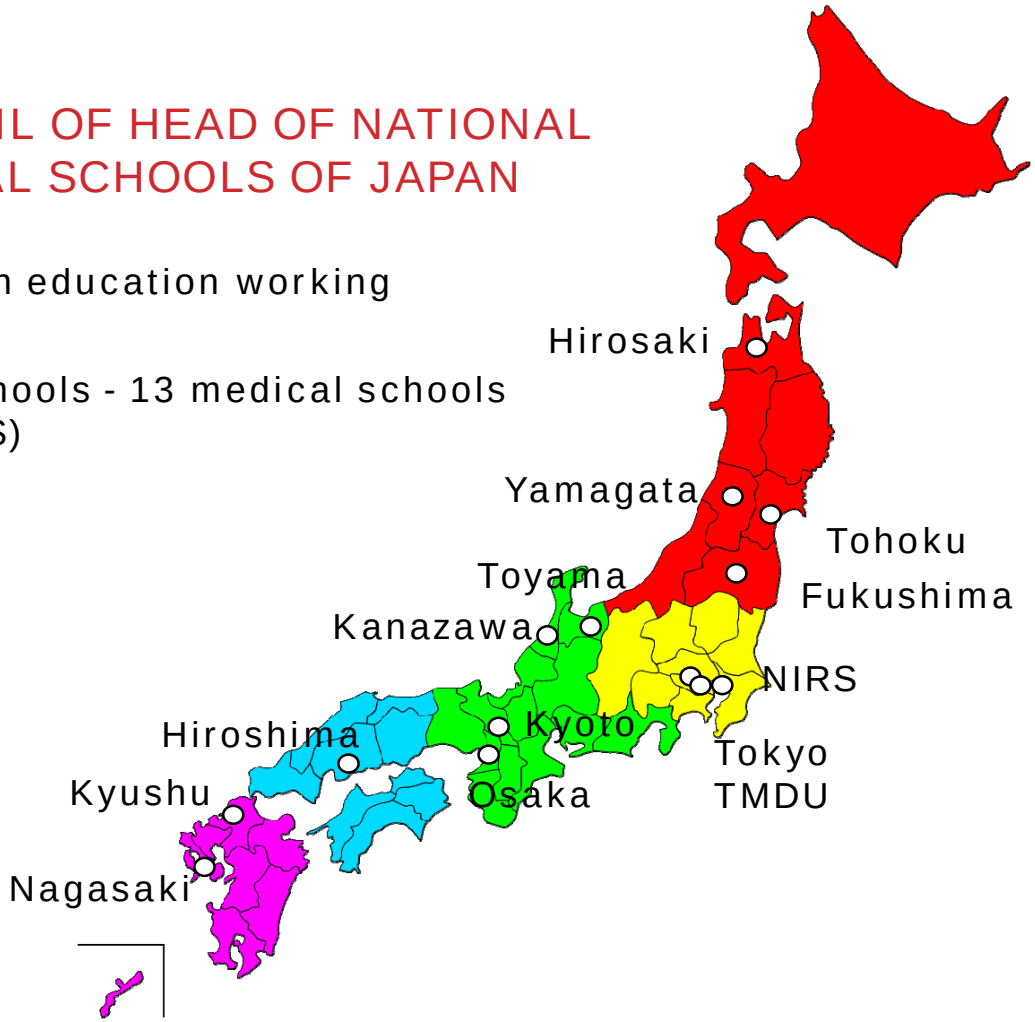
Open to co-medical students

Arrange educational base through intercollege collaborations

COUNCIL OF HEAD OF NATIONAL MEDICAL SCHOOLS OF JAPAN

Radiation education working group

(core schools - 13 medical schools and NIRS)



RANGE OF RADIATION HEALTH RISK SCIENCE

Health effect

- Biological effect
- Radiation protection and management

Risk communications

- Mutual understanding and agreement between
  - doctor and patients
  - doctor and victims of nuclear disaster
  - government and victims of nuclear disaster

