2nd Kobe Univ. Brussels European Centre Symposium
September 19, 2011

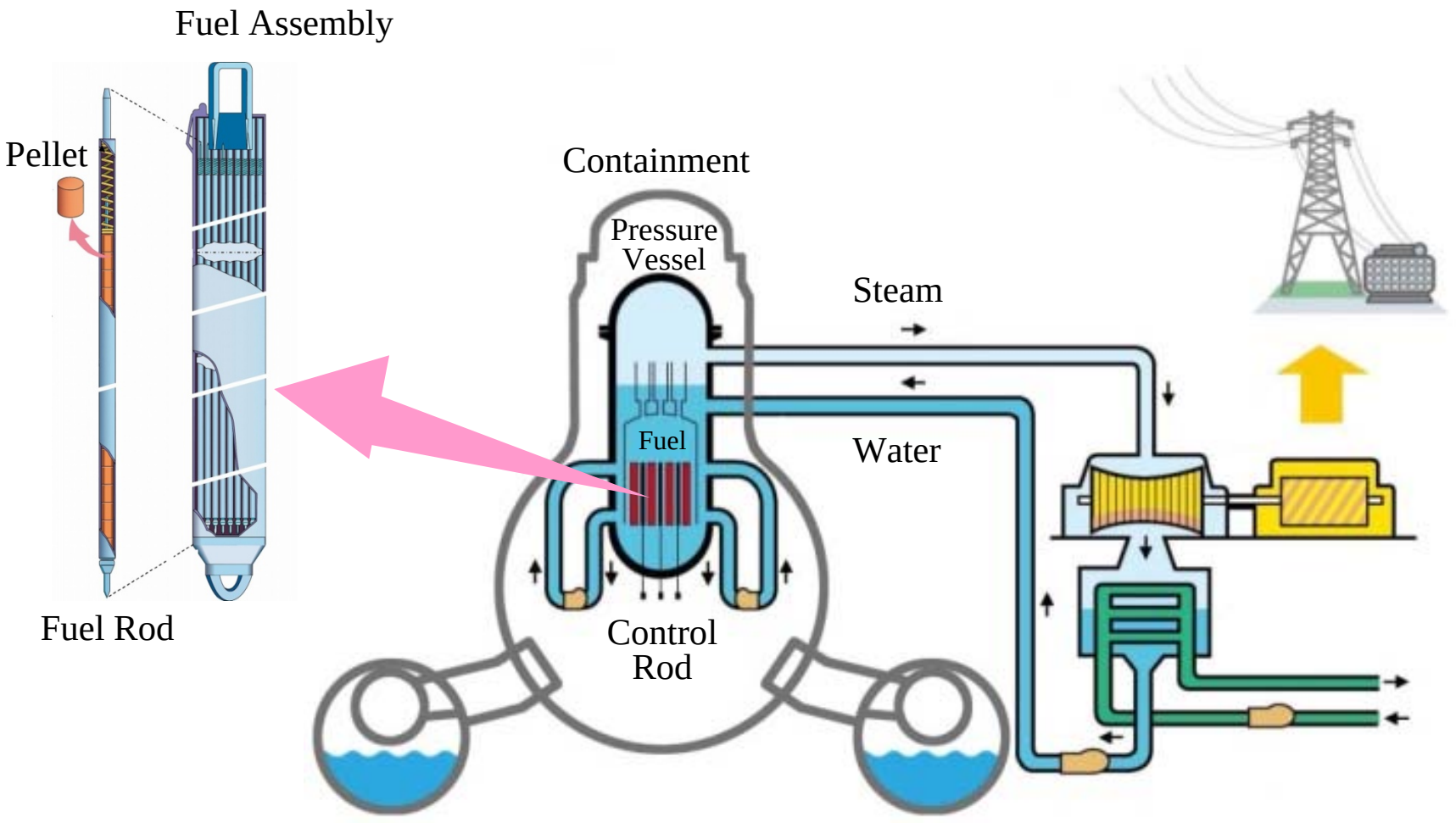
Present Status of Japanese Nuclear Power Plants and Radiation Disaster

