Radiation Protection Regs –
Time For Update And Uniformity

Let's Examine the Policy, Recommendations, Regulations at the Federal and State Level, and the LNT Model and ALARA.

David J. Allard, MS, CHP, FHPS
Radiation Health Physics Program Advisor

March 28, 2026

PSRT Meeting, Allentown PA

David J. Allard, CHP

Bio –

In July of 2022 Mr. Allard retired from his position as the Pennsylvania DEP's Director of the Bureau of Radiation Protection. He was responsible for the: accelerator, X-ray, environmental surveillance, nuclear safety, radiological emergency response, radioactive materials, NORM / TENORM, decommissioning / site clean-up, low-level radioactive waste and radon programs within the Commonwealth. During his 23+ years with DEP, he has also served as acting Deputy Secretary for Waste, Air, Radiation & Remediation on two occasions. Mr. Allard was also in leadership roles within his professional organizations, and continues to serve as a member or advisor on several national and international radiation protection committees. He has been involved in the various aspects of governmental, industrial, reactor, medical and academic radiation protection for over 48 years. And, has authored numerous professional papers and reports, and frequently lectures on a wide variety of radiation protection topics and concerns.

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The author has no conflicts of interest, and, all graphics, photos and figures used under 'fair use' for education.

Chairperson, TMI Unit-2 Community Advisory Panel

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Retired Director, of the PA DEP Bureau of Radiation Protection

Appalachian States Low-Level Radioactive Waste Commission

Past Chairman and Commissioner of the interstate ASLLRWC

HEALTH PHYSICS SOCIETY
FOUNDED 1956

Fellow, Past Officer, and Emeritus Member of the HPS

Conference of Radiation Control Program Directors, Inc.
C R C P D
Est. 1968

Past Chairperson, Board, and (now) Life Member of the CRCPD

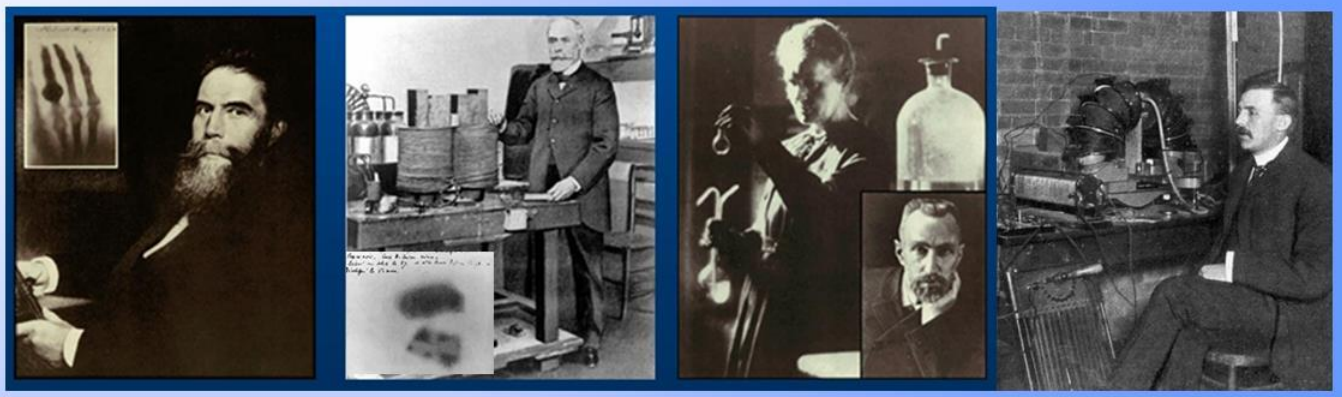
Objectives of This Talk

- Short History of Radiation Protection
- Sources of Radiation Exposure
- Uses of Radioactivity & Radiation
- Radiation Protection System
- National & International Standards
- Radiation Protection Organizations
- Federal & State Regulations
- Update on the LNT & ALARA Issues

Evolution of Radiation Science

Discovery

X rays, Radioactivity and Radium c1900



Application

Medicine and Industry

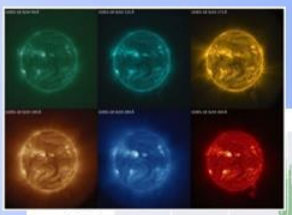
Protection

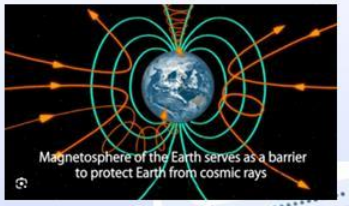
Workers, public and environment [ICRP 1928]

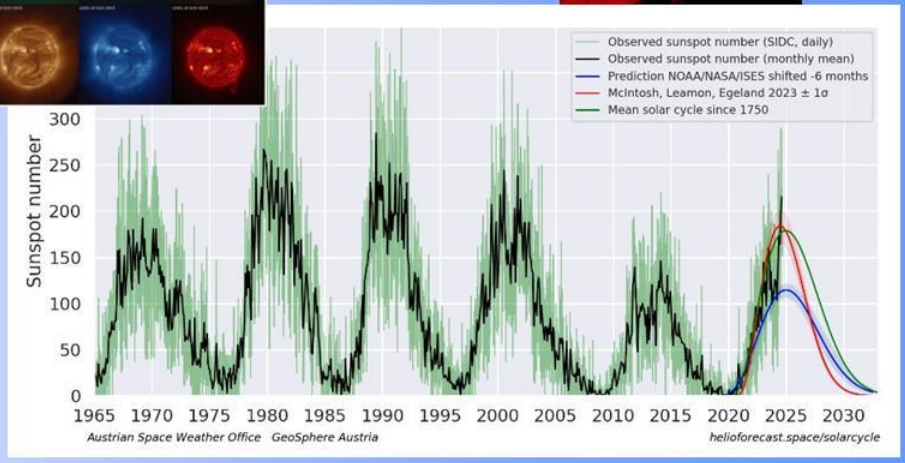
Sources of Radiation Exposure

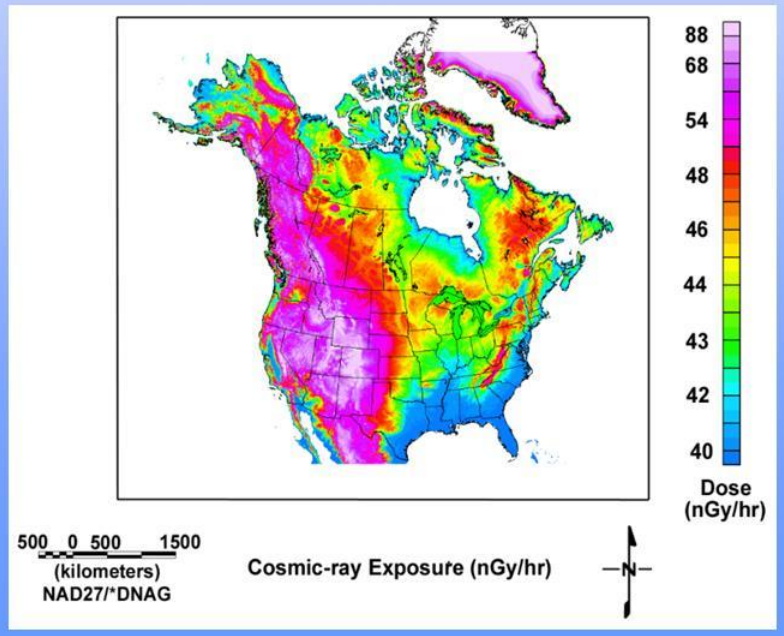
- Cosmic Rays
- Natural Radioactive Material (RAM)
- Radon
- Radioactive Devices
- Medical, Dental and Industrial X rays
- Consumer Products with RAM
- Nuclear Power Plants
- Occupational Exposure

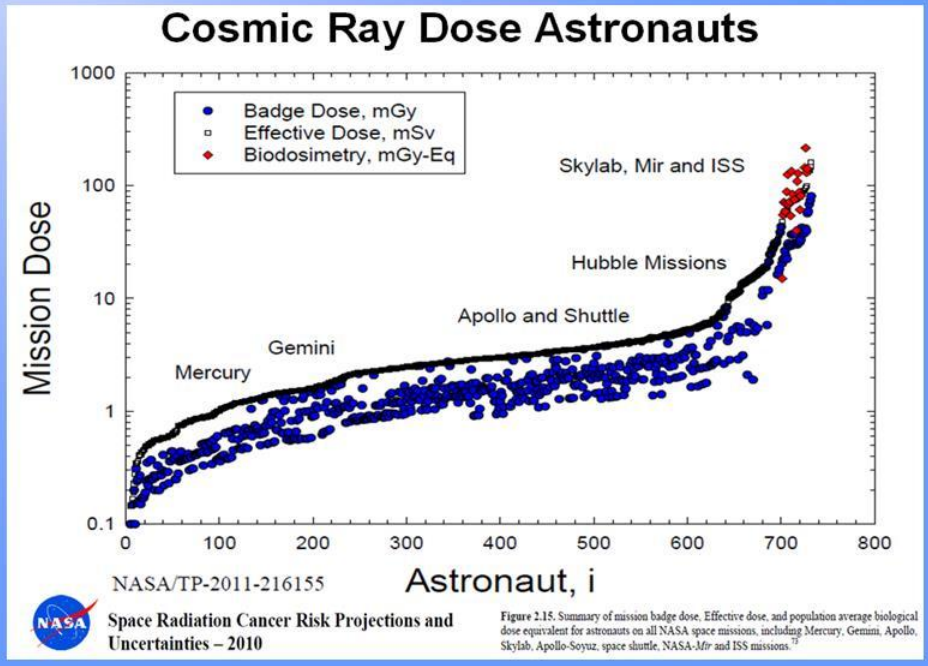
Cosmic Radiation











Radon

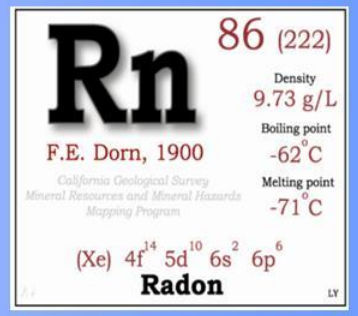
Natural Source

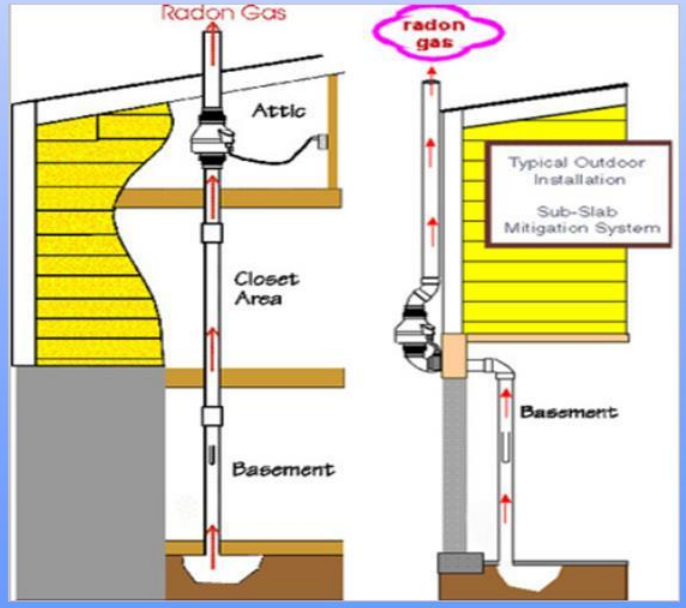
In PA homes

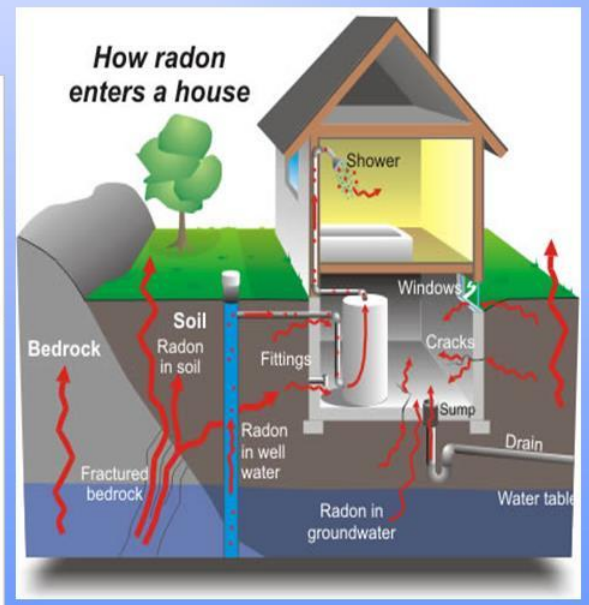
~ 580 mrem/yr (5.8 mSv/a)

EPA Action Level

< 4 pCi/L
(< 148 Bq/m^3)