Nuclear disaster medicine

- Radiation emergency medicine covering mental health
- Examples of nuclear/radiation accidents

PROBLEM-SOLVING DEVELOPMENT PROGRAM FOR HIGH-LEVEL MEDICAL PROFESSIONALS (MEXT)

Development of Professionals on Radiation Health Risk Science

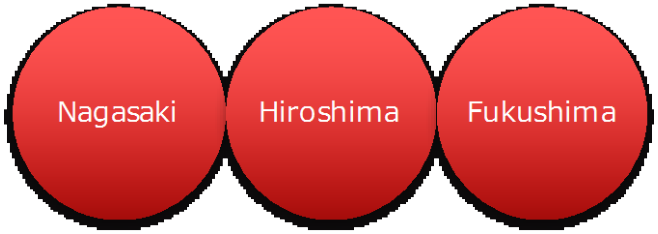
Collaboration of

- Nagasaki University
- Hiroshima University
- Fukushima Medical University

Development of Professionals on Radiation Disaster

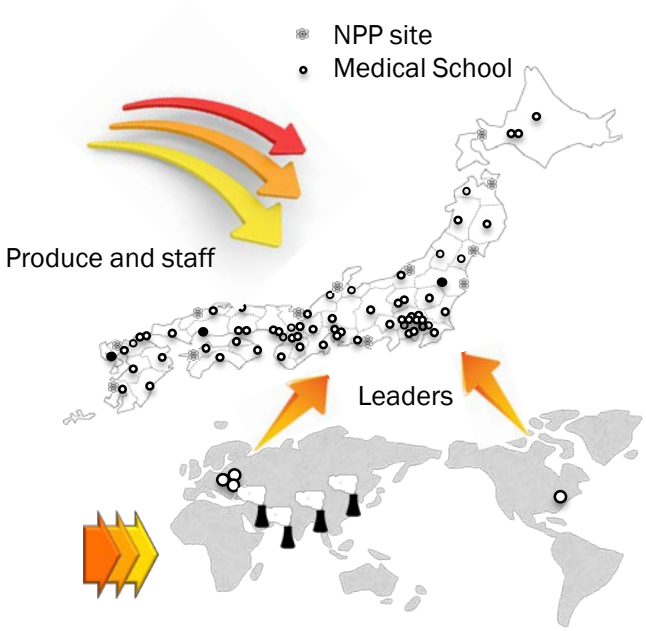
Tsukuba University

Development of Professionals on Radiation Health Risk Science



By the collaboration of three Universities who have suffered from radiation disaster and possess the educational resources in radiation health risk science, this program provides stepwise, systematic and realistic education to develop medical professionals for promotion of global health.

Undergraduate	Subject on Radiation Health Risk in medical school - Regular course and Intensive course
Graduate	Nagasaki-Fukushima Joint Course on Disaster and Radiation Medical Sciences Hiroshima Leading Program for Renaissance from Radiation Disaster
Research Professionals	Hiroshima-Nagasaki-Fukushima Research Base for Radiation Accidents and Medical Science
Radiation Disaster Professionals	Centers for Advanced Radiation Emergency Medicine and Radiation Disaster Medicine



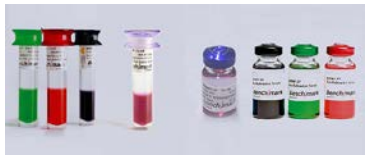
Contribution to international organizations
Preparedness to global radiation risk due to increasing energy demand

Measurement of external radiation exposure

GM survey meter

measure radiation count rate at different distances

$^{68}Ge/^{68}Ga$ source for calibration purpose

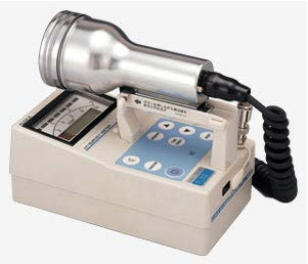


Calculate conversion factor from count rate (cpm) to effective dose rate (μSv/h)