Keiji ODA
Graduate School of Maritime Sciences
Kobe University

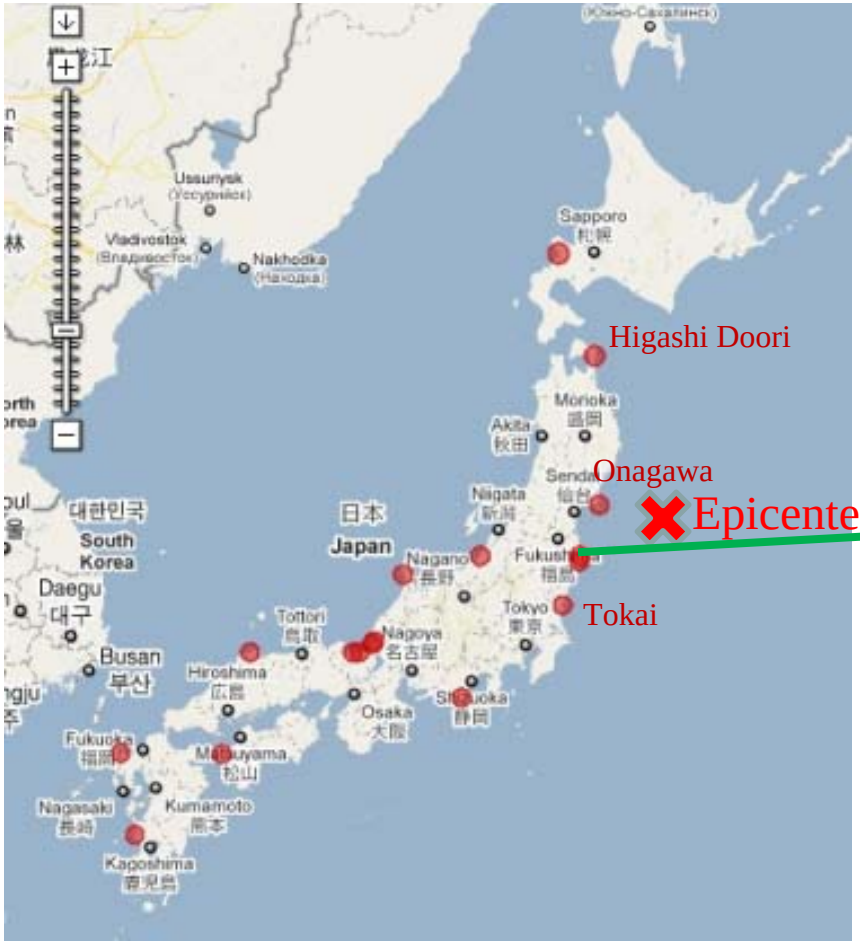
Contents

1. Nuclear accident in Fukushima
2. Discharge of radioactive materials
3. Exposure risk & radiation protection
4. Future problems