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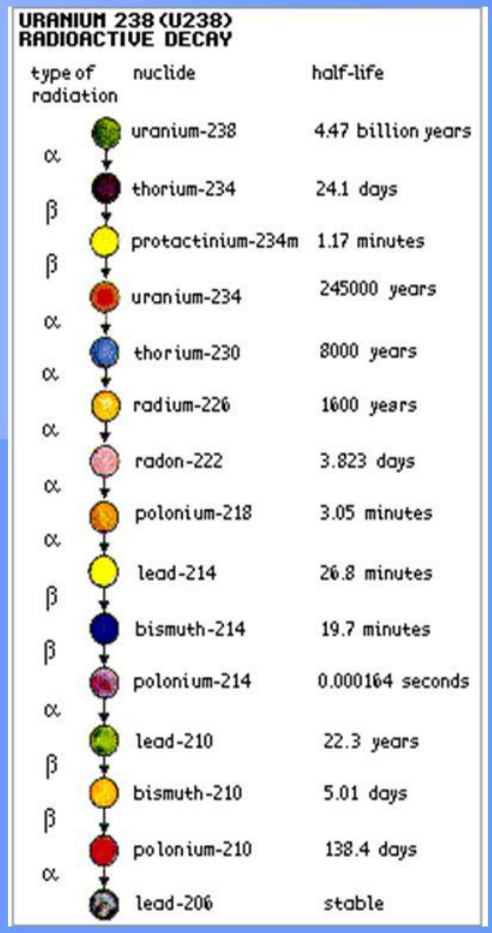
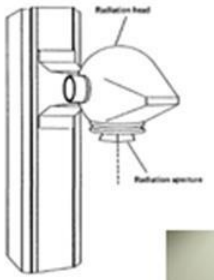
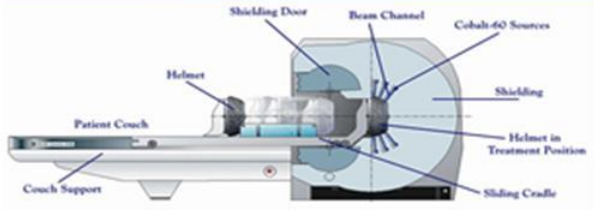


Radioactive Devices

- Teletherapy
- Gamma Knife
- * Radio-thermal Generator
- Blood / Tissue Irradiator
- High Dose Brachytherapy
- Industrial Radiography
- Well Logging
- Sealed Sources & Gauges





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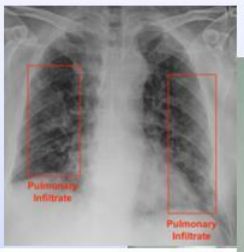
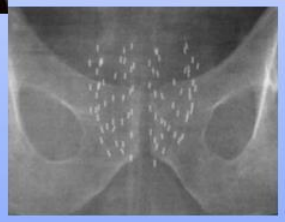
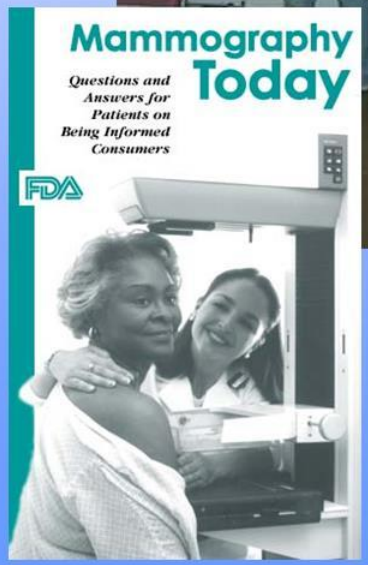
Medical & Dental X-ray, and Nuclear Medicine Applications

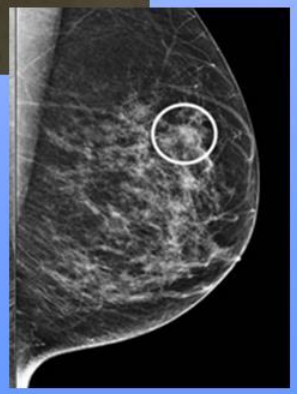
Strontium-90 Beta Radiotherapy

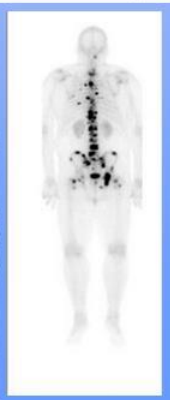


COVID-19 patient









Radioactive Consumer Products

Uranium pottery glaze and glass, “No Salt” [K-40], smoke detector [Am-241], watch [Ra-226], etc.

NORM and TENORM in Industry

https://www.pa.gov/agencies/dep/programs-and-services/oil-and-gas/related-topics/radiation-protection.html

- Oil & Gas Well Development and Production

- Mineral Sands Industry (e.g., zircons)

- Uranium and Other Mining Operations

- Water Treatment (residuals)

- Metal Refining and Recycle Industries

- Phosphate Production

- Geothermal Energy

Nuclear Power Plants

PA NPPs

- Beaver Valley 1 & 2
- Limerick 1 & 2
- Peach Bottom 1, 2 & 3
- Susquehanna 1 & 2
- TMI 1 & 2

Shippingport

Saxton

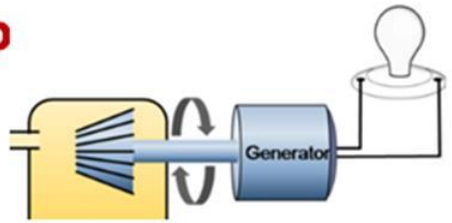
Light Water Reactors - BWR and PWR

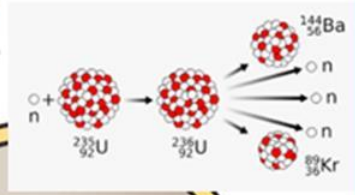
U.S.NRC
United States Nuclear Regulatory Commission
Protecting People and the Environment

Typical PWR Type NPP

In a typical design concept of a commercial PWR, the following process occurs:

1. The core inside the reactor vessel creates heat.
2. Pressurized water in the primary coolant loop carries the heat to the steam generator.
3. Inside the steam generator, heat from the primary coolant loop vaporizes the water in a secondary loop, producing steam.
4. The steamline directs the steam to the main turbine, causing it to turn the turbine generator, which produces electricity.



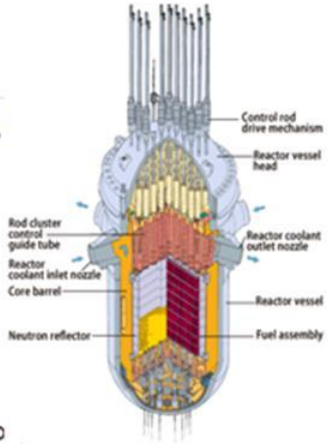


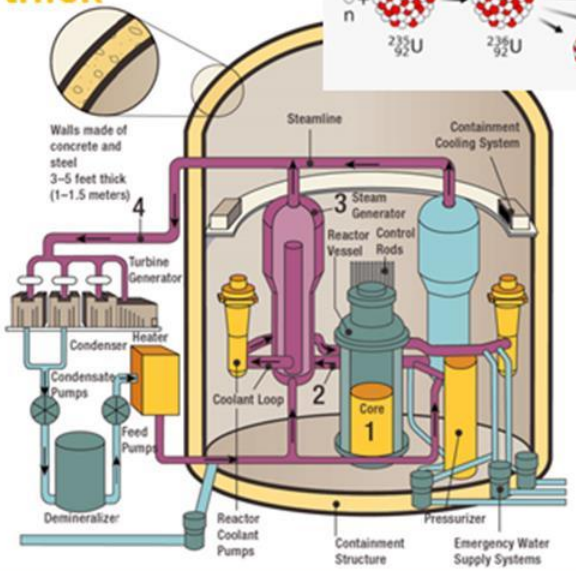
TMI Unit-1

Shut down Sept. 2019

Location: Middletown, PA (10 miles SE of Harrisburg,
Operator: Exelon Generation Co., LLC
Operating License: Issued - 04/19/1974
Renewed License Issued - 10/22/2009
License Expires - 04/19/2034
Docket Number: 05000289

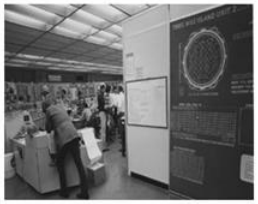
Reactor Type: Pressurized Water Reactor
Licensed MWt: 2,568
Reactor Vendor/Type: Babcock & Wilcox Lowered Lo
Containment Type: Dry, Ambient Pressure

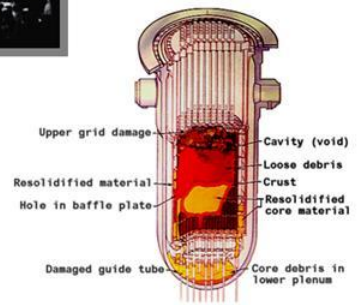




Three Mile Island

1979 TMI Unit-2 Accident Emergency Response – Core Damage





Community Advisory Panel Meeting (TMI-2 CAP)

Thursday, March 20th, 6pm–7:30pm (Hybrid)

Gallery Lounge in the Olmsted Building

Building (A)

777 W Harrisburg Pike, Middletown, PA 17057

Click here to watch live

or

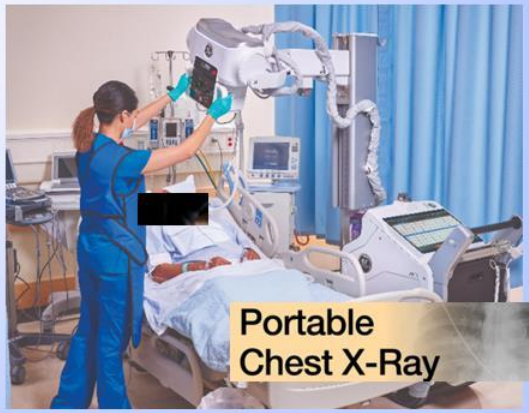
Dial +1 385-500-4880
Phone Conference ID: 377086967#

David J. Allard, MS, CHP, FHPS
Chairperson TMI Unit-2 CAP

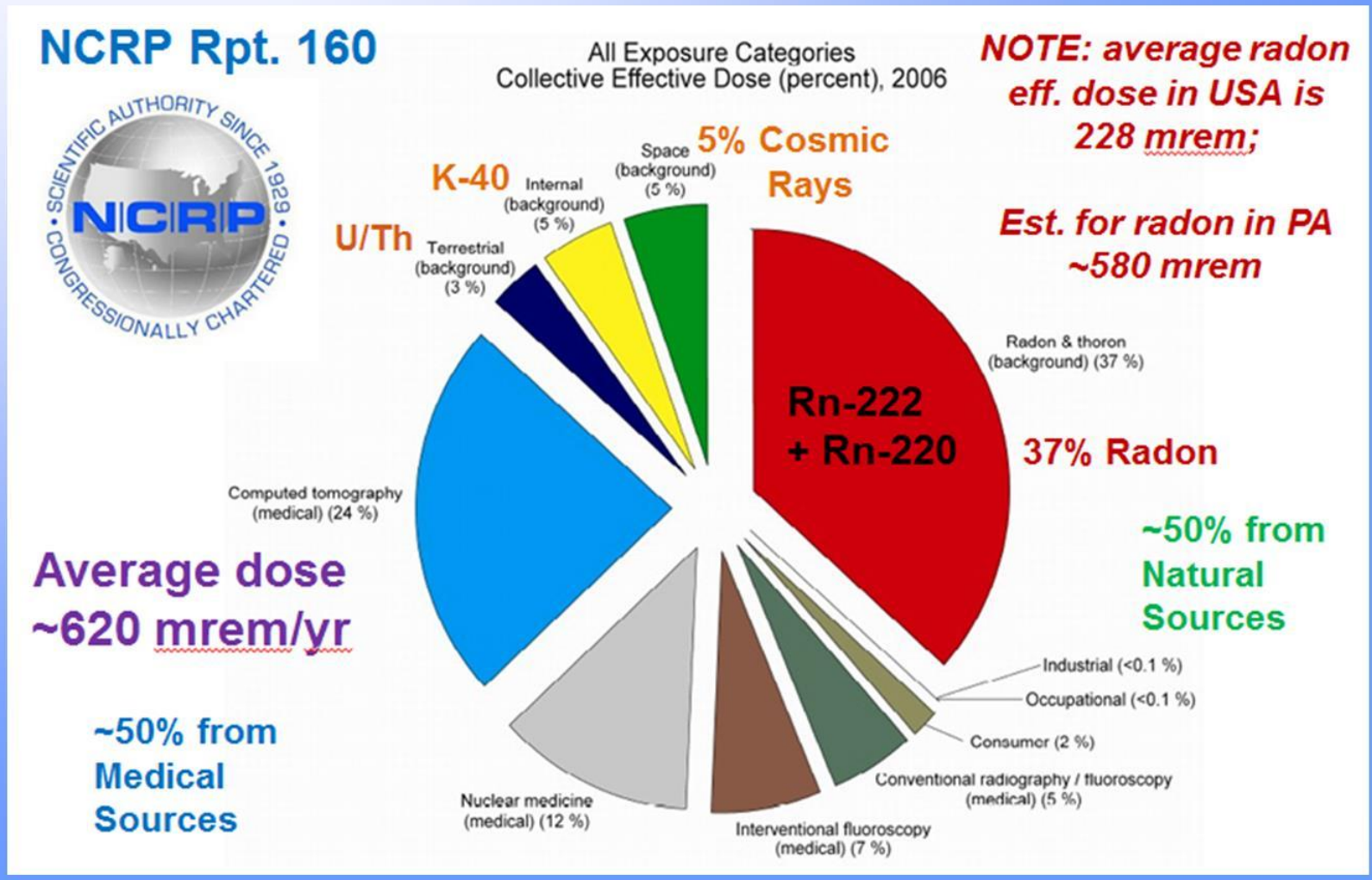
Tel: 717-361-4428
Email: allradcon@comcast.net

