



U.S. NRC

UNITED STATES NUCLEAR REGULATORY COMMISSION

Protecting People and the Environment

Technical Basis for the Public Dose Limit in 10 CFR Part 20, Standards for Protection Against Radiation

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Agenda

- System of Radiological Protection
- Issues that influence the regulations
- What would prompt a change in NRC's regulatory limits

Radiation – a source of public fascination and scientific acclaim !



Wilhelm Röntgen -
discovered x-rays in
1895



Henri Becquerel -
discovered radioactivity
in 1896



Early uses of radiation

- X-rays - Medical diagnosis
 - Locating bullets or shrapnel
 - Diagnosing injuries to imaging body parts
 - “obtaining a shadow picture of a fetal head” ...
“might prove useful in the diagnosis of pregnancy.”
- Radium
 - Cures for acne to heart disease
 - Luminescent dials

Early Health Effects

- By 1915, scientists and physicians concluded that exposure to ionizing radiation had harmful consequences
- First set of exposure limiting suggestions (1915)
- Muller's research with fruit flies (1920s)
- Radium dial painters become gravely ill

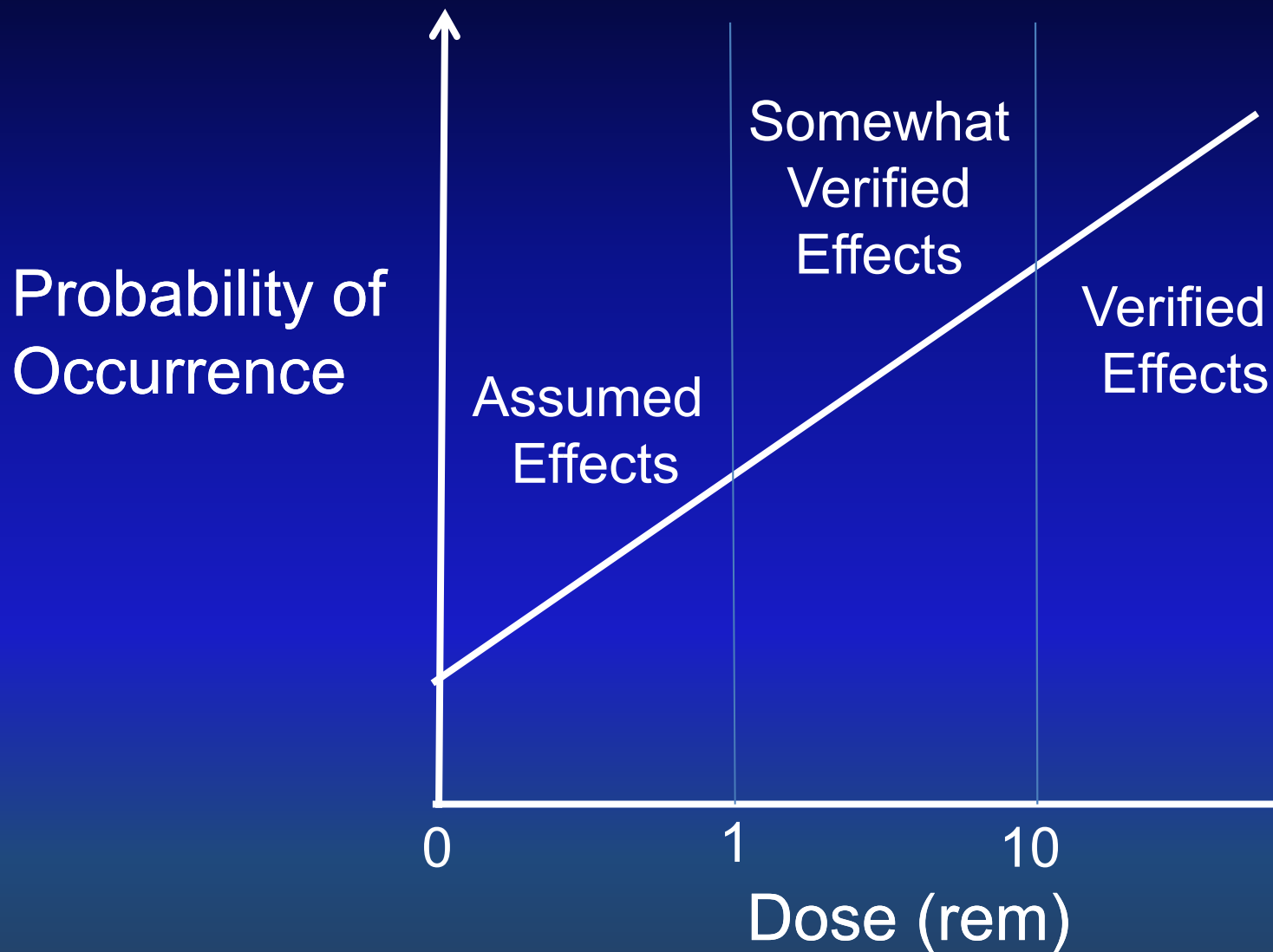
Evolution of Radiation Protection Standards

- Establishment of the International Advisory Committee on X-ray and Radium Protection
- Tolerance dose limits of 0.1 to 0.2 Roentgen per day (1930s). Avoid threshold effects.
- During and after WWII, there was extensive research in radiation biology and radiological physics.
- Maximum permissible exposure limits.