Structure of BWR



Fukushima Daiichi NPS

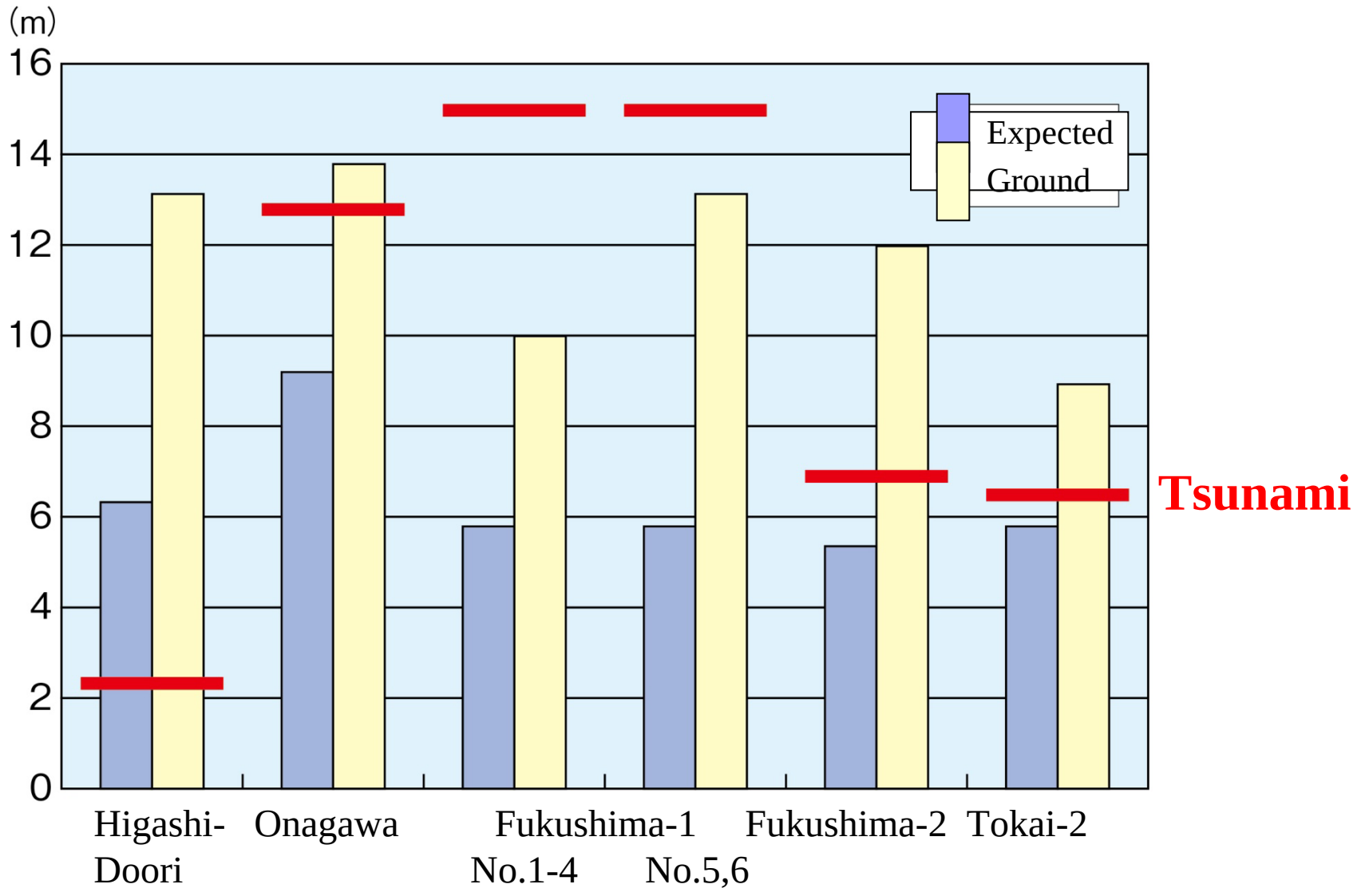


NPS's in Japan

6 units in Fukushima-1 NPS

KOBE UNIVERSITY

Height of Tsunami



KOBE UNIVERSITY

Tsunami Attack

KOBE UNIVERSITY

Plant Status as of August

Unit		#1	#2	#3	#4	#5	#6
OK		1971.3	1974.7	1976.3	1978.10	1978.4	1979.10
Power output [MW]		460	784	784	784	784	1100
Shutdown		Automatic Shutdown just after earthquake			Shutdown for Outage		
Cooling	Reactor	Circulating water cooling Injection N_2 gas			OK Fuel removed	OK Cold Shutdown	
	Pool	OK Circulating cooling system				OK	
Containment		Decontamination by processing facility			OK	OK	

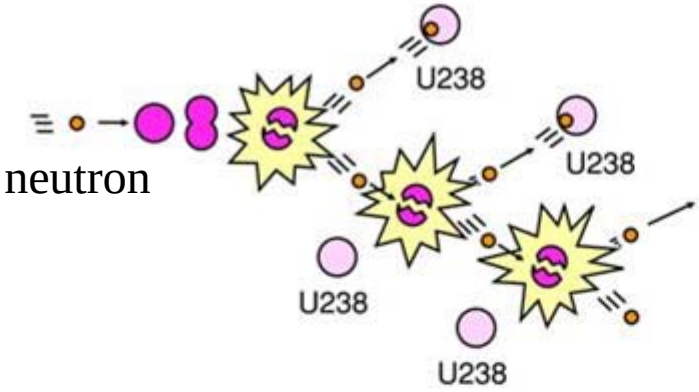
Explosion

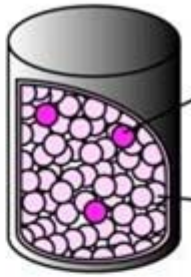
1. Nuclear explosion
   - Chain reactions take place in a moment like A-bomb
   - Never occurs in nuclear fuels (enrichment: 3-5 %) for power plants

2. Vapor explosion
   - Melt fuel contacts with water (cooling or ground water)
   - All fission products released like Chernobyl accident

