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Radiation Hazard Scale: A Communication Tool for Radiation Emergencies

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Communicating Radiation Risk to the Public



- People want to be reassured that a situation involving radiation or radioactive materials is “safe” for them or their families.
- Radiation experts struggle to address this need.

Some Concepts and Terminology

- ❑ There is no consensus as to what dose or radiation level constitutes a “public health concern.”
- ❑ There is no consensus regarding a dose threshold for radiation hazard.

**Below Regulatory
Concern**

De Minimis dose

**Negligible Individual
Dose**

**“Not a public health
concern”**

mSv

n+4
n+3
n+2
n+1
n
n-1
n-2



Perceived as unsafe



Safe Dose



INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION

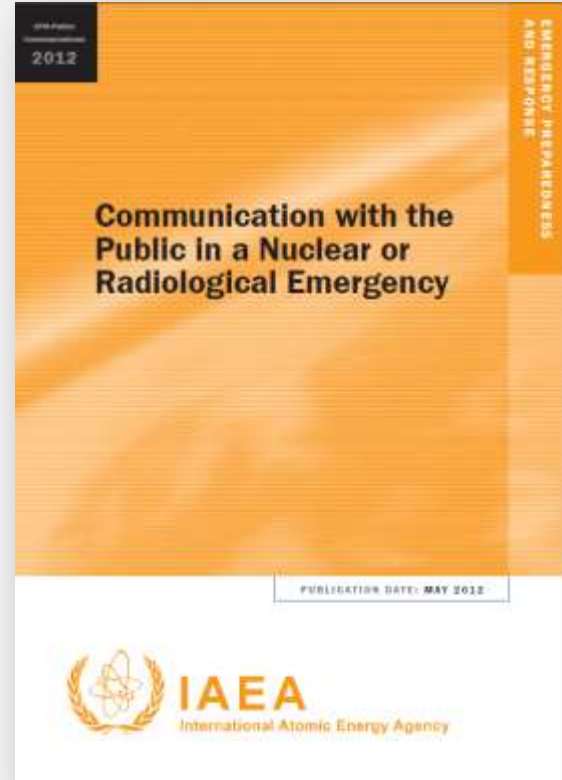
ICRP ref 4832-8604-9553

2012 November 22

**Report of ICRP Task Group 84 on Initial Lessons Learned from
the Nuclear Power Plant Accident in Japan vis-à-vis the ICRP
System of Radiological Protection**

- ❑ “In the aftermath of the accident, the quantities and units used for quantifying radiation exposure of individuals in terms of radiation doses have caused considerable communication problems.”
- ❑ “There are great difficulties to communicate radiological information to non-experts and the public at large using the ICRP system and its quantities.”

“when possible [radiation quantities and units] should not be used when communicating with the public.”



Examples of Scale in Communicating Relative Hazards

- Natural Disasters

- Hurricanes
- Earthquakes
- Tornadoes
- Asteroid Impacts

(Torino Scale)

- Sports

- White water rafting
- Ski trails
- Rock climbing

Radiation Hazard Scale



Category

5

Death may occur in days to weeks

4

Increased risk of radiation sickness, but death is not likely (symptoms may appear in hours to days)

3

Increased risk of cancer later in life (symptoms may take decades to appear)

2

Above the range of normal, everyday radiation levels, but no health effects expected

1

Within the range of normal, everyday radiation levels

Supporting Text (Tested by Public Information Officers)