Calculate effective dose rate at 1 m from the source based on radioactivity and effective dose rate coefficient

Measurement of external radiation exposure

GM survey meter (cpm)



NaI-scintillation survey meter (μSv/h)

Soil sample from high background radiation area in Tamil Nadu, India (Th-228)

Measurement →

→ Evaluate effective dose rate (μSv/h) by direct and indirect method

Soil sample from TEPCO Fukushima Daiichi NPP (Cs-137, Cs-134)

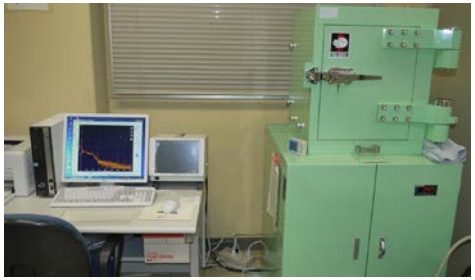
Radionuclide analysis and estimate exposure dose and health risk

Soil sample from high background radiation area in Tamil Nadu, India (Th-228)

Soil sample from various places in Fukushima (Cs-137, Cs-134)

Radionuclide analysis →

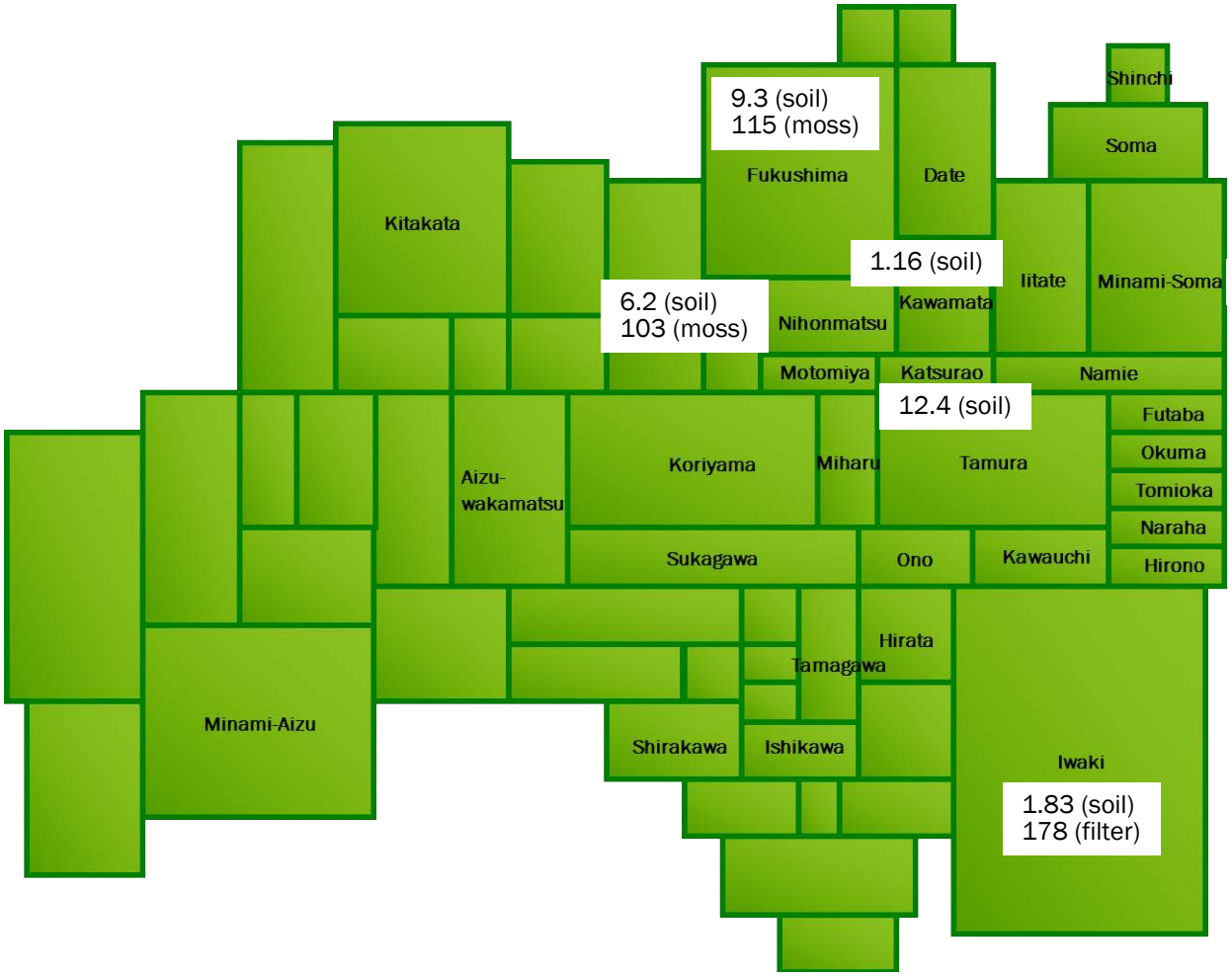
Ac-228 / Th-228
Cs-134 / Cs-137



HPGe semiconductor detector and gamma energy spectrum analyzer