Occupational Exposure

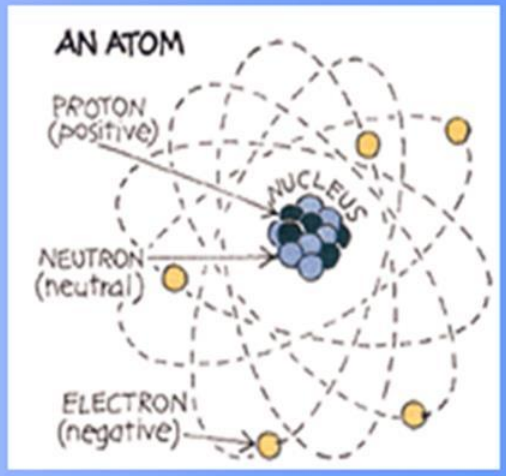
Cosmic Rays



Average Radiation Dose from Various Sources

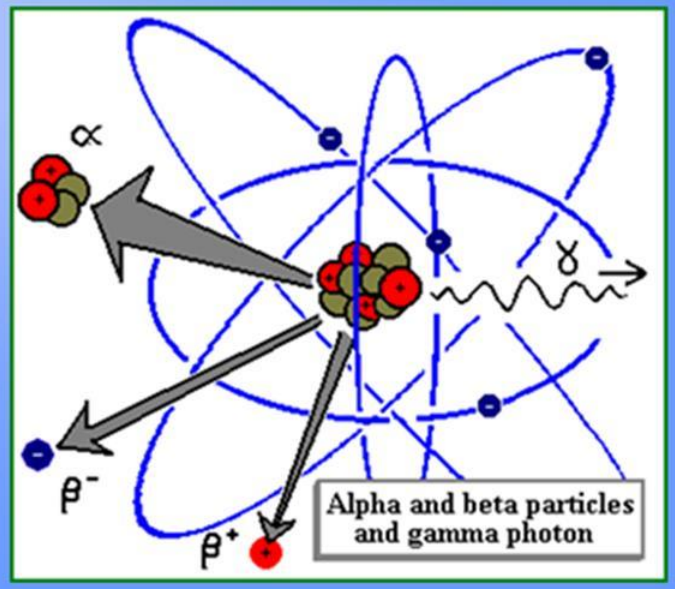


Atomic and Nuclear Structure



- Atomic model
- Orbital electrons
- Nucleus: protons and neutrons
- Isotopes, radioisotopes
- Nuclear stability
- Radioactivity
- Radiation…

⇒ Causes ionization, energy deposition, and biological effects.



Nuclear Structure

Isotopes and Radio-isotopes

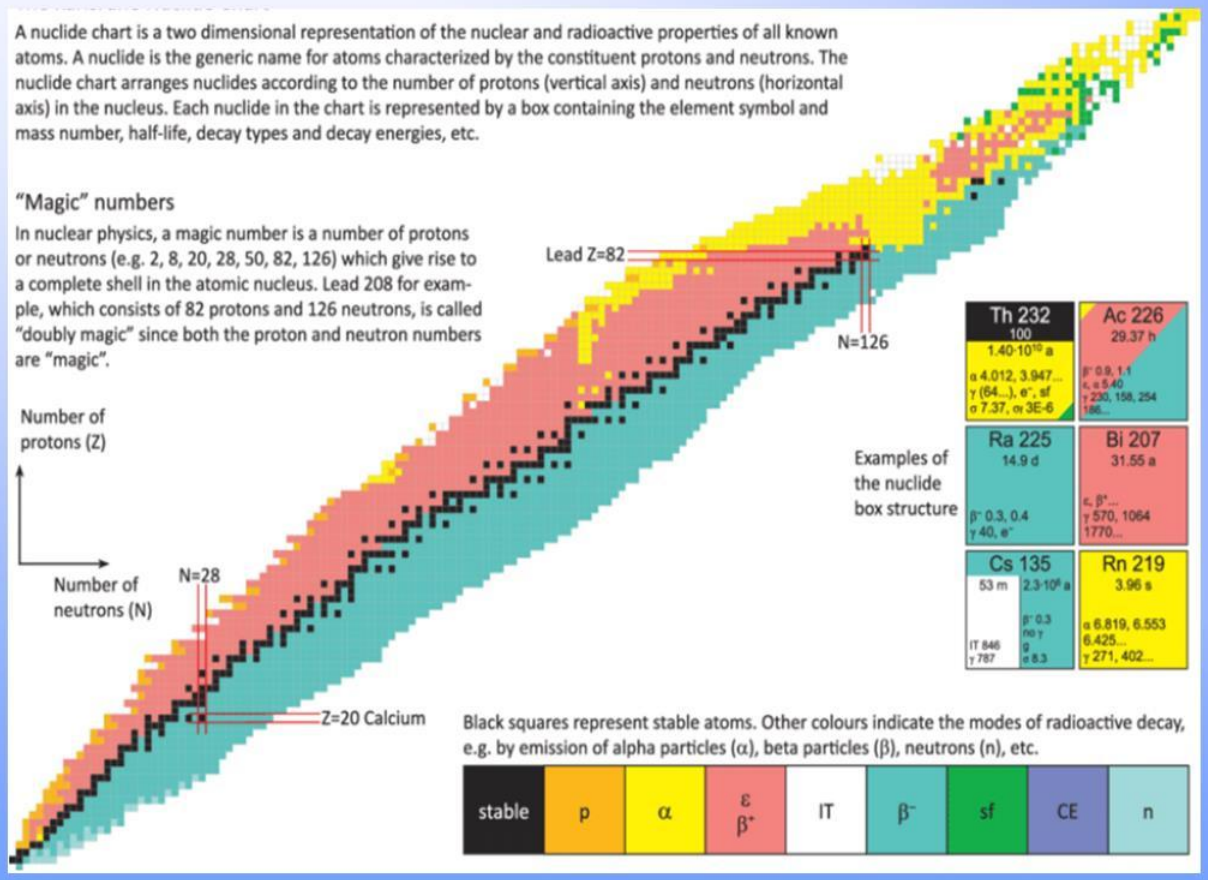
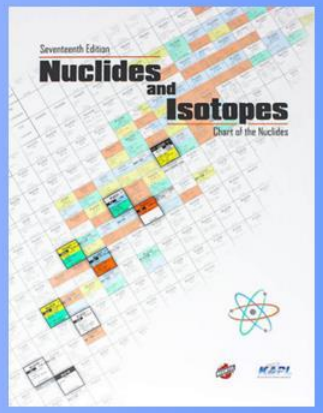
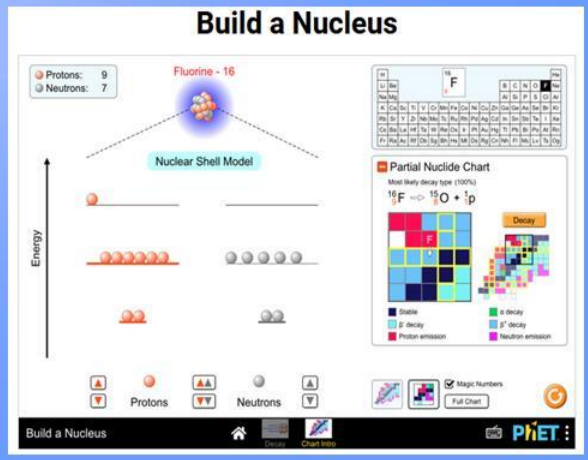


Chart of the Nuclides

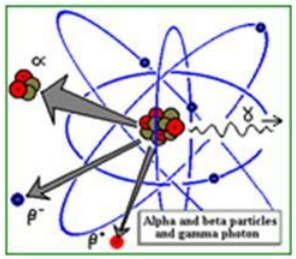


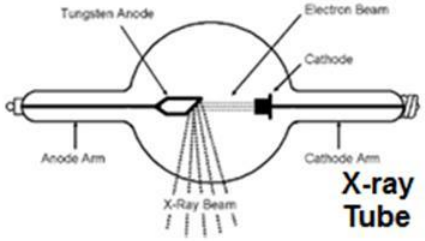


https://phet.colorado.edu/en/simulations/build-a-nucleus/activities

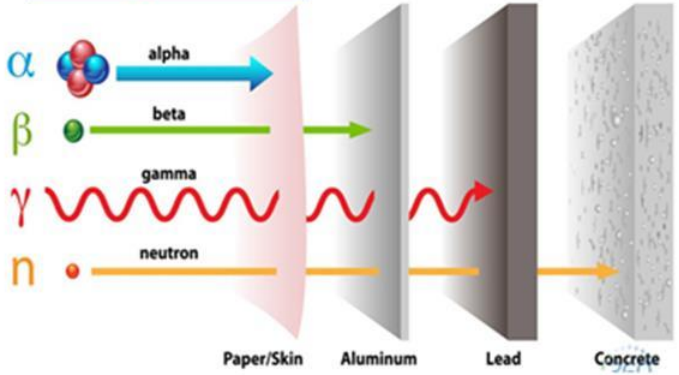
Energy Deposition, Dose and Biological Effects

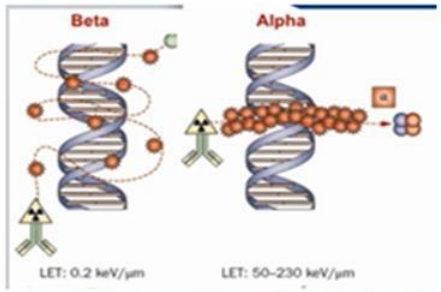
Radiation & Effects =>



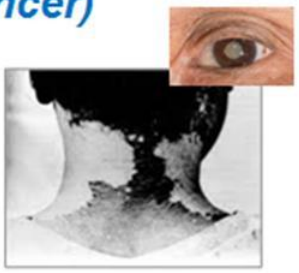


X-ray Tube

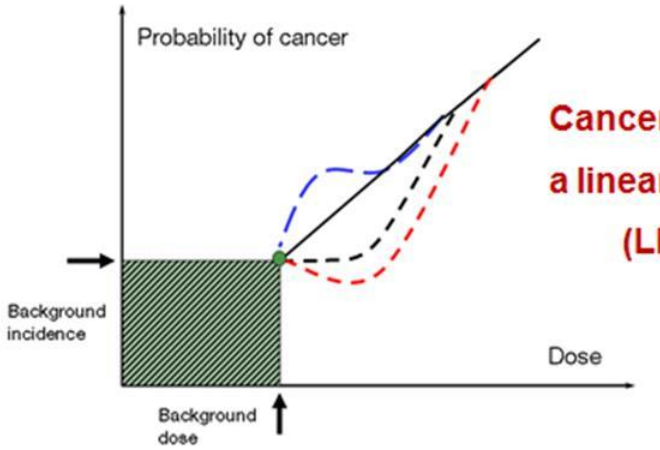




Non-stochastic Effects (skin)
Stochastic Effects (cancer)



Dose-Response Relationships



Cancer – we assume a linear no threshold (LNT) model

Energy Deposition & Biological Effects

See NCRP Report No. 136 (2001) for a detailed description of the contrasting types of dose-response relationships.

Radiation Measurement, Quantities and Units

Wt. & Temp.

Radiation Units

Measure of	Quantity	Unit	SI
Amount of radioactive material	Activity	curie (Ci)	Bq
Ionization in air	Exposure	roentgen (R)	C/kg
Absorbed energy per mass	Absorbed Dose	rad	Gy
Absorbed dose weighted by type of radiation	Dose Equivalent	rem	Sv

For most types of radiation 1 R ≈ 1 rad ≈ 1 rem

How Do We Get to 'Dose & Risk?'

ICRU provides Science for 'Policy' of RP

Dose quantities in SI units for external radiological protection

Sources of external radiation

- Monitored quantities
- Instrument responses

Measured in practice by Radiological Protection Instruments

Related by instrument calibration.

Physical quantities

- Fluence, Φ
- Kerma, K *(gray)*
- Absorbed dose, D *(gray)*

Dose equivalents calculated using absorbed dose and Q (L), and simple phantoms (sphere or slab). Validated by measurements and calculations.

A "phantom" is a device used to model and calculate the absorbed dose for an irradiated entity.

Calculated using anthropomorphic phantom for organ absorbed dose, then factors W_R and W_T for biological effect.

Operational quantities

- Ambient dose equivalent, $H^*(d)$
- Directional dose equivalent, $H'(d,\Omega)$
- Personal dose equivalent, $H_p(d)$

Unit = sievert

These quantities are measurable, and used for practical evaluation of dose for regulation and assessment.

Comparison using the measured and calculated values to establish relationship

Protection quantities

- Organ absorbed dose, D_T *(gray)*
- Organ equivalent dose, H_T *(sievert)*
- Effective dose, E *(sievert)*

These quantities are not measurable; they are calculated quantities used to compare against observed health effects, and to set limits for exposure.

