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National Institute for Strategic Studies (NISS)
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Project of prioritization on de-contamination (clean-up) based on cost-effectiveness analysis

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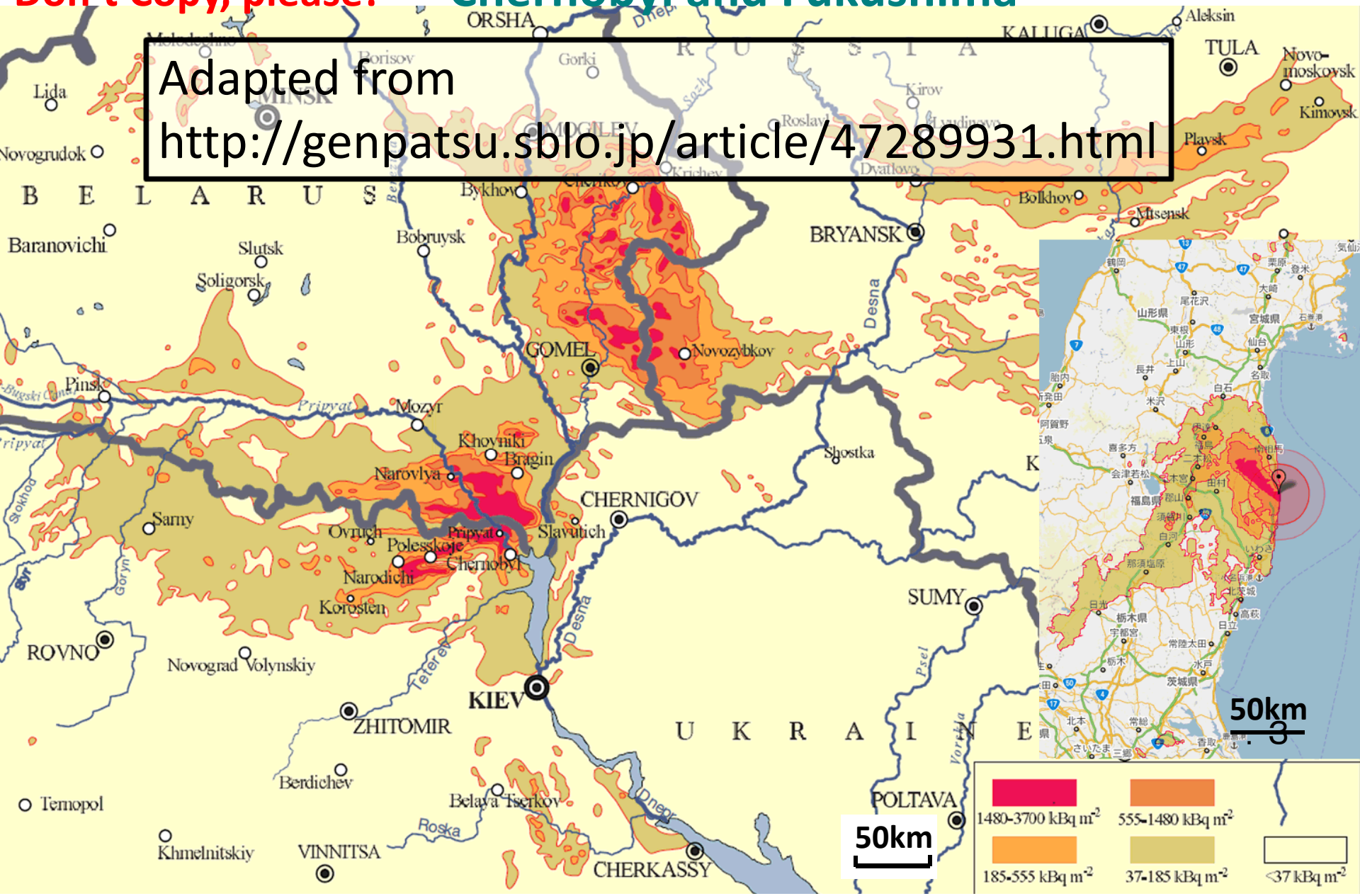
Chernobyl and Fukushima