Radiation Hazard Scale

Category	Description
5	<p>Category 5 means that radiation doses are dangerously high and potentially lethal.</p> <p>High doses of radiation can cause massive damage to organs of the body and kill the person. The exposed person loses white blood cells and the ability to fight infections. Diarrhea and vomiting are likely. Medical treatment can help, but the condition may still be fatal in spite of treatment. At extremely high doses of radiation, the person may lose consciousness and die within hours. For more information, see www.remm.nlm.gov/ars_summary.htm#whatisars</p>
4	<p>Category 4 means that radiation doses are dangerously high and can make people seriously ill. Radiation doses are not high enough to cause death, but one or more symptoms of radiation sickness may appear.</p> <p>Radiation sickness, also known as Acute Radiation Syndrome (ARS), is caused by a high dose of radiation. The severity of illness depends on the amount (or dose) of radiation. The earliest symptoms may include nausea, fatigue, vomiting, and diarrhea. Symptoms such as hair loss or skin burns may appear in weeks. For more information about the health effects of radiation, see http://emergency.cdc.gov/radiation/healtheffects.asp For more information about medical treatment of radiation exposure, see http://emergency.cdc.gov/radiation/countermeasures.asp</p>
3	<p>Category 3 means that radiation doses are becoming high enough where we may expect increased risk of cancer in the years ahead for people who are exposed. Leukemia and thyroid cancers can appear in as few as 5 years after exposure. Other types of cancer can take decades to develop.</p> <p>Studies have shown that radiation exposure can increase the risk of people developing cancer. This increased risk of cancer is typically a fraction of one percent. The lifetime risk of cancer for the population due to natural causes is approximately 40%. The increase in risk of cancer from radiation depends on the amount (or dose) of radiation, and it becomes vanishingly small and near zero at low doses of radiation. For more information, see http://emergency.cdc.gov/radiation/cancer.asp</p>
2	<p>Category 2 means that radiation levels in the environment are higher than the natural background radiation for that geographic area. However, these radiation levels are still too low to observe any health effects.</p> <p>When radiation levels are higher than what we normally have in our natural environment, it does not necessarily mean that it will cause us harm. For more information about health effects of radiation, see http://www.cdc.gov/nceh/radiation/health.html</p>
1	<p>Category 1 means that radiation levels in the environment are within the range of natural background radiation for that geographic area.</p> <p>Low amounts of radioactive materials exist naturally in our environment, food, air, water, and consequently in our bodies. We are also exposed to radiation from space that reaches the surface of the Earth. These conditions are natural, and this radiation is called the natural background radiation. For more information about radiation and radioactivity in everyday life and how it can vary by location, see http://www.cdc.gov/nceh/radiation/sources.html</p>

Radiation Hazard Scale



- Not a be-all and end-all to risk communication!
- Different from IAEA International Nuclear Event Scale (INES)
- Not a tool for medical triage!
- Provides frame of reference
- Conveys meaning w/o using radiation measurements or units
- Best used when accompanied with protective action recommendations
- Audience-tested!

Use in Messaging

With Protective Action Recommendations

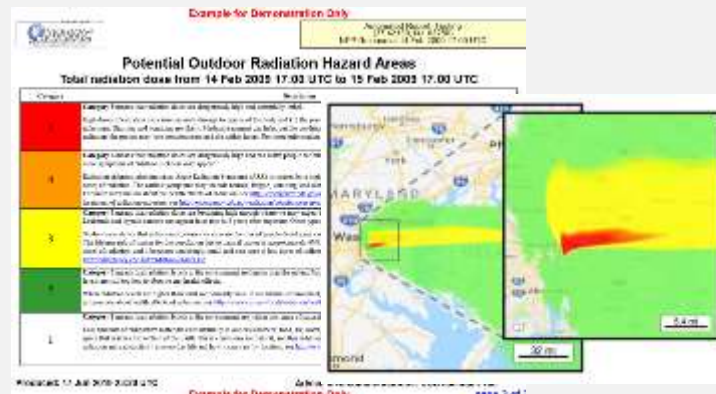


- Example: If contaminated with nuclear fallout, self decontamination can decrease radiation risk from Category 5 to Category 2 or 1.
- Example: After a nuclear detonation, self-directed evacuation can place a person at Category 4 or 5 whereas staying inside shelter can help maintain a Category 2 or 3 risk until instructed to evacuate.
- **Question:** After the Fukushima accident, what were the radiation levels in the United States?