Standards for Protection Against Radiation

- Assumptions:
 - Linear, non-threshold (LNT) relationship between dose and probability of cancer or genetic effect occurring
 - Severity of illness is independent of dose
 - Non-cancer effects can be prevented by limiting exposure

Development of Cancer



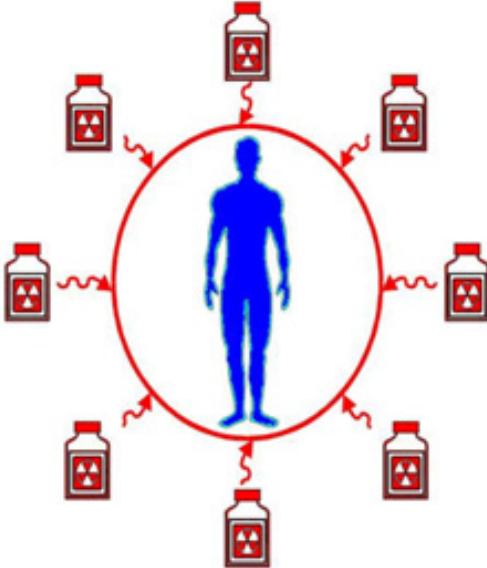
Lifetime risk of developing or dying from cancer

	Risk of Developing	Risk of Dying
Male	44.29 %	23.20 %
Female	37.76 %	19.58 %

$$0.1 \text{ rem/yr} \times 70 \text{ yrs} = 0.35\%$$

$$0.004 \text{ rem/yr} \times 70 \text{ yrs} = 0.014\%$$

Individual Dose Limits

Dose Limits
Protect the Representative Person from radiation exposure
 A diagram showing a blue silhouette of a human figure inside a red circle. Surrounding the circle are eight red rectangular boxes, each containing a white radiation symbol (a stylized 'X' with three dots). Red wavy lines connect each box to the red circle, representing radiation exposure.
From all regulated sources in planned exposure situations

Total effective dose equivalent to individual members of the public from the licensed operation does not exceed **0.1 rem (1 mSv)** in a year

10 CFR Part 20 – last major revision (May 1991)

What has happened since then?



Major technical developments

- Developments in basic science (e.g., DOE low dose research program, RERF, IARC)
- UNSCEAR Reports (2000 – 2008)
- BEIR V (1990) and BEIR VII (2005)
- French National Academy report (2005)
- ICRP Publication 60 (1990) and 103 (2007)

What would prompt a recommendation to revise NRC regulations?

- Substantial increase in public health and safety, and costs are justified
- Updated scientific information / biophysical models
- Interagency alignment (DOE, NRC, EPA, OSHA)

What is going on now?

- New ICRP Recommendations were published in 2007
- Exploring implications of greater alignment with ICRP Publication 103.
- Undertaking stakeholder dialogue and technical basis development.

Conclusions

- NRC regulations and standards are adequately protective of public health and safety.
- Adoption of new biokinetic models, risk coefficients, weighting factors, etc. is being considered.

Thank you !

Comments / Questions ?



References

- J. Samuel Walker, Permissible Dose, A History of Radiation Protection in the Twentieth Century, University of California Press (2000).
- Charles Meinhold, Lauriston S. Taylor Lecture: The Evolution of Radiation Protection – From Erythema to Genetic Risks to risk of cancer to ...? Health Physics, volume 87, No. 3, pp 240-248, (2004).
- UNITED NATIONS Scientific Committee on the Effects of Atomic Radiation Sources and Effects of Ionizing Radiation, UNSCEAR Report 2000, Volume 1 United Nations, New York (2000).
- UNITED NATIONS Scientific Committee on the Effects of Atomic Radiation Sources and Effects of Ionizing Radiation, UNSCEAR Report 2008, Volume 1, United Nations, New York (2010).
- INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, 1990 Recommendations of the ICRP, Publication 60, Pergamon Press, Oxford (1991).
- INTERNATIONAL COMMISSION ON RADIOLOGICAL PROTECTION, 2007 Recommendations of the ICRP, Publication 103, Pergamon Press, Oxford (2007).
- E.P. Davis, The Roentgen Rays in Surgery, American Journal of Medical Sciences, March 14, 1896.
- Regulatory Guide 4.16, Revision 2. Monitoring and Reporting Radioactive Materials in Liquid and Gaseous Effluents from Nuclear Fuel Cycle Facilities, December 2010.

Technical Sources / Resources

- United Nations Scientific Committee on the Effects of Atomic Radiation (UNSCEAR) <http://www.UNSCEAR.org>
- International Commission on Radiological Protection (ICRP) <http://www.icrp.org>
- International Atomic Energy Agency (IAEA) <http://www.iaea.org>
- National Council on Radiation Protection and Measurements (NCRP) <http://www.ncrponline.org>
- National Academy of Science (NAS) – Nuclear and Radiation Studies Board <http://www.nationalacademies.org>