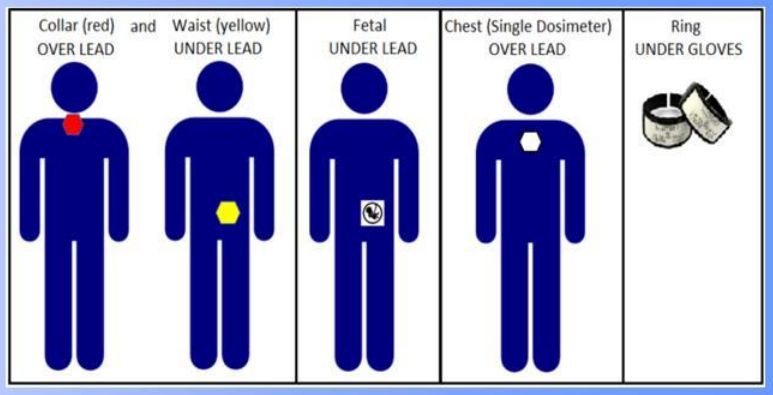
Radiation Dosimetry

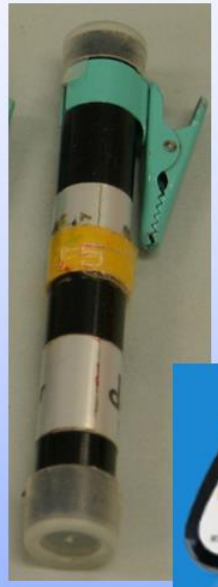
- Exposure (roentgen or “R,” air “kerma”)
- Absorbed dose (rad, gray)
- Quality factor or radiation weighting factor
- Dose equivalent (rem, sievert)

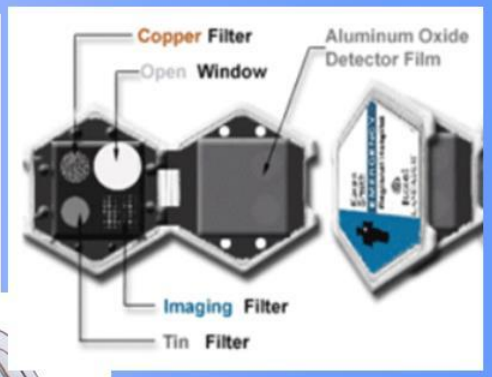
- R = 2.58E-4 C/kg (charge one sign, dry air)
- rad = 100 ergs/gram
- rem = rad x QF
- Sv = Gy x wt_r
- Gy = J/Kg (1 Gy = 100 rad)
- Sv = J/Kg* (1 Sv = 100 rem)

**Note: for RP, the R = rad = rem*

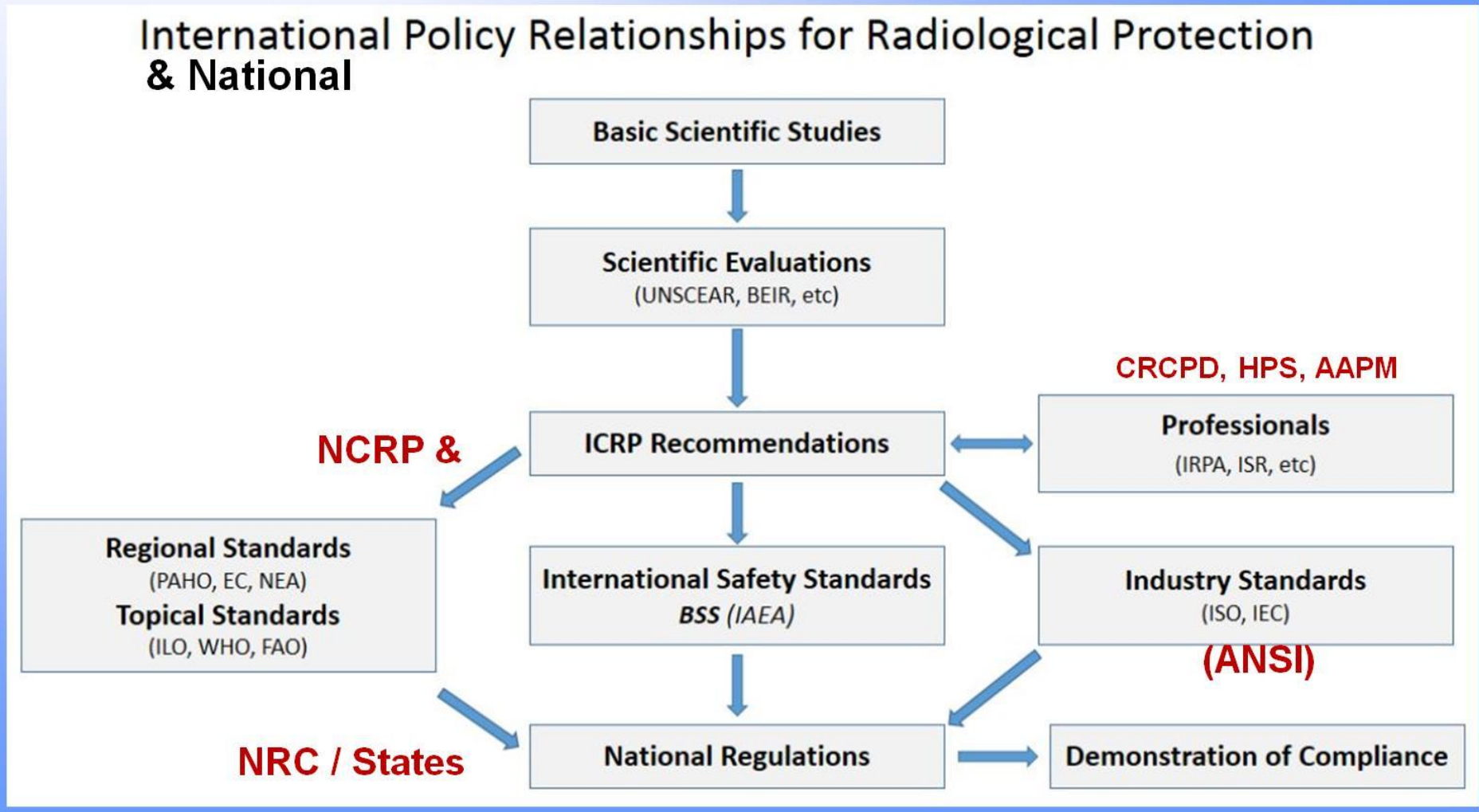
Radiation Detectors and Devices







From Science to Standards



Radiation Protection Standards

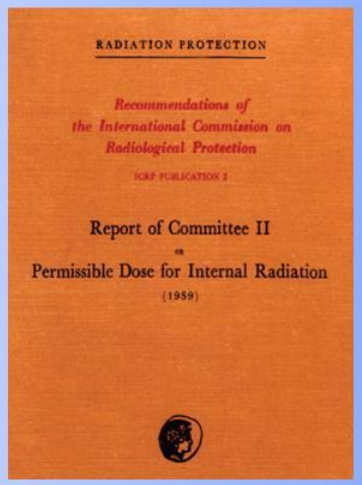
ICRP Recommendations

- Justification
- Optimization [ALARA]
- Limitation

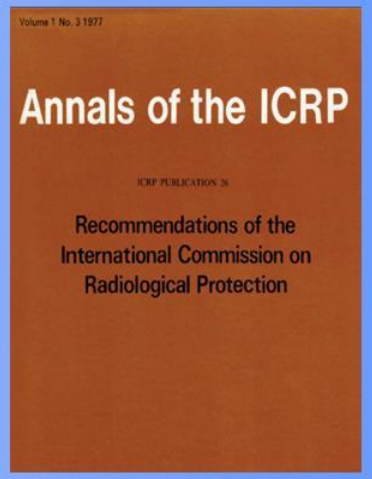
> Existing Conditions

> Planned Scenarios

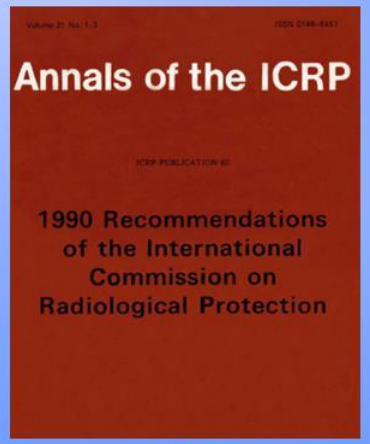
> Emergencies



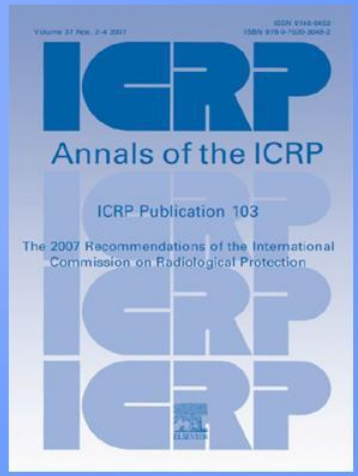
1959



1976



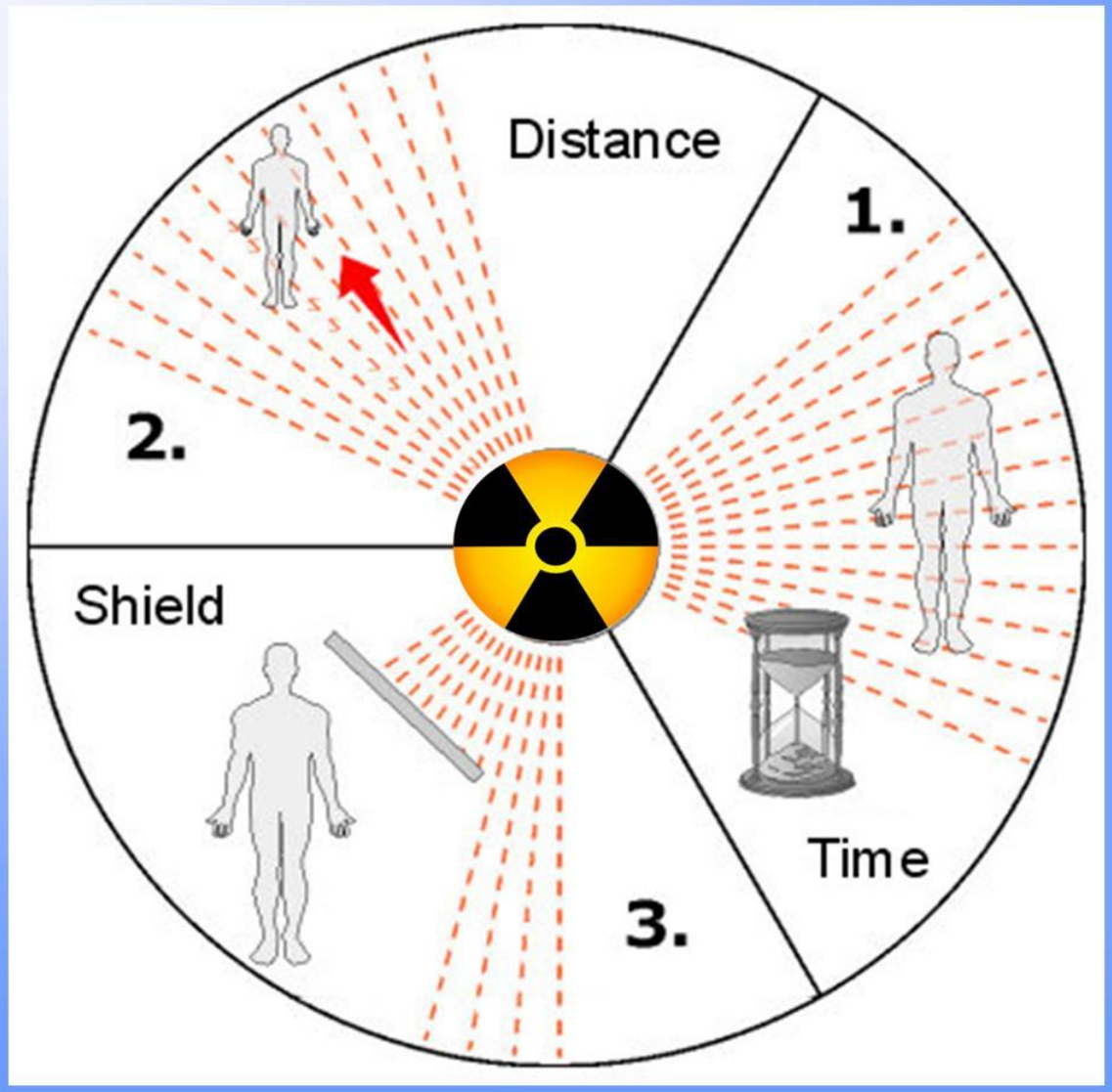
1991



2007

http://www.icrp.org/

ALARA 'Philosophy'



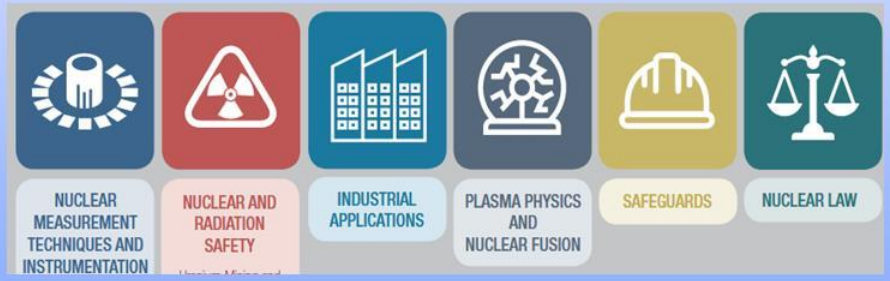
And 4. => Admin. RP Procedures

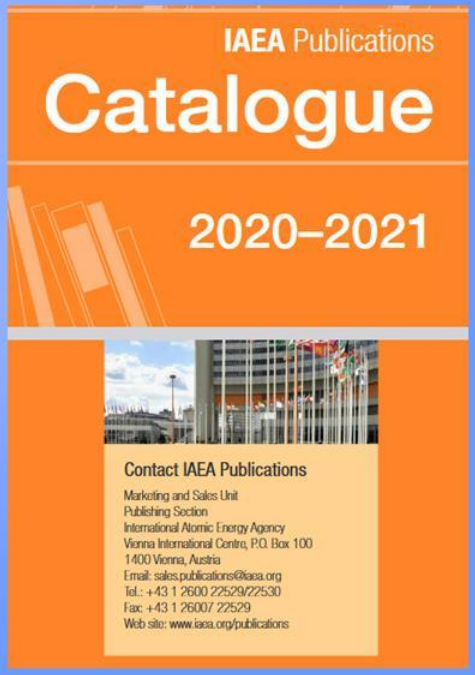
IAEA
International Atomic Energy Agency

The System of Radiation Protection

IAEA Recommendations

Widely known as the world's "Atoms for Peace and Development" organization within the United Nations family, the IAEA is the international centre for cooperation in the nuclear field. The Agency works with its Member States and multiple partners worldwide to promote the safe, secure and peaceful use of nuclear technologies.