Adapted from
http://genpatsu.sblo.jp/article/47289931.html



The map of Chernobyl from UNSCEAR(2008)

1480kBq/m2～3700
（～75mSv/year）

Radionuclides released in the accidents

Fukushima[*1)]

Atmosphere	
^{131}I	0.15×10^{15} kBq
^{134}Cs	12×10^{12} kBq[*2)]
^{137}Cs	12×10^{12} kBq
Sea	
^{131}I	2.8×10^{12} kBq
^{134}Cs	0.94×10^{12} kBq
^{137}Cs	0.94×10^{12} kBq

Chernobyl [*3)]

Total	14×10^{15} kBq
^{131}I	1.8×10^{15} kBq
^{134}Cs	47×10^{12} kBq
^{137}Cs	85×10^{12} kBq
^{90}Sr	10×10^{12} kBq
Total Pu[*4)]	0.046×10^{12} kBq

[*1)] Report by Independent Investigation Commission on the Fukushima Daiichi Nuclear Accident. [*2)] Estimated by Nakanishi. [*3)] UNSCEAR（2008）, Volume Ⅱ. [*4)] By Junko Nakanishi

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Area of Radionuclides Deposition Level

Chernobyl

Contamination Level (kBq/m^2)*1)	Area km^2
37-185	162,160
185-555	19,100
555-1480	7,200
>1480	3,100

*1) ^{137}Cs soil deposition

*1) ^{137}Cs and ^{134}Cs soil deposition

Fukushima

Contamination Level (kBq/m^2)*2)	Area km^2
--------	--------
300-600	500
600-1000	200
1000-3000	400
3000-14,710	200

The evacuation area is contaminating to dose level with a dose of 20 mSv/year and greater.

20 mSv/year ≒3.8 μSv/h ≒1000 (kBq/m^2)

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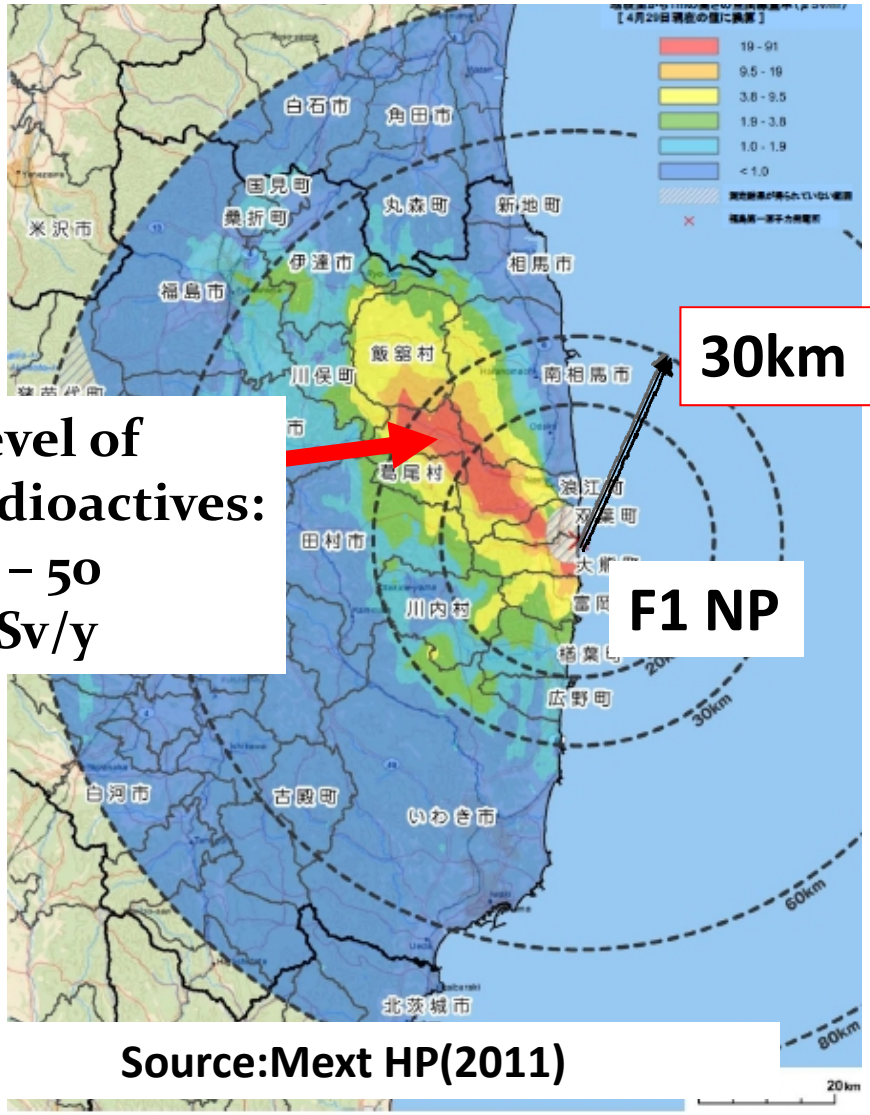
Contamination & Evacuation