→ Mapping

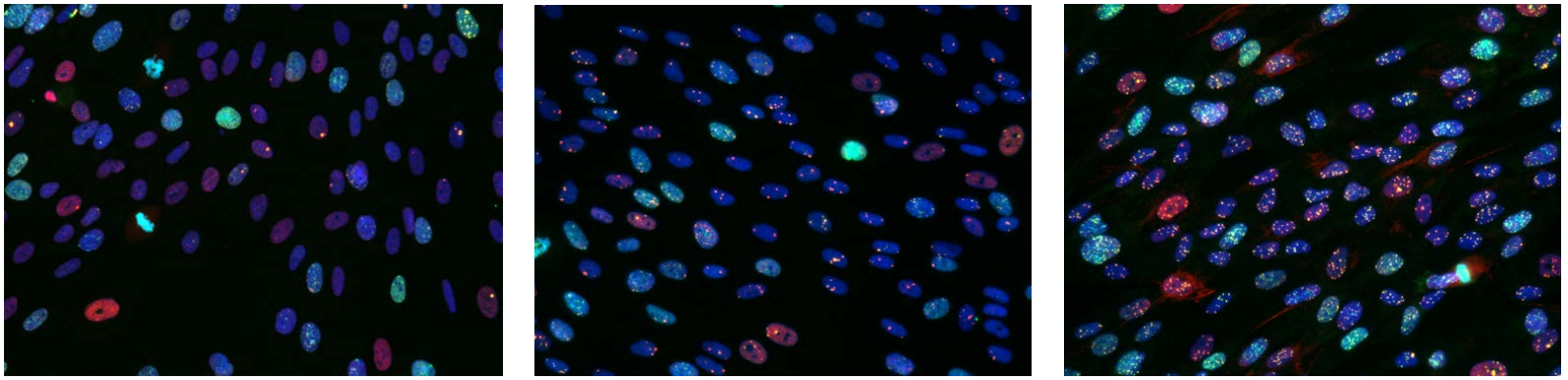
→ Estimate exposure dose according to IAEA TECDOC 1162 Procedure E3 and discuss health risk



16.2 21.8 7.45 (Sea sand)

Quantitation of DNA double strand breaks

Immunofluorescent observations of phosphorylated histon H2A.X and 53BP1 in normal human fibroblasts
after exposure to gamma-ray of 0Gy, 0.1Gy, or 0.25Gy
at immediate, 6h or 12h following irradiations.



Count the number of foci and discuss the dose-response and repair kinetics.

Challenges for expansion

- **Lecture**
  - package of radiation biology + medical radiation + radiation disaster medicine + risk communication
- **Practice**
  - package of measurement and biology and health risk assessment
- **Evaluation**
  - linkage to postgraduate education
- **System**
  - preparation of instructors, practical training rooms, measuring devices