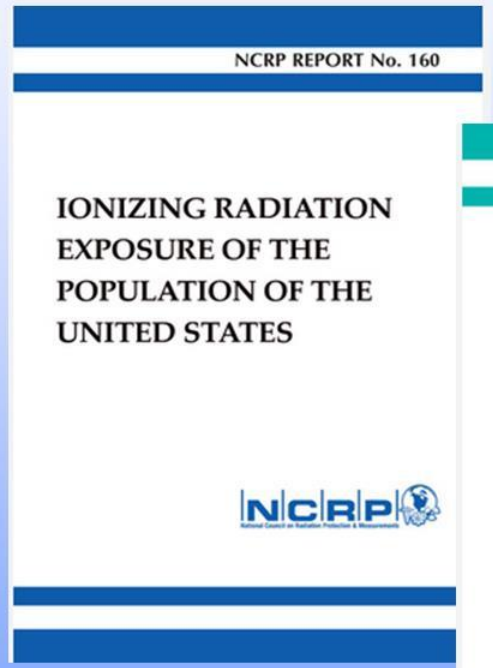


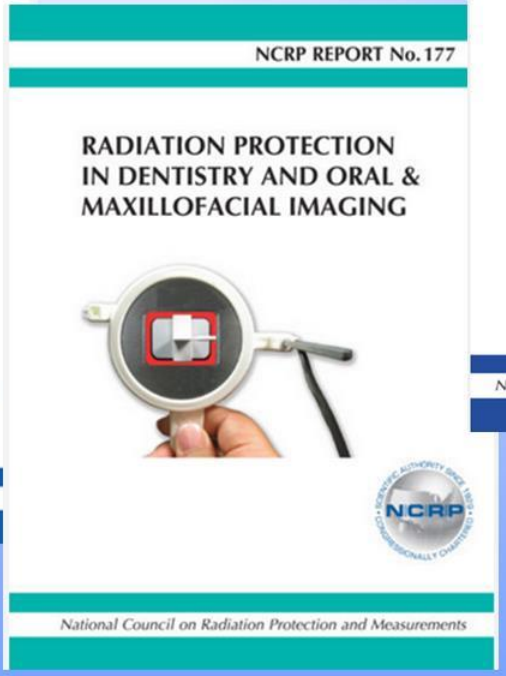


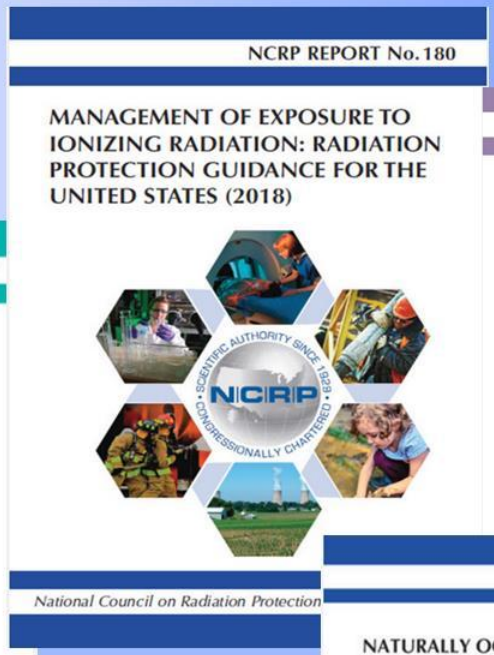
https://www.iaea.org/

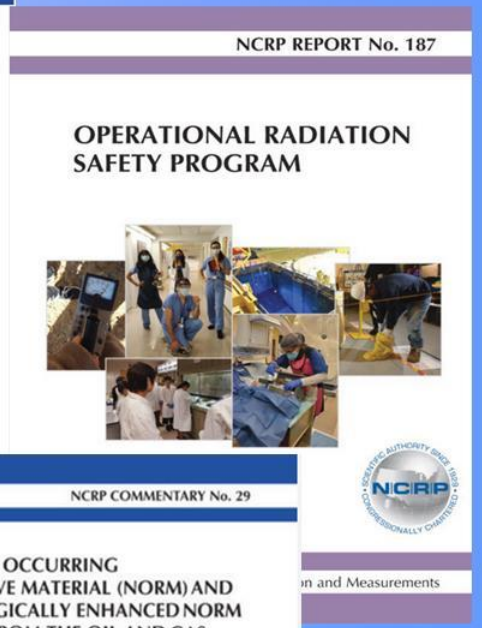
Radiation Protection Standards

NCRP Recommendations









https://ncrponline.org/

D. Allard [2013], adopted from an IRPA 11 meeting graphic

RADIATION PROTECTION SYSTEM

RADIATION BIOLOGICAL EFFECTS

RADIOLOGICAL PROTECTION STANDARDS, STATUTES AND REGULATION (FEDERAL AND STATE)

RADIATION MEASUREMENTS –INSTRUMENTATION & DOSIMETRY

RADIATION PROTECTION OF WORKERS

RADIATION PROTECTION OF THE ENVIRONMENT

RADIATION PROTECTION OF PATIENTS

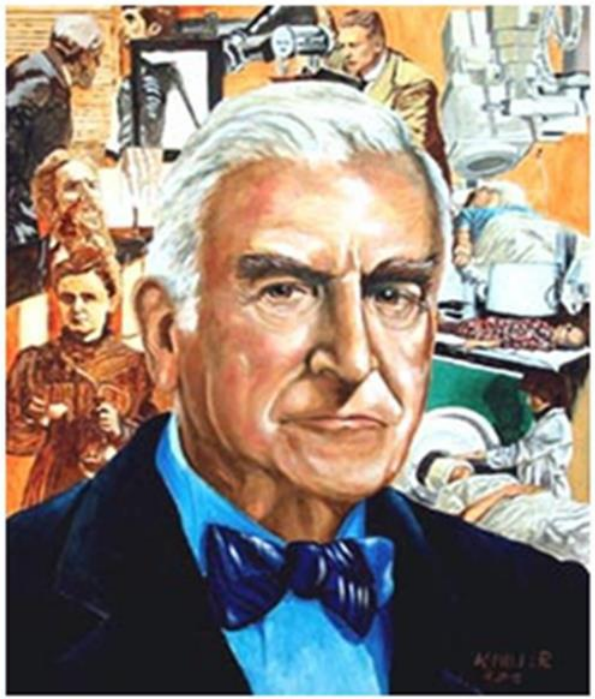
RADIATION PROTECTION OF THE PUBLIC

BASIC & APPLIED RESEARCH, INCIDENTS, ACCIDENTS AND ANALYSIS

SOCIETAL AND POLITICAL INFLUENCES

The System of Radiation Protection

NCRP Recommendations



Taylor painting by Ken Miller
https://kmillerartgallery.com/

"Radiation protection is not only a matter of science. It is a problem of philosophy, and morality, and the utmost wisdom."

(L.S. Taylor, 1956)

https://ncrponline.org/

RP Regulatory Framework

Public Health Reports Vol. 74, No. 12, December 1959

The Federal Radiation Council*

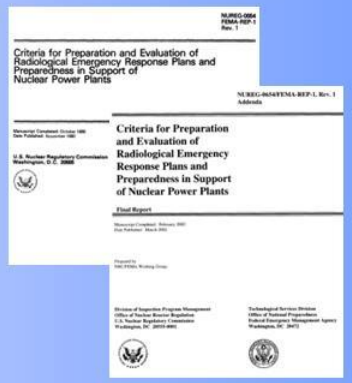
* FRC duties transferred to U.S. EPA in early 1970s

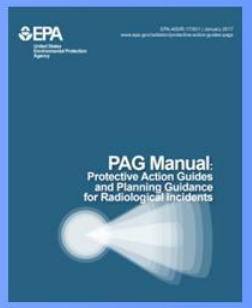
- Environmental Protection Agency (EPA)
- Nuclear Regulatory Commission (NRC)
- Federal Emergency Management Agency (FEMA)
- Dept. of Energy (DOE)
- Dept. of Transportation (DOT)
- Food & Drug Administration (FDA)
- Dept. of Labor - Occupational Safety & Health Administration (OSHA)

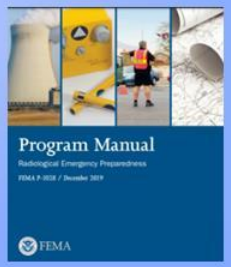
https://www.ecfr.gov/

- States Radiation Control Programs (CRCPD SSRs)

https://www.crcpd.org/page/SSRfactSheets





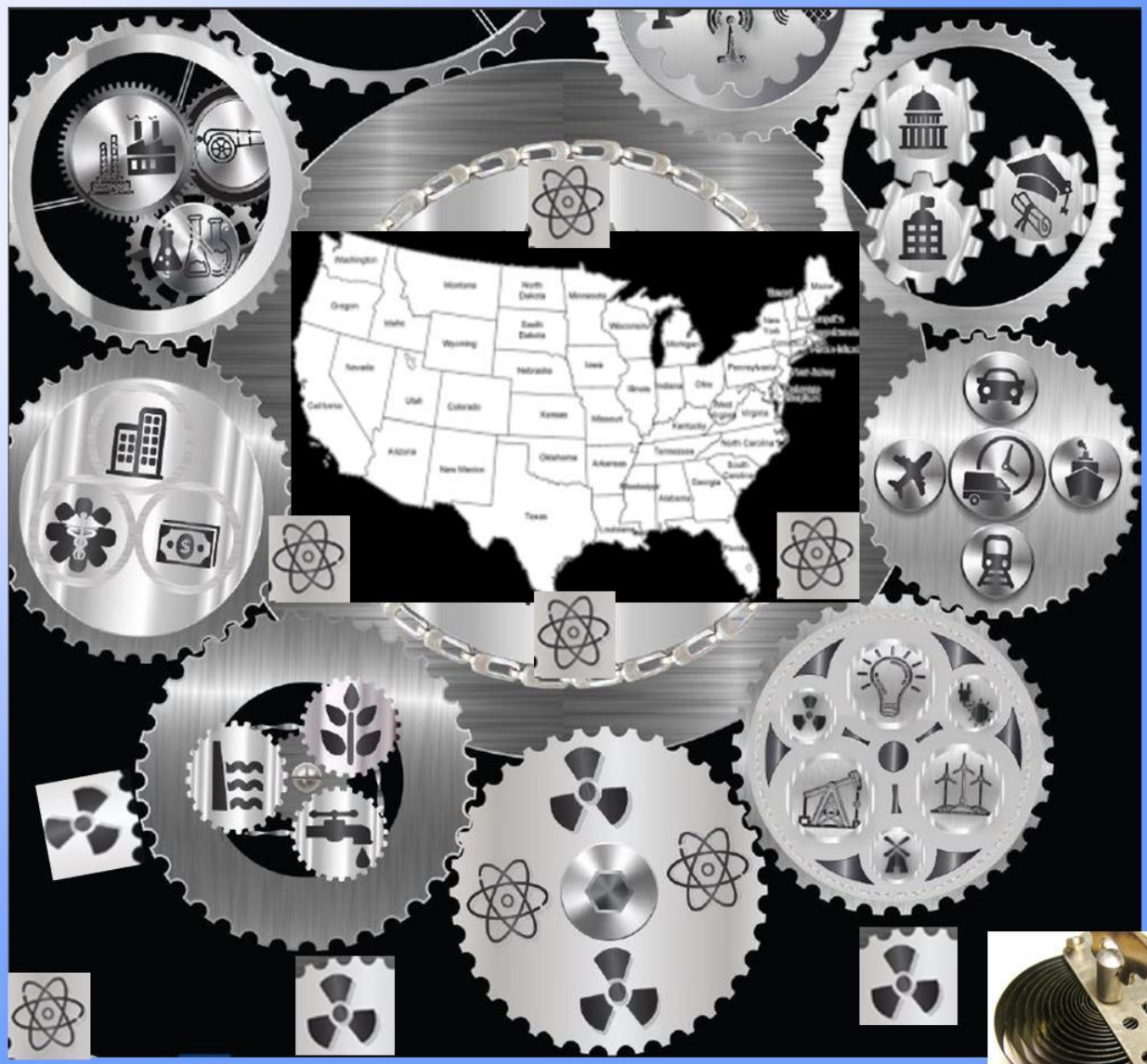


Radiation Protection in the USA

State and local governments are the 'main spring' for the clock works of national Radiation Protection Programs.