Testing the Scale

(First version developed in 2011)

- In-Depth phone interviews (pilot testing)
 - Members of the public, public information officers, public health planners
 - First round: April 30 – May 9, 2014
 - Second round: June 16 – 20, 2014
- In-person focus groups (OMB-approved)
 - December 2014 – February 2015; Atlanta, St. Louis, Houston, Phoenix
 - Parameters tested included:
 - Numbering of scale, colors, orientation; Wording choices; Context-driven questions
- Testing of supporting text for the Scale
 - Public information Officers, July 2016
- Testing of data products based on the Scale
 - emergency managers, risk communicators, rad control program
 - Middlesex County, New Jersey, September 2017
 - State of Connecticut, June 2019



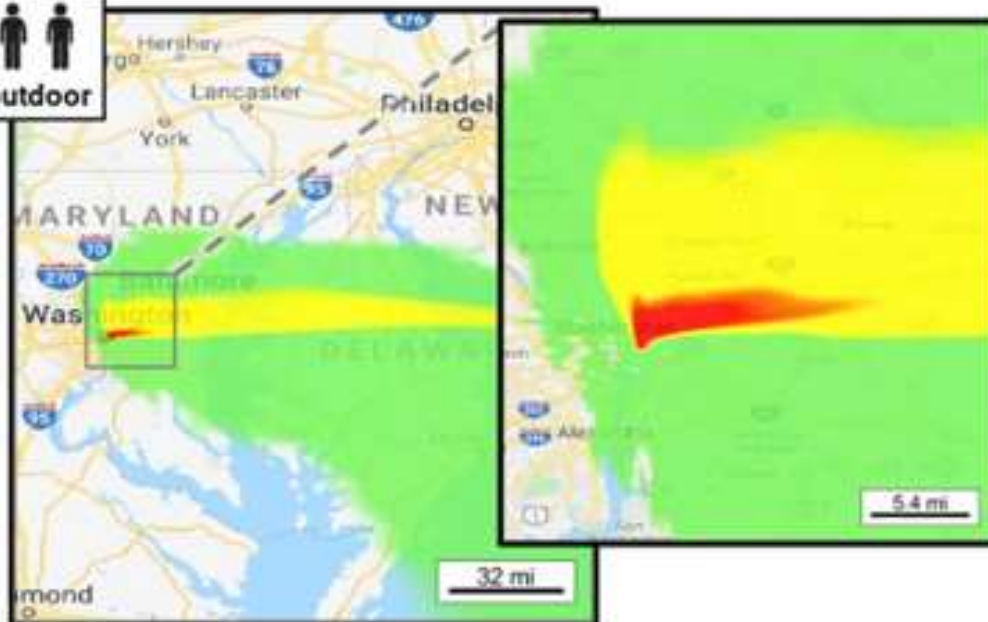
Using the Scale in Action!

Developing Briefing Products

- CDC Collaboration with:
 - DOE/NNSA
 - Lawrence Livermore National Laboratory
 - U.S. EPA
- Developing template “briefing products”
- Seek feedback
 - Full-day workshops with state and local stakeholders

A Few Example Products

Get Inside! Stay Inside! Stay Tuned!



Deaths Possible

Radiation Sickness

Cancer Risk

No Effect

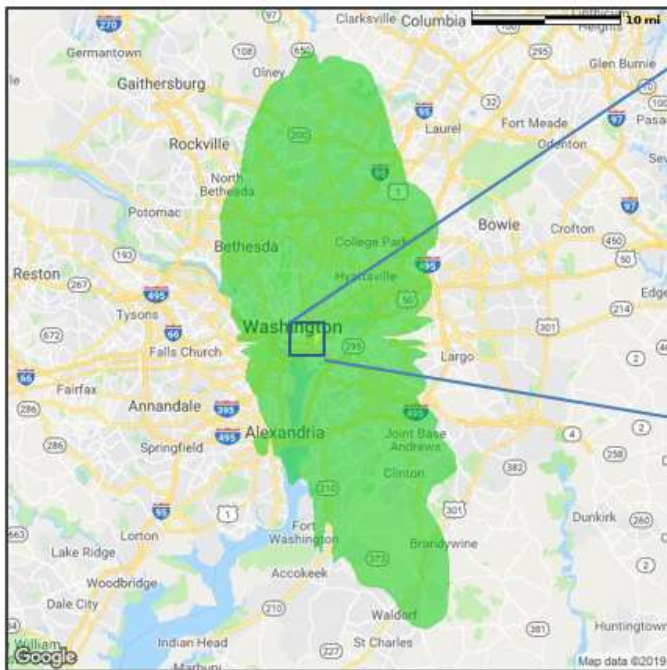
Natural Levels

(effects shown due to dose received at or before Feb 15, 2009 17 UTC)