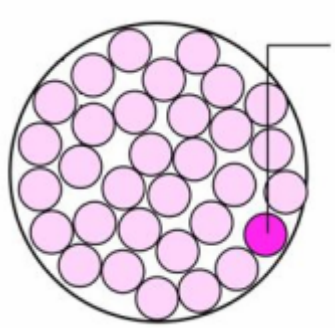
3. Hydrogen explosion
   - Zircalloy clad with high temperature interact chemically with water
   - Release of gaseous and volatile materials (Iodine, Cesium)

Nuclear Fuel & Atomic Bomb

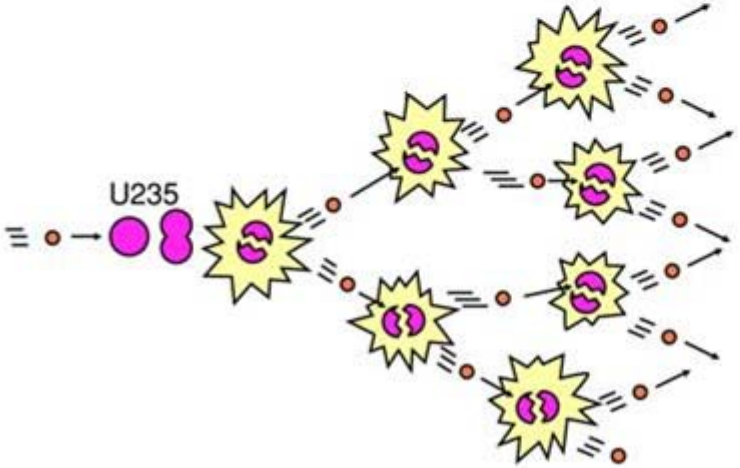


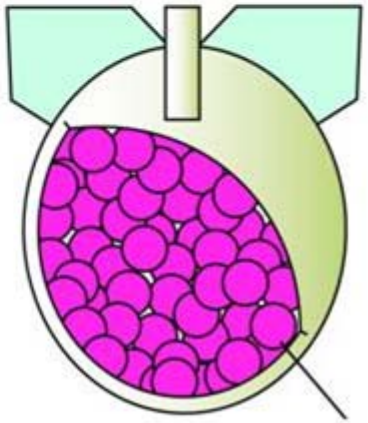


Nuclear Fuel
(3-5%)



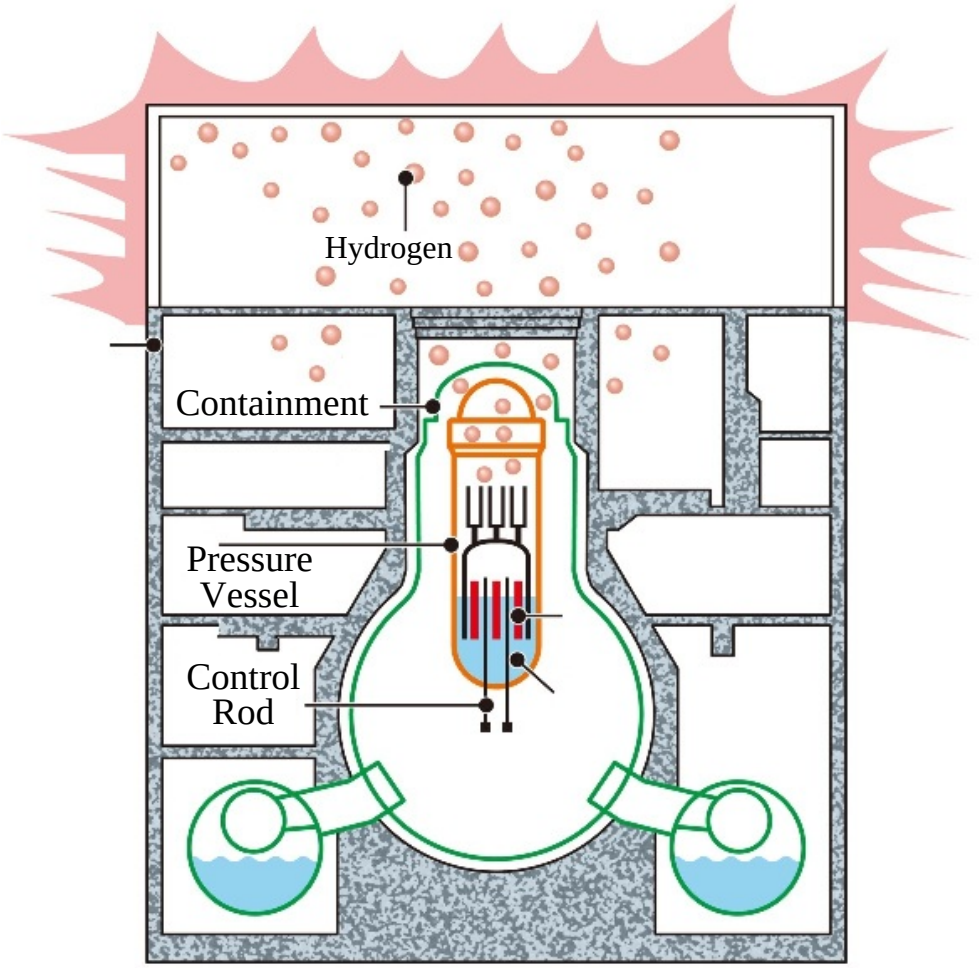
Natural Uranium
(0.7%)