They make it happen - every day!

CRCPD members are there to protect the public, workers, patients, and environment.



CRCPD - A Partnership Dedicated to Radiation Protection

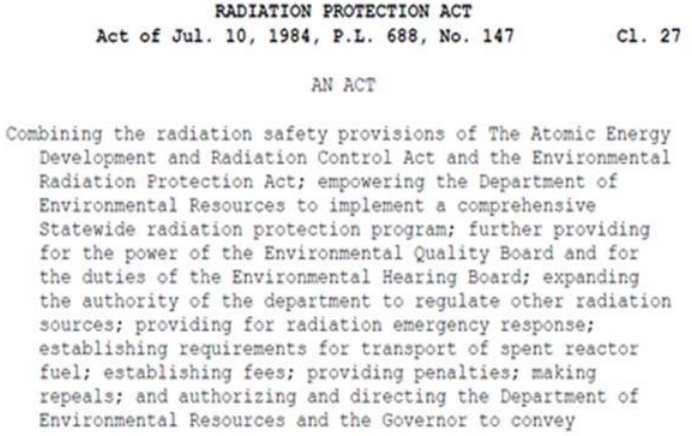
Penn. RP Statutes

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

- **Radiation Protection Act (Act 1984-147)**
- **Appalachian States LLRW Compact Act (Act 1985-120)**
- **LLRW Disposal Act (Act 1988-12)**
- **LLRW Disposal Regional Facility Act (Act 1990-107)**
- **Radon Certification Act (Act 1987-43)**

< *Post TMI Accident Update*

Note: the Commonwealth's Nuclear Power Plants are regulated by the U.S. Nuclear Regulatory Commission (NRC) under the Atomic Energy Act (AEA) and Code of Federal Regulations (CFR).



RADIATION PROTECTION ACT
Act of Jul. 10, 1984, P.L. 688, No. 147 Cl. 27

AN ACT

Combining the radiation safety provisions of The Atomic Energy Development and Radiation Control Act and the Environmental Radiation Protection Act; empowering the Department of Environmental Resources to implement a comprehensive Statewide radiation protection program; further providing for the power of the Environmental Quality Board and for the duties of the Environmental Hearing Board; expanding the authority of the department to regulate other radiation sources; providing for radiation emergency response; establishing requirements for transport of spent reactor fuel; establishing fees; providing penalties; making repeals; and authorizing and directing the Department of Environmental Resources and the Governor to convey

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

Example State Agency

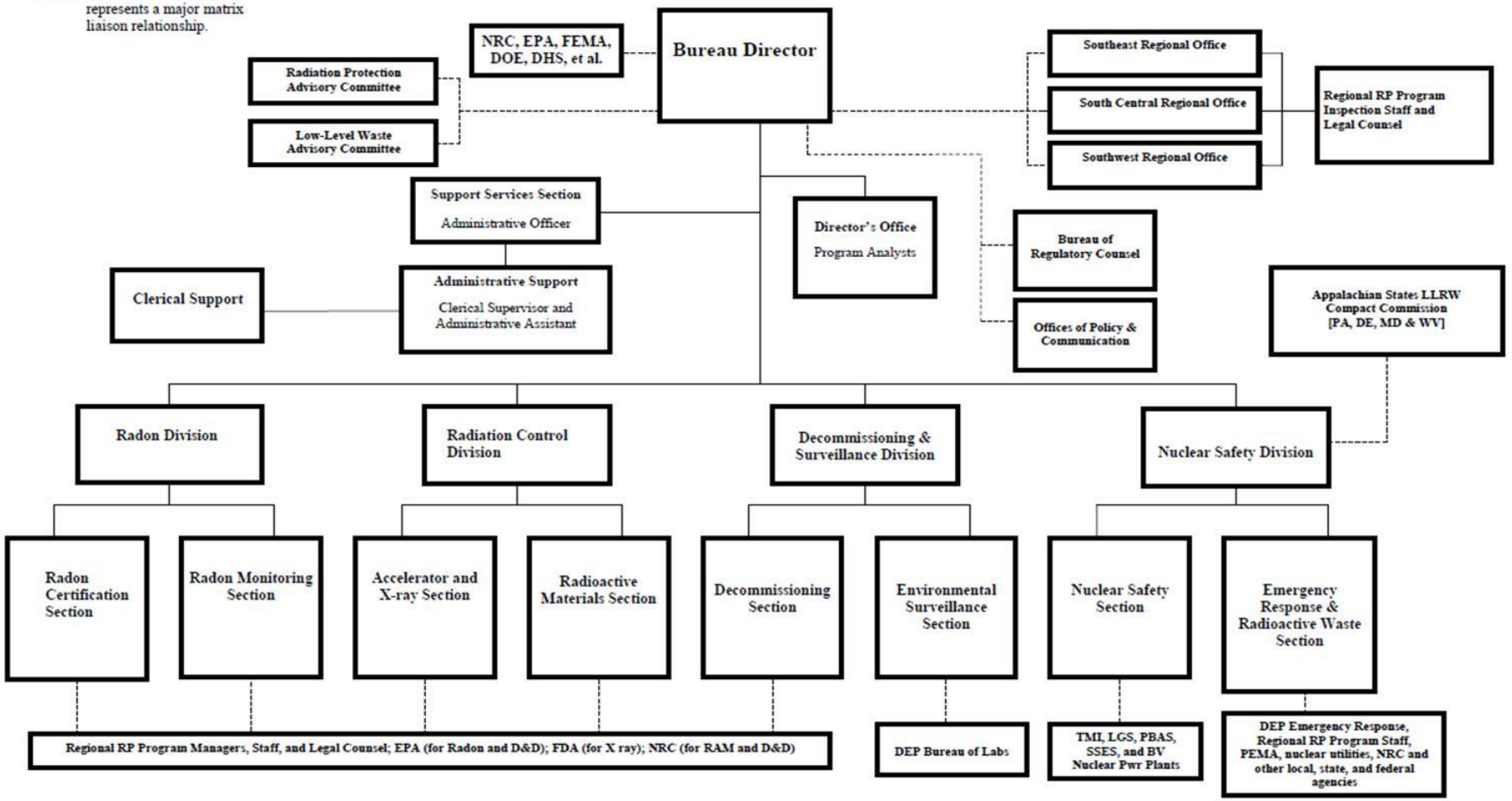
PA DEP BRP Functional Areas:

- Radioactive Materials (RAM),
- Decommissioning / Clean-up,
- Environmental Surveillance,
- X rays, Accelerators,
- Radon,
- Nuclear Safety, and
- Emergency Preparedness & Response

pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

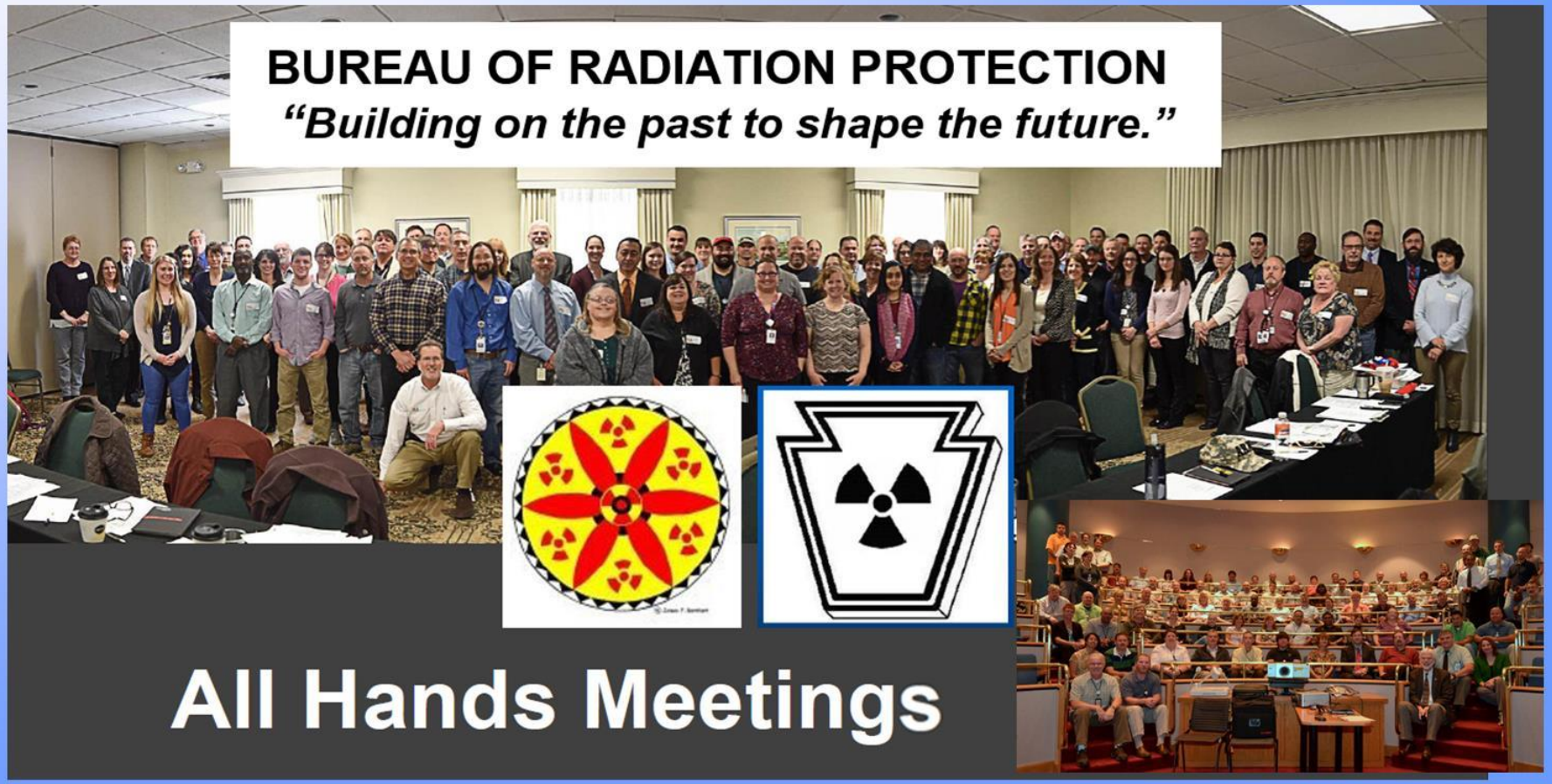
BRP

BUREAU RADIATION PROTECTION



pennsylvania
DEPARTMENT OF ENVIRONMENTAL PROTECTION

State Agencies…



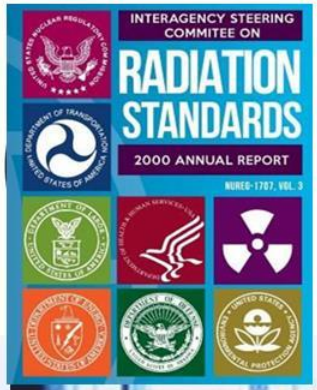
A wonderful place to work and learn!