Example for Demonstration Only

Outdoor Radiation Hazard First 24 hours following a dirty bomb explosion



This is a predictive model of potential outdoor radiation hazards (no measurement data used):

What: Explosion of a radiological dispersal device

Where: Washington, DC, USA (38.889460, -77.009430)

When: Explosion on 2/14/2009 at 1:00 PM EST

For: Outdoor Radiation Exposure Received between
1:00 PM EST on 2/14/2009 and 1:00 PM EST on 2/14/2009

Analysis generated on 6/17/2019 at 7:20 PM EST. Predicted hazard areas will be updated regularly as information becomes available. Contact CDC for latest.

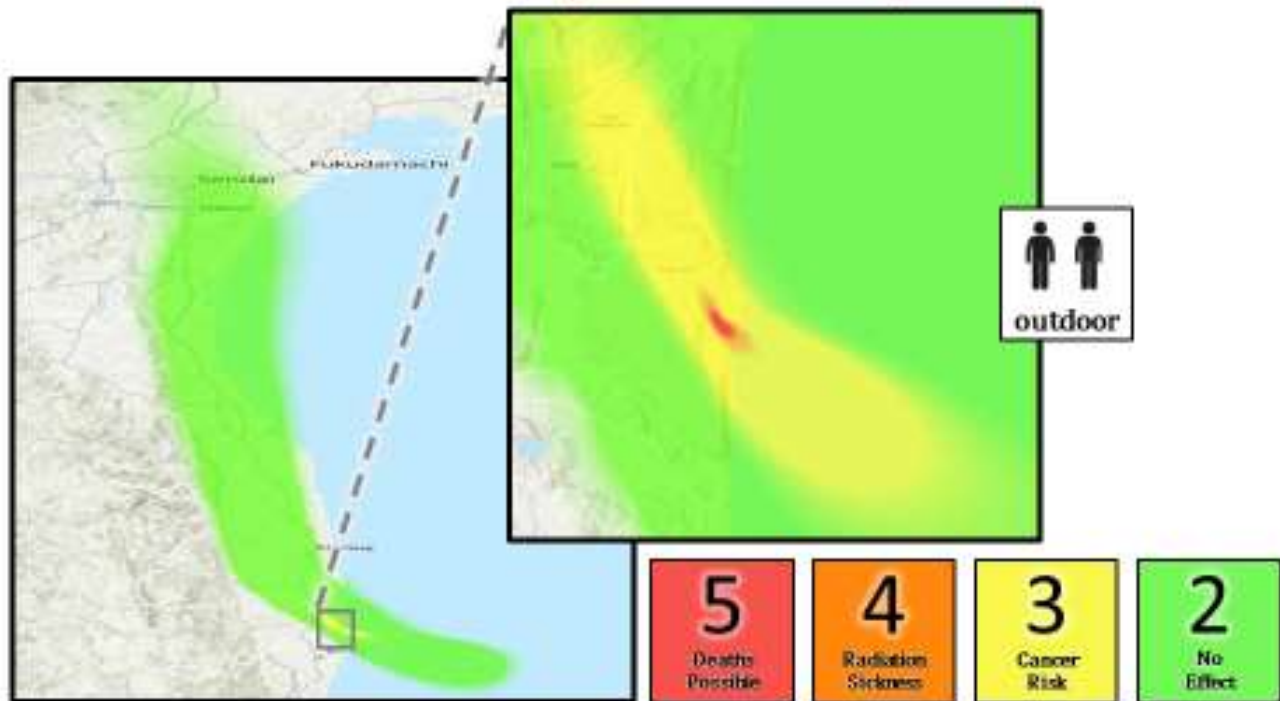
Category 5 Death	Category 4 Injury	Category 3 Cancer Risk	Category 2 No Effect	Category 1 Natural
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Get Inside, Stay Inside, Stay Tuned
to significantly reduce your radiation risk in affected areas.
Contact CDC 800-488-7100 for Advice & Recommendations

Example for Demonstration Only



Get Inside! Stay Inside! Stay Tuned!