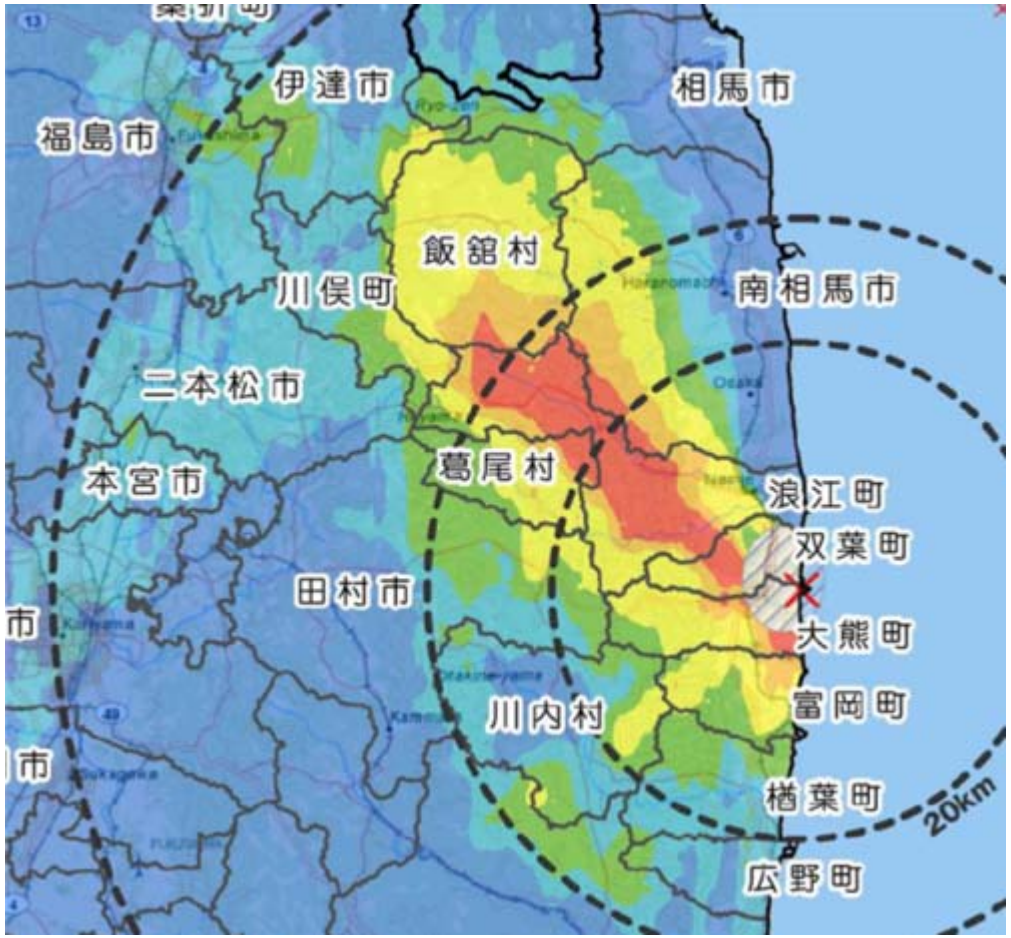


Atomic Bomb
(>90%)