Health Physics Functional Work Areas:

Government (federal and state),
Industrial and Academic
Radioactive Materials (RAM) users,
Decommissioning / Clean-up,
Environmental Surveillance,
Medical HP (X rays, Accelerators),
Radon Testing and Mitigation,
Power or Research Reactors, and
Emergency Preparedness & Response

https://hps.org/

RP Professional Associations & Involvement



Radiation Protection Partners

Federal Agencies

https://www.epa.gov/iscors

Scientific, Professional and other Organizations

AAPM

National Alliance for Radiation Readiness

Organization of Agreement States — A Partnership in Radioactive Material Regulation

HEALTH PHYSICS SOCIETY — FOUNDED 1956

AAHP

IAEA 60 Years — Atoms for Peace and Development 1957–2017

AARST

ASTRO — TARGETING CANCER CARE

astho 75 years 1942 - 2017

LLW FORUM

AMERICAN NUCLEAR SOCIETY

SNMMI

NCRP — SCIENTIFIC AUTHORITY SINCE 1928 • CONGRESSIONALLY CHARTERED

AMERICAN SOCIETY of RADIOLOGIC TECHNOLOGISTS

ACR AMERICAN COLLEGE OF RADIOLOGY — QUALITY IS OUR IMAGE

NEI

ANSI

ICRU

RADIATION RESEARCH SOCIETY

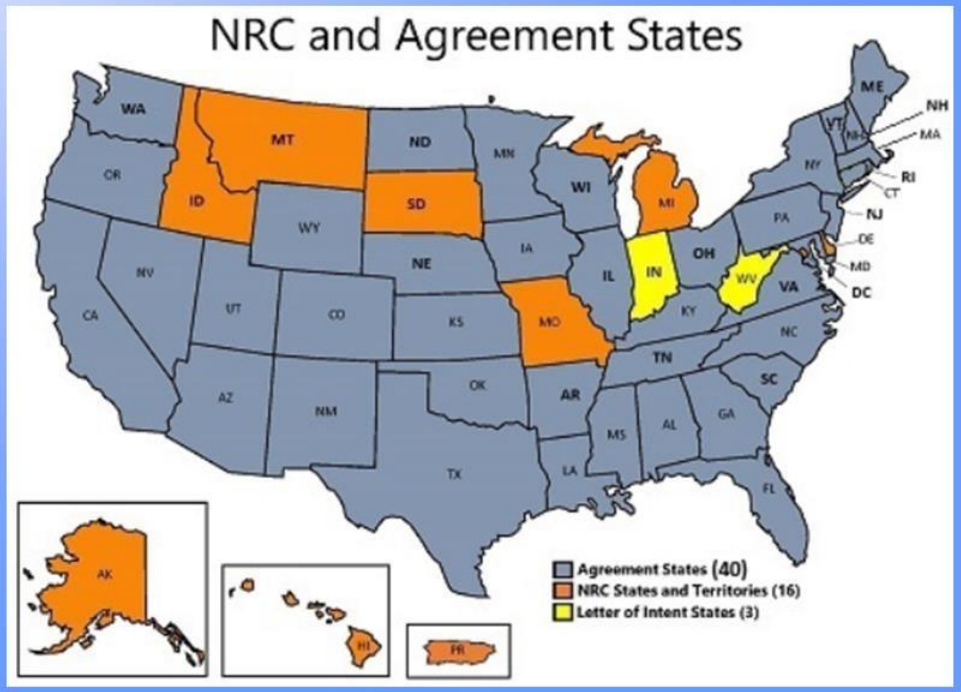
ICRP

US NRC & Agreement States

NRC AS and Non-AS Implement Most of the RP Requirements in the Country

- *Need Uniform Standards*
- *Comprehensive RP Regs*
- *Effective Rad. Control*
- *Practical to Implement*
- *Science Based*
- *Must Continue to Review*
- *Update as Needed*
- *Timely Revisions*

- *So, where are we?*



NRC 10CFR Part 20

§ 20.1101 Radiation protection programs.

(a) Each licensee shall develop, document, and implement a radiation protection program commensurate with the scope and extent of licensed activities and sufficient to ensure compliance with the provisions of this part. (See § 20.2102 for recordkeeping requirements relating to these programs.)

(b) The licensee shall use, to the extent practical, procedures and engineering controls based upon sound radiation protection principles to achieve occupational doses and doses to members of the public that are as low as is reasonably achievable (ALARA).

(c) The licensee shall periodically (at least annually) review the radiation protection program content and implementation.

(d) To implement the ALARA requirements of § 20.1101 (b), and notwithstanding the requirements in § 20.1301 of this part, a constraint on air emissions of radioactive material to the environment, excluding Radon-222 and its daughters, shall be established by licensees other than those subject to § 50.34a, such that the individual member of the public likely to receive the highest dose will not be expected to receive a total effective dose equivalent in excess of 10 mrem (0.1 mSv) per year from these emissions. If a licensee subject to this requirement exceeds this dose constraint, the licensee shall report the exceedance as provided in § 20.2203 and promptly take appropriate corrective action to ensure against recurrence.

NRC 10CFR Part 20

§ 20.1201 Occupational dose limits for adults.

(a) The licensee shall control the occupational dose to individual adults, except for planned special exposures under § 20.1206, to the following dose limits.

(1) An annual limit, which is the more limiting of—

(i) The total effective dose equivalent being equal to 5 rems (0.05 Sv); or

(ii) The sum of the deep-dose equivalent and the committed dose equivalent to any individual organ or tissue other than the lens of the eye being equal to 50 rems (0.5 Sv).

(2) The annual limits to the lens of the eye, to the skin of the whole body, and to the skin of the extremities, which are:

(i) A lens dose equivalent of 15 rems (0.15 Sv), and

(ii) A shallow-dose equivalent of 50 rem (0.5 Sv) to the skin of the whole body or to the skin of any extremity.

NRC 10CFR Part 20

§ 20.1301 Dose limits for individual members of the public.

(a) Each licensee shall conduct operations so that—

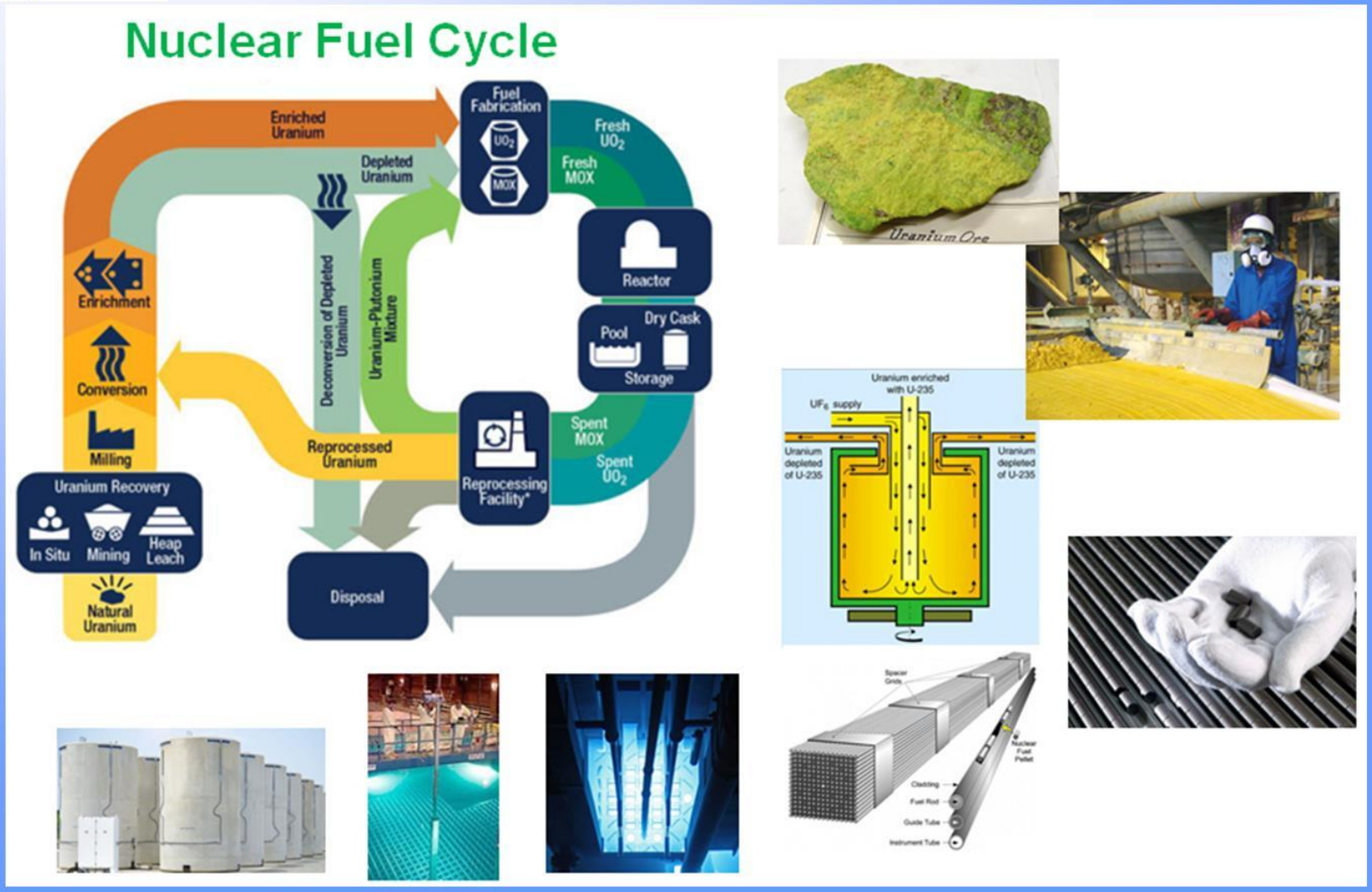
(1) The total effective dose equivalent to individual members of the public from the licensed operation does not exceed 0.1 rem (1 mSv) in a year, exclusive of the dose contributions from background radiation, from any medical administration the individual has received, from exposure to individuals administered radioactive material and released under § 35.75, from voluntary participation in medical research programs, and from the licensee's disposal of radioactive material into sanitary sewerage in accordance with § 20.2003, and

(2) The dose in any unrestricted area from external sources, exclusive of the dose contributions from patients administered radioactive material and released in accordance with § 35.75, does not exceed 0.002 rem (0.02 millisievert) in any one hour.

(b) If the licensee permits members of the public to have access to controlled areas, the limits for members of the public continue to apply to those individuals.

(c) Notwithstanding paragraph (a)(1) of this section, a licensee may permit visitors to an individual who cannot be released, under § 35.75, to receive a radiation dose greater than 0.1 rem (1 mSv) if—

NRC Licensing and Oversight



DOE 10 CFR Part 835

§ 835.1 Scope.

(a) *General.* The rules in this part establish radiation protection standards, limits, and program requirements for protecting individuals from ionizing radiation resulting from the conduct of DOE activities.

ALARA means "As Low As is Reasonably Achievable," which is the approach to radiation protection to manage and control exposures (both individual and collective) to the work force and to the general public to as low as is reasonable, taking into account social, technical, economic, practical, and public policy considerations. As used in this part, ALARA is not a dose limit but a process which has the objective of attaining doses as far below the applicable limits of this part as is reasonably achievable.

DOE 10 CFR Part 835

§ 835.101 Radiation protection programs.

(a) A DOE activity shall be conducted in compliance with a documented radiation protection program (RPP) as approved by the DOE.

(b) The DOE may direct or make modifications to a RPP.

(c) The content of each RPP shall be commensurate with the nature of the activities performed and shall include formal plans and measures for applying the as low as reasonably achievable (ALARA) process to occupational exposure.

(d) The RPP shall specify the existing and/or anticipated operational tasks that are intended to be within the scope of the RPP. Except as provided in § 835.101(h), any task outside the scope of a RPP shall not be initiated until an update of the RPP is approved by DOE.

(e) The content of the RPP shall address, but shall not necessarily be limited to, each requirement in this part.

DOE 10 CFR Part 835

§ 835.202 Occupational dose limits for general employees.

(a) Except for planned special exposures conducted consistent with § 835.204 and emergency exposures authorized in accordance with § 835.1302, the occupational dose received by general employees shall be controlled such that the following limits are not exceeded in a year:

(1) A total effective dose of 5 rems (0.05 Sv);

(2) The sum of the equivalent dose to the whole body for external exposures and the committed equivalent dose to any organ or tissue other than the skin or the lens of the eye of 50 rems (0.5 Sv);

(3) An equivalent dose to the lens of the eye of 15 rems (0.15 Sv); and

(4) The sum of the equivalent dose to the skin or to any extremity for external exposures and the committed equivalent dose to the skin or to any extremity of 50 rems (0.5 Sv).

(b) All occupational doses received during the current year, except doses resulting from planned special exposures conducted in compliance with § 835.204 and emergency exposures authorized in accordance with § 835.1302, shall be included when demonstrating compliance with §§ 835.202(a) and 835.207.

(c) Doses from background, therapeutic and diagnostic medical radiation, and participation as a subject in medical research programs shall not be included in dose records or in the assessment of compliance with the occupational dose limits.