(effects shown due to dose received at or before May 28, 2019 12:00 UTC)

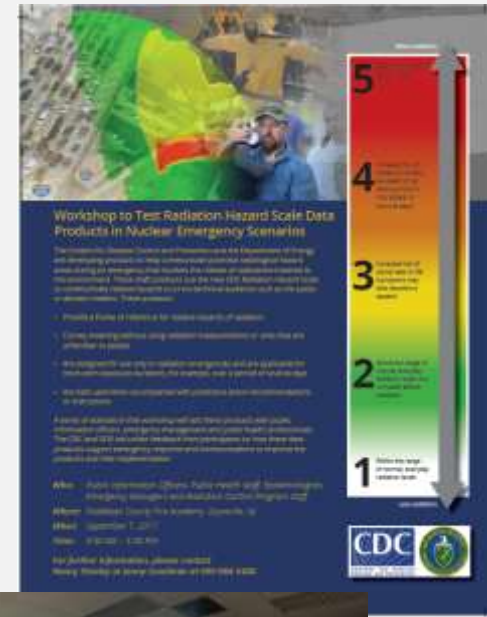
(6,000,000 people in the DC Metro area)

Advice & Recommendations:
[insert contact information]

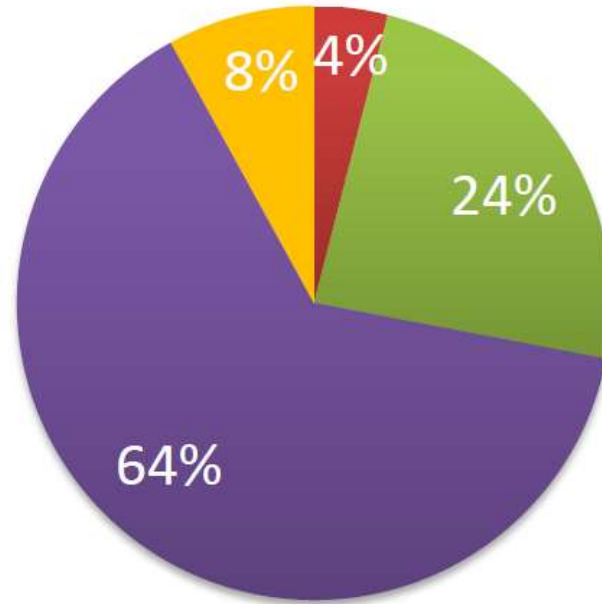
Workshop to Test Radiation Hazard Scale Data Products in Nuclear Emergency Scenarios

Middlesex County Fire Academy, Sayreville, NJ, September 7, 2017

- Essex Regional Health Commission
- Hudson Regional Health Commission
- Middlesex County Department of Public Safety and Health
- Morris County Office of Emergency Management
- Morris County Office of Health Management
- New Jersey Department of Environmental Protection
- New Jersey Department of Human Services
- New Jersey Department of Public Health
- New Jersey State Police
- New Jersey Voluntary Organizations Active in Disaster
- Rutgers New Jersey Medical School