Radioactive exposure dose map



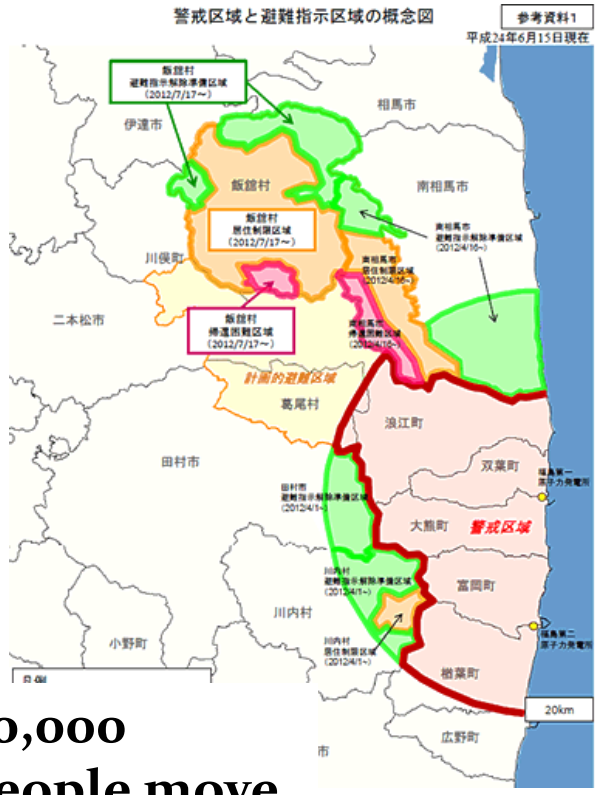
Level of radioactives: 10 – 50 mSv/y

30km

F1 NP

Source:Mext HP(2011)