Federal Government

Accelerators, National Labs & Cleanup Sites

Argonne NATIONAL LABORATORY

Brookhaven National Laboratory

Los Alamos NATIONAL LABORATORY

Hanford Site

Lawrence Livermore National Laboratory

INL Idaho National Laboratory

Savannah River Site

Pacific Northwest NATIONAL LABORATORY

OAK RIDGE National Laboratory

Office of Science Laboratories

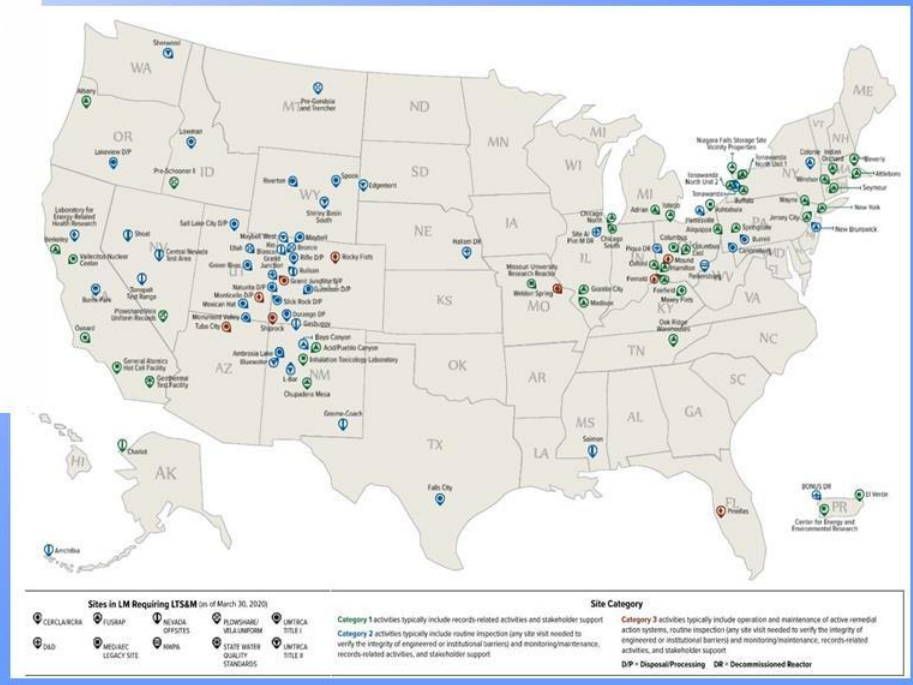
1. Ames Laboratory
   Ames, Iowa
2. Argonne National Laboratory
   Argonne, Illinois
3. Brookhaven National Laboratory
   Upton, New York
4. Fermi National Accelerator Laboratory
   Batavia, Illinois
5. Lawrence Berkeley National Laboratory
   Berkeley, California
6. Oak Ridge National Laboratory
   Oak Ridge, Tennessee
7. Pacific Northwest National Laboratory
   Richland, Washington
8. Princeton Plasma Physics Laboratory
   Princeton, New Jersey
9. SLAC National Accelerator Laboratory
   Menlo Park, California
10. Thomas Jefferson National Accelerator Facility
    Newport News, Virginia

Other DOE Laboratories

1. Idaho National Laboratory
   Idaho Falls, Idaho
2. National Energy Technology Laboratory
   Morgantown, West Virginia
   Pittsburgh, Pennsylvania
   Albany, Oregon
3. National Renewable Energy Laboratory
   Golden, Colorado
4. Savannah River National Laboratory
   Aiken, South Carolina

NNSA Laboratories

1. Lawrence Livermore National Laboratory
   Livermore, California
2. Los Alamos National Laboratory
   Los Alamos, New Mexico
3. Sandia National Laboratory
   Albuquerque, New Mexico
   Livermore, California



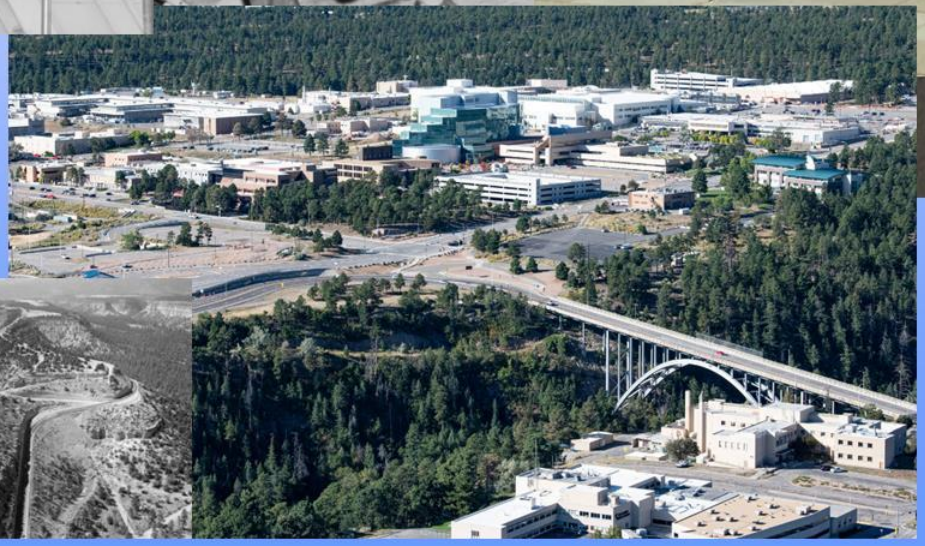
SLAC

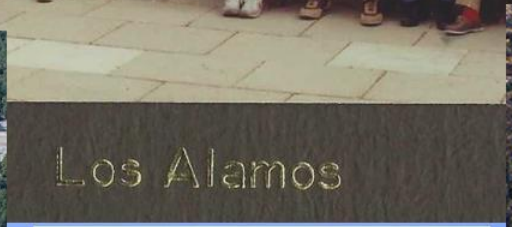
Fermilab

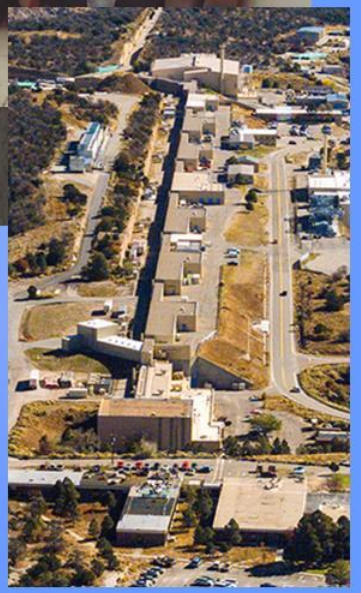
BERKELEY LAB
Bringing Science Solutions to the World

Jefferson Lab
Exploring the Nature of Matter

Los Alamos - Tiger Team

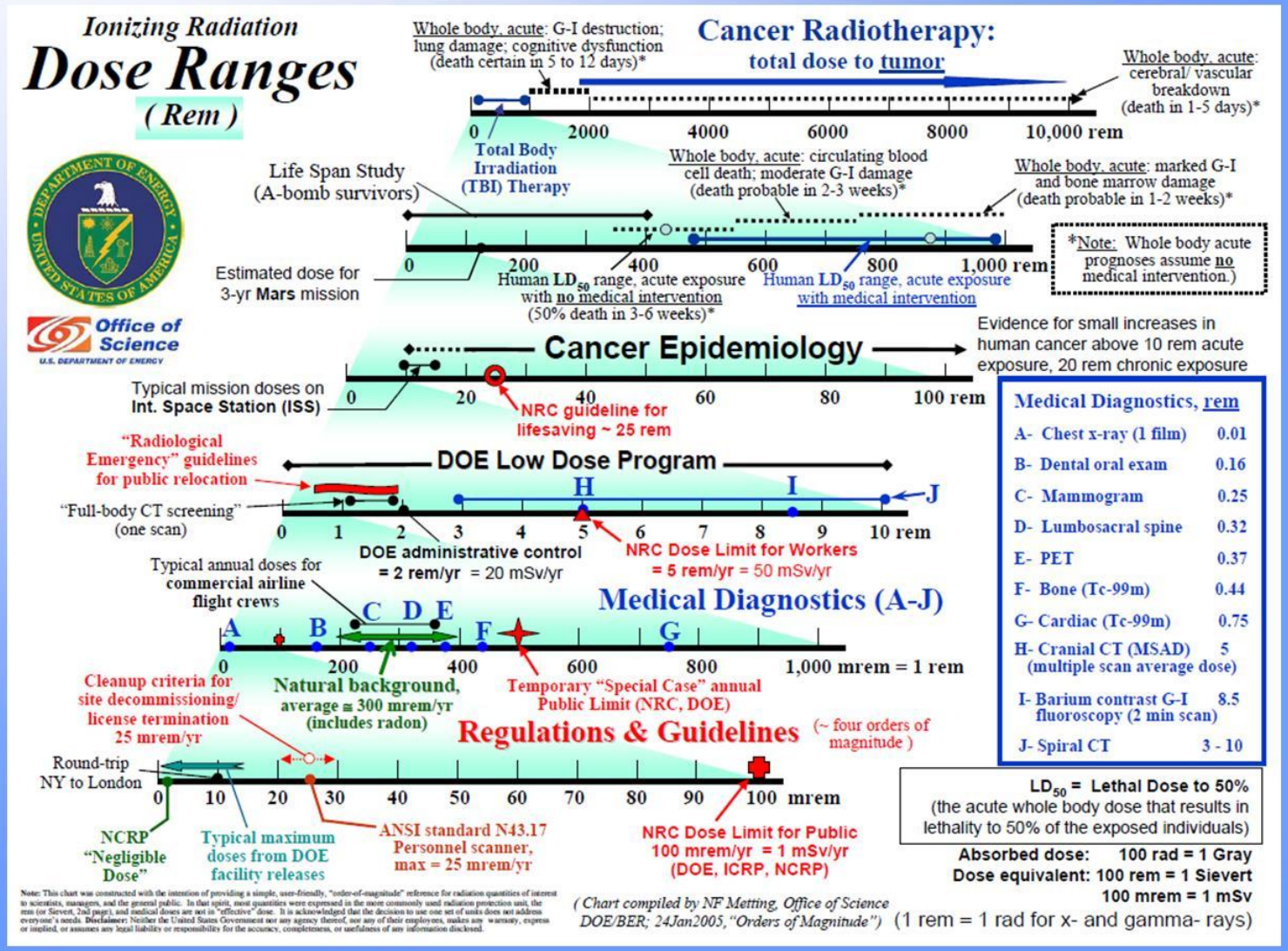






Range of Radiation Exposure

From background to radiation therapy…



Radiation Dose Limits

Public 100 mrem/yr; 500 mrem/yr;

25 mrem/yr any one source; 4 mrem/yr drinking water

Worker 5,000 mrem/yr whole body

15,000 mrem/yr lens of eye

50,000 mrem/yr skin / extremity / organ

Worker's embryo / fetus 500 mrem; and less than

50 mrem/month

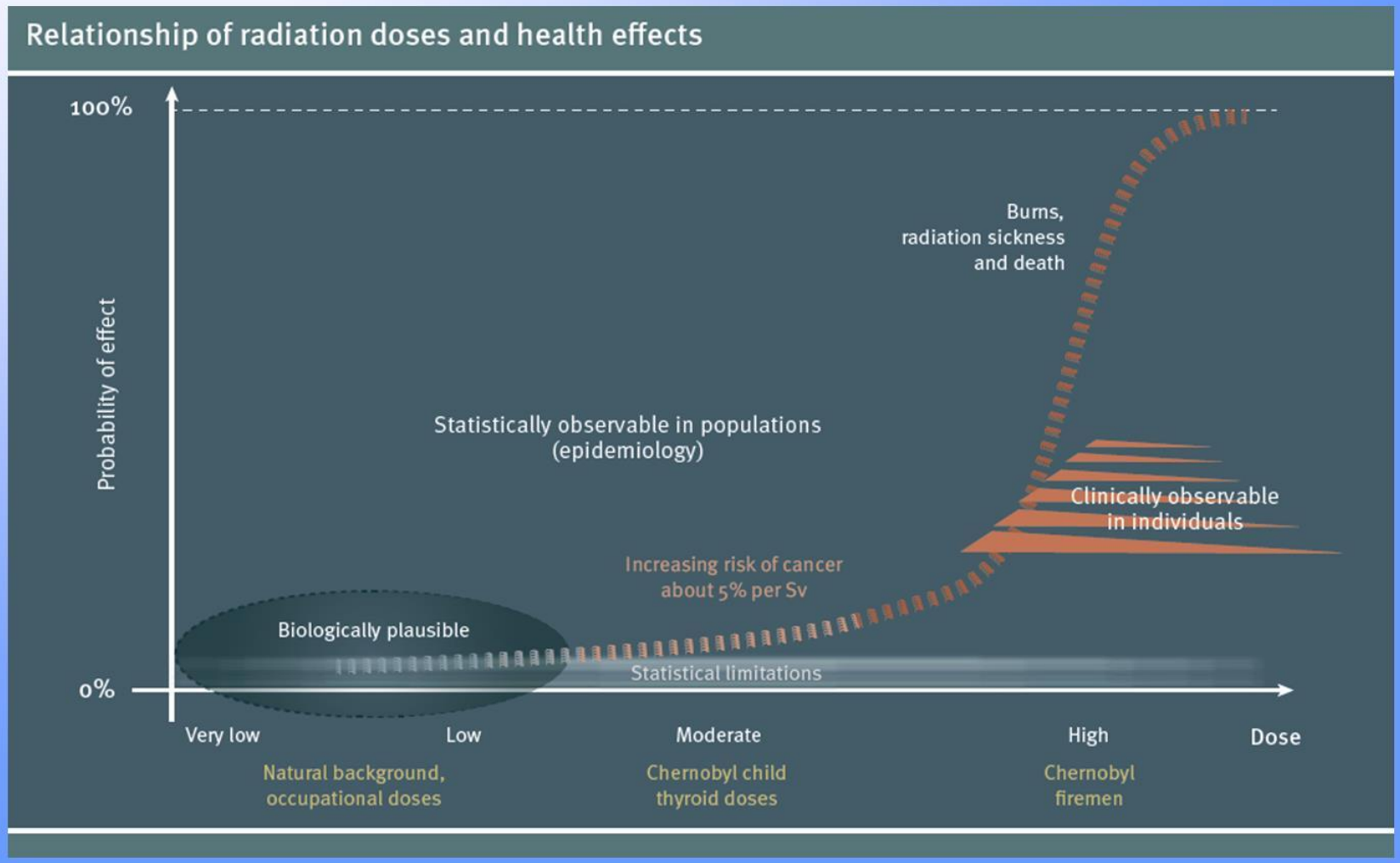
Patients few dose limits; 300 mrad mammography

FEMA