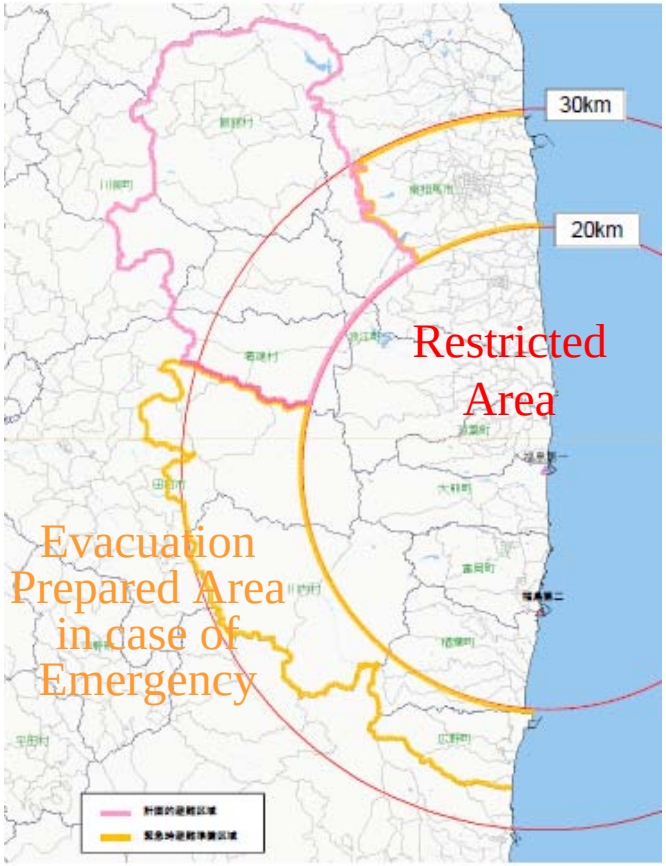
Hydrogen Explosion



Contamination

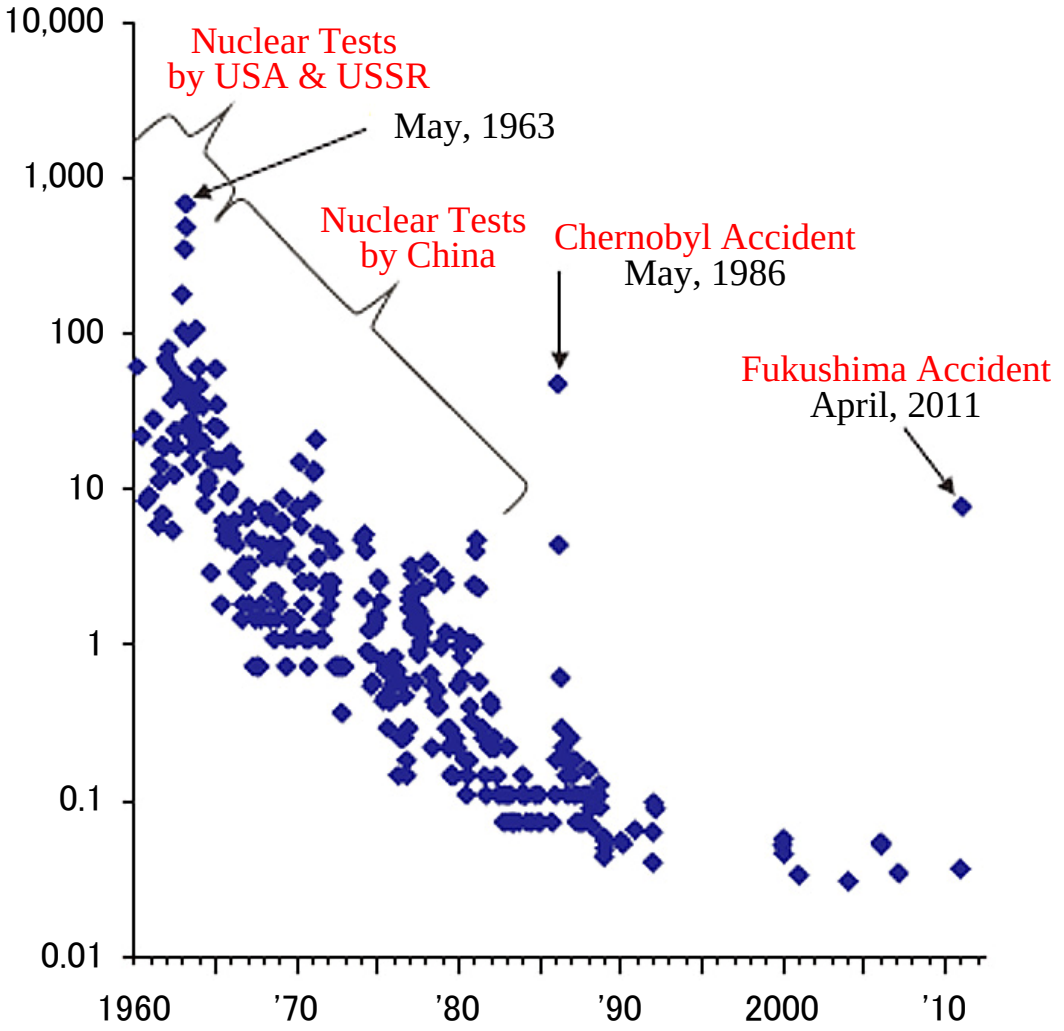


Deliberate Evacuation Area



Monthly Change of Fallout

Cesium fallout [MBq/km^2] observed in Osaka



Estimation of Radiation Risk

For better understanding …

1. Existing of natural radiation
   cosmic rays, soils, food, etc

2. Investigation of A-bomb survivors
   - No effect on embryo and fetus under 100-150 mSv
   - Significant increase in relative cancer risk over 300 mSv
   - No hereditary effect observed on human