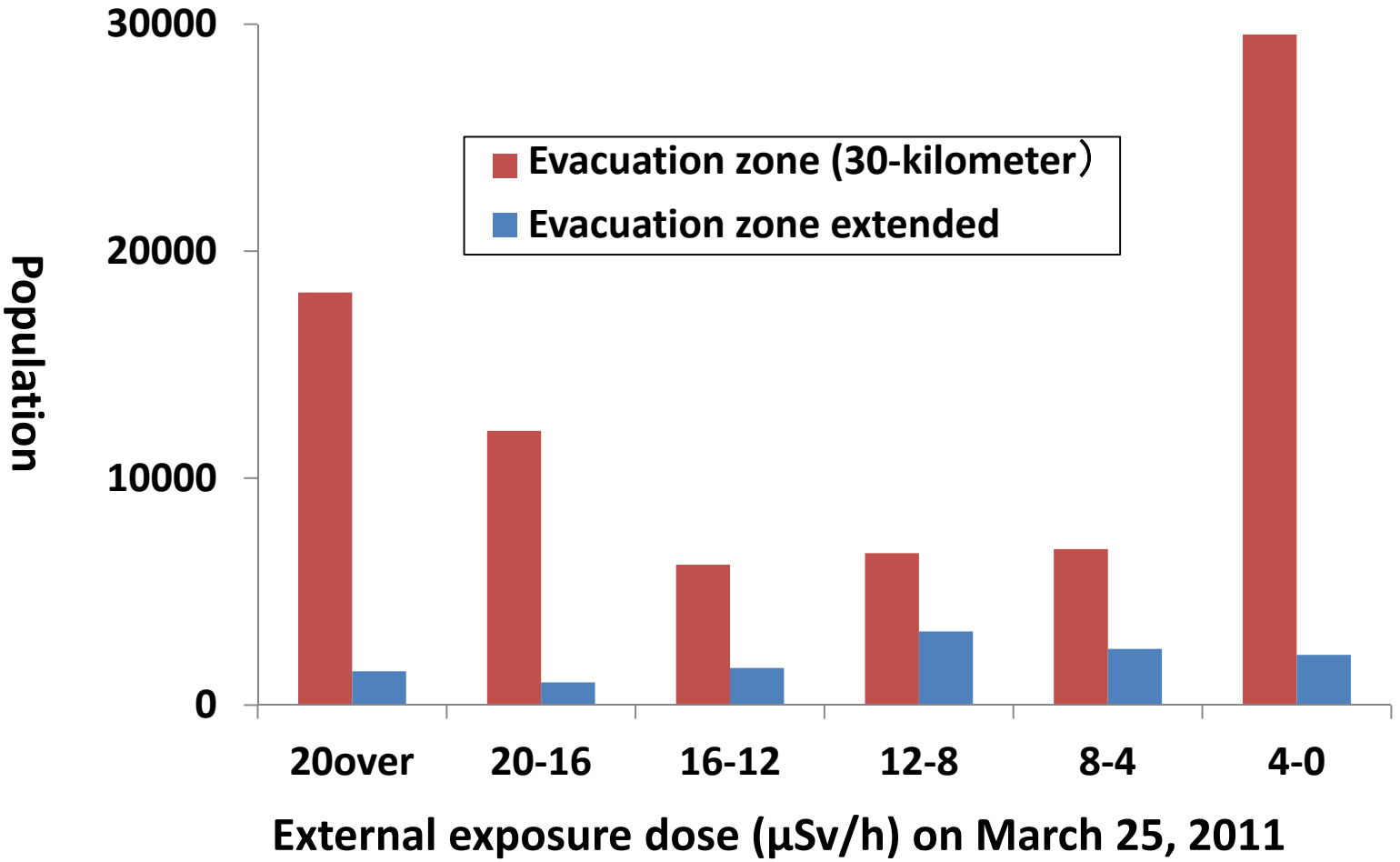
Evacuation Area(June/2012)



90,000 people move out the evacuated place.

Source:Meti HP(2012)
T.Yasutaka(2012)

Population in the evacuation area by classification



The external exposure dose on March 25, 2011 was estimated based on the MEXT and DOE airborne monitoring data on November 5, 2011.
Population: National census on Oct 1, 2005