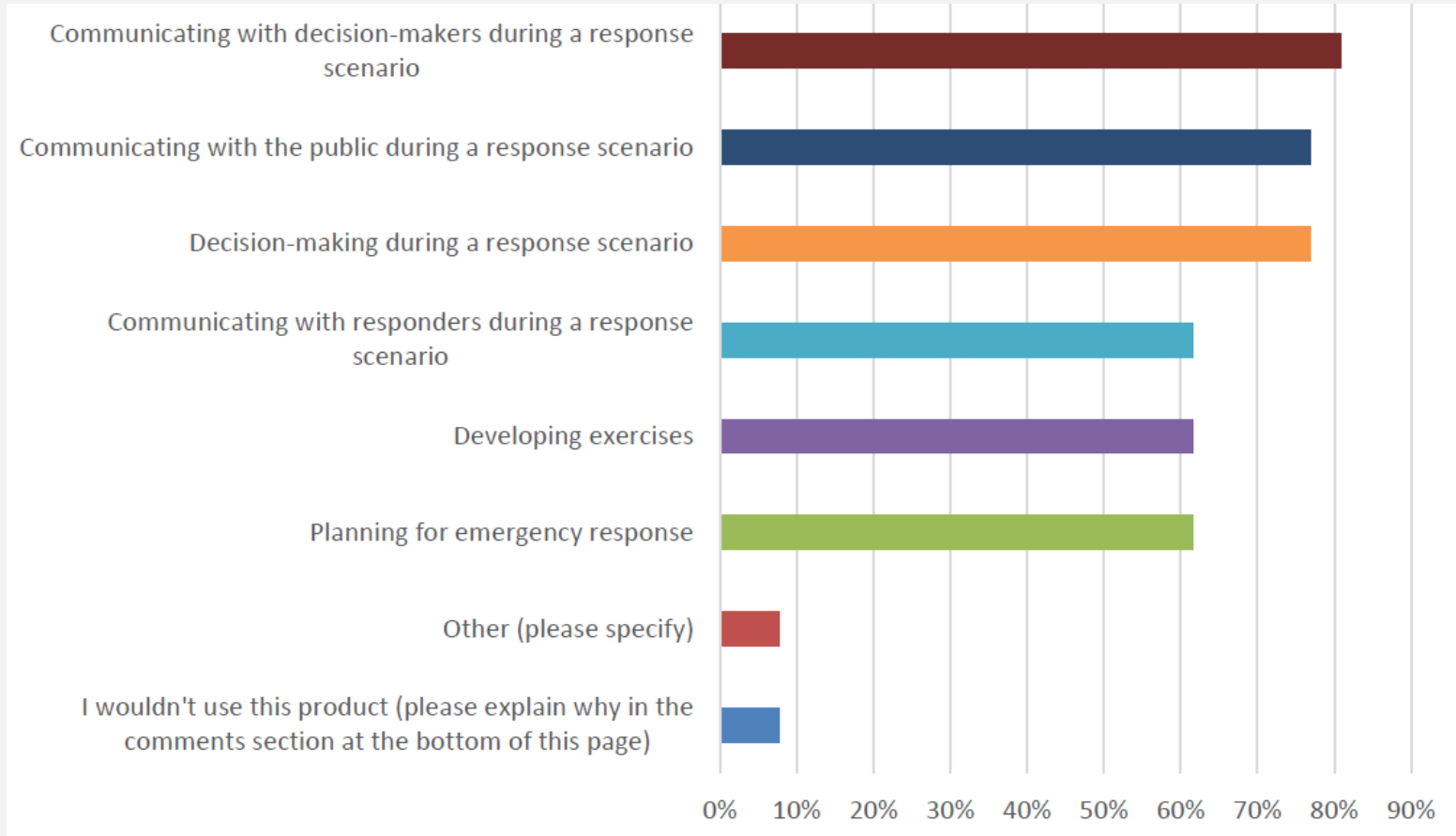


How useful do you think these products will be for you in your role?



■ Not useful at all ■ Slightly useful ■ Moderately useful ■ Very useful ■ Extremely useful

How should these products be used?



Workshop to Test Radiation Hazard Scale Data Products in Nuclear Emergency Scenarios

Connecticut Fire Academy, Windsor Locks, CT, June 26, 2019



Thank you!

For more information, contact NCEH
1-800-CDC-INFO (232-4636)
TTY: 1-888-232-6348 www.cdc.gov
Follow us on Twitter @CDCEnvironment

The findings and conclusions in this report are those of the authors and do not necessarily represent the official position of the Centers for Disease Control and Prevention.