3. Ability of repairing DNA damage

4. Comparison with other cancer risks
   - 50 % for cancer risk, 30 % for cancer death by other causes

Natural Radiation

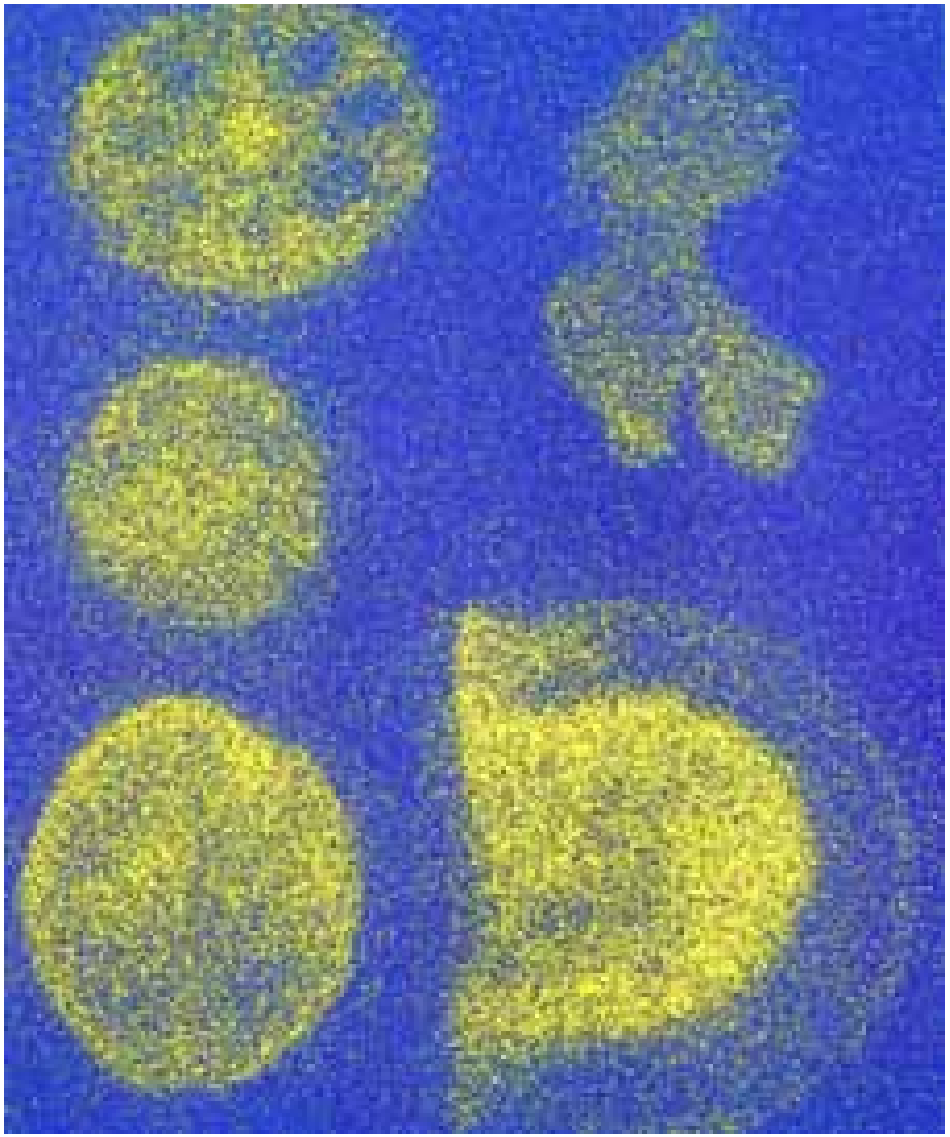


Image of radiation emitted from vegetables

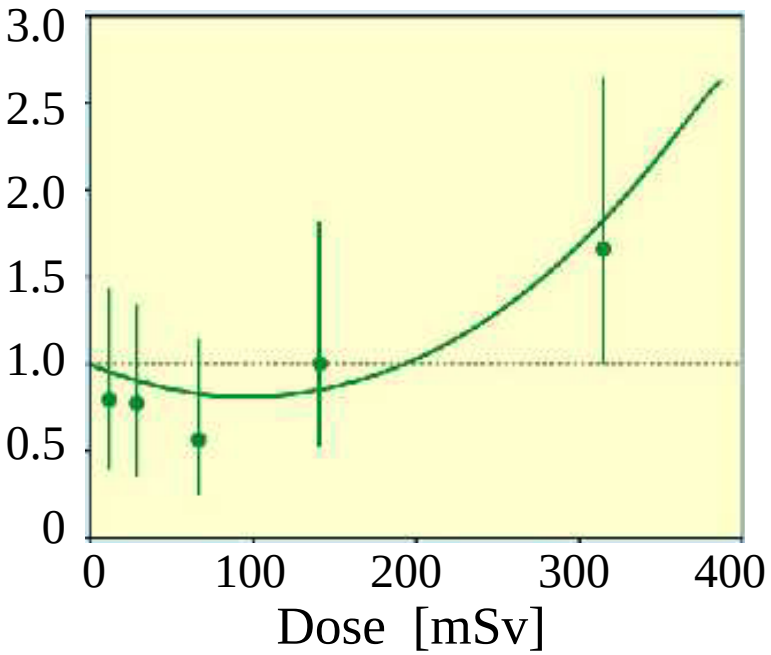
β-rays from K-40

↓

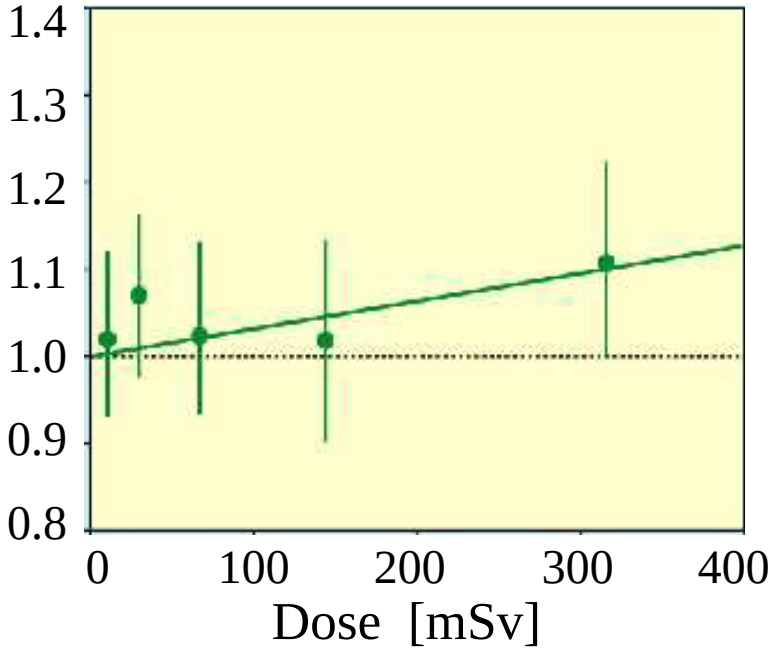
About 7,000 Bq in human body
(0.2 mSv/year)

Data from A-Bomb Survivors

- Investigation for 120,000 persons
- Relative risk
  = Cancer risk for exposed group to that for control group



Leukemia



Solid Tumor

Response under 300 mSv is unclear for statistical reason

Future Problems

1. Technical Problem
   - Natural circulating cooling system
   - Securement power source (multiplicity)

2. Security
   - Energy security
   - Counter-terrorism

3. Contamination and harmful rumor
   - Decontamination technique and handling of radioactive wastes
   - Control of discrimination and over-response against exposure

4. Tradition of nuclear engineering to next generation
   - Technology of nuclear safety
   - Sustainable education system