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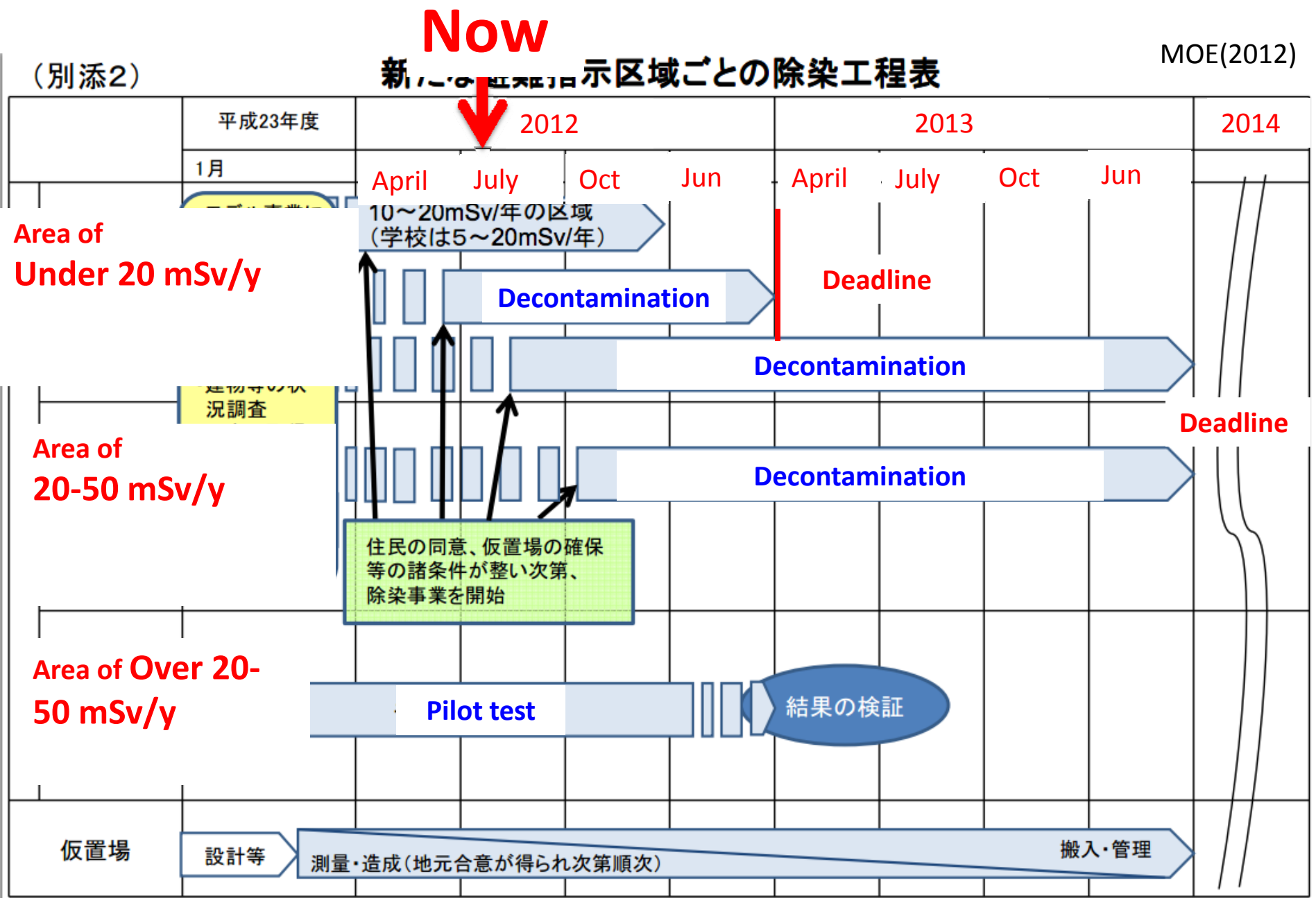
Evacuation Area
about 30km From F1

Schedule of Decontamination at high risk area



Decontamination is going on..

Photo by Tetsuo Yasutaka


After Decontamination.....
Dose was reduced, but what extent?
Photo by Tetsuo Yasutaka

Process of Decontamination

1. To remove the contaminated soil, stone, and various materials
2. To pack the contaminated disposal in the Frecon Pack (Flexible Containers)
3. To move the Frecon packs to a tentative-tentative neighbor hood refuge dump and keep them for a while
4. To move the Frecon packs from the tentative-tentative refuge dump to a tentative city refuge dump made for radioactive refuge and keep them for 30 years.
5. To move them to the final dump

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Problems of the ongoing Clean-up

Technical problem

Effectiveness of risk reduction is limited.

Limited stockyard spaces for contaminated soil

The dose level attained by the cleanup is much higher than those are acceptable by the residents and the Government has made public commit to attain.

The Government has promised the two goal dose levels:1) 1mSv/year (final goal), and 2) to reduce doses by 50%. Which is true? And how safe it is.

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Problems of the Clean-up

Social Problem

Does people really return home after decontamination completed?
-- As for elderly people, Yes, but as for younger with children, No (?). How many people return?

Cost of decontamination

Huge cost ($20 billion/2 yrs)!? And $60 billion for completion
Who pays the cost?

The Government does not prioritize the areas according to "Effectiveness"

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Prioritization for decontamination is necessary, but how?

Our Challenging project

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Project of prioritization on decontamination based on cost-effectiveness analysis

- **Transparent steps including**
  - Estimation of dose (and risk) reduction, using site-specific land use/soil property and population data
  - Estimation of costs, using realistic unit costs corresponding to several decontamination options
  - Evaluation of happiness on resettlement or return home, comparing to previous case studies e.g. evacuation on air pollution due to volcano explosion

Project's output: a proposal to decision-making agency

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Our three approaches

- First:　The ΔB greater, the more preferable;
  ΔB　＝{R（contaminated）－R（cleaned up）}
×｛People returning}/Cost

- Second : The greater ΔB is, the more preferable;
ΔB　＝{（Benefit　of returning home）
－ΔR（Increase in risk associated returning home ）*}
×（People　returning）/（Cost)

- Third: Under the premise that the dose for life span should not exceed 100mSv/for approx. 10 to 20 years , the greater ΔB is, the more preferable.
ΔB＝（People returning）/（Cost）

R: Human health risk (mainly cancer risk)

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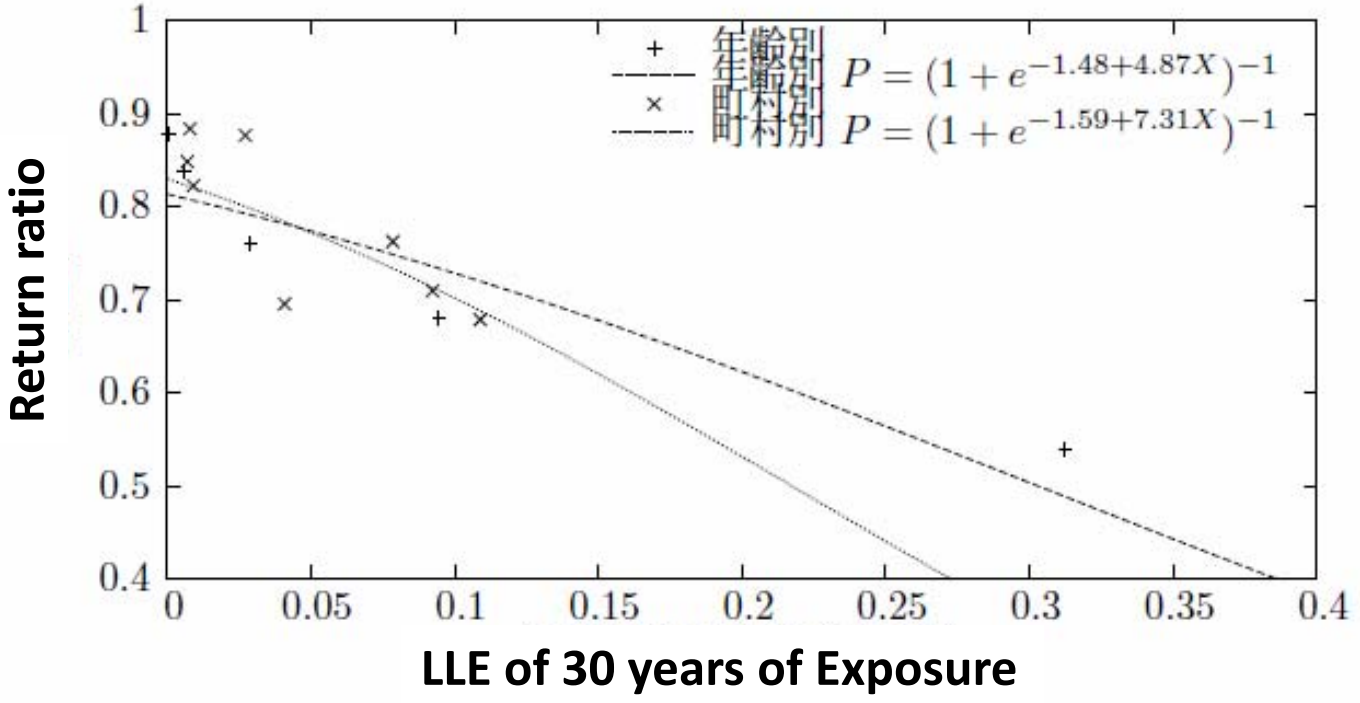
Return Ratio (Tentative)
(Internal Use Only)

- **Return ratio and Loss of Life Expectancy (LLE) based on a questionnaire survey in Futaba area in Fukushima**
  - ✓ **LLE increase → Return ratio decrease**



Thank you for Your attention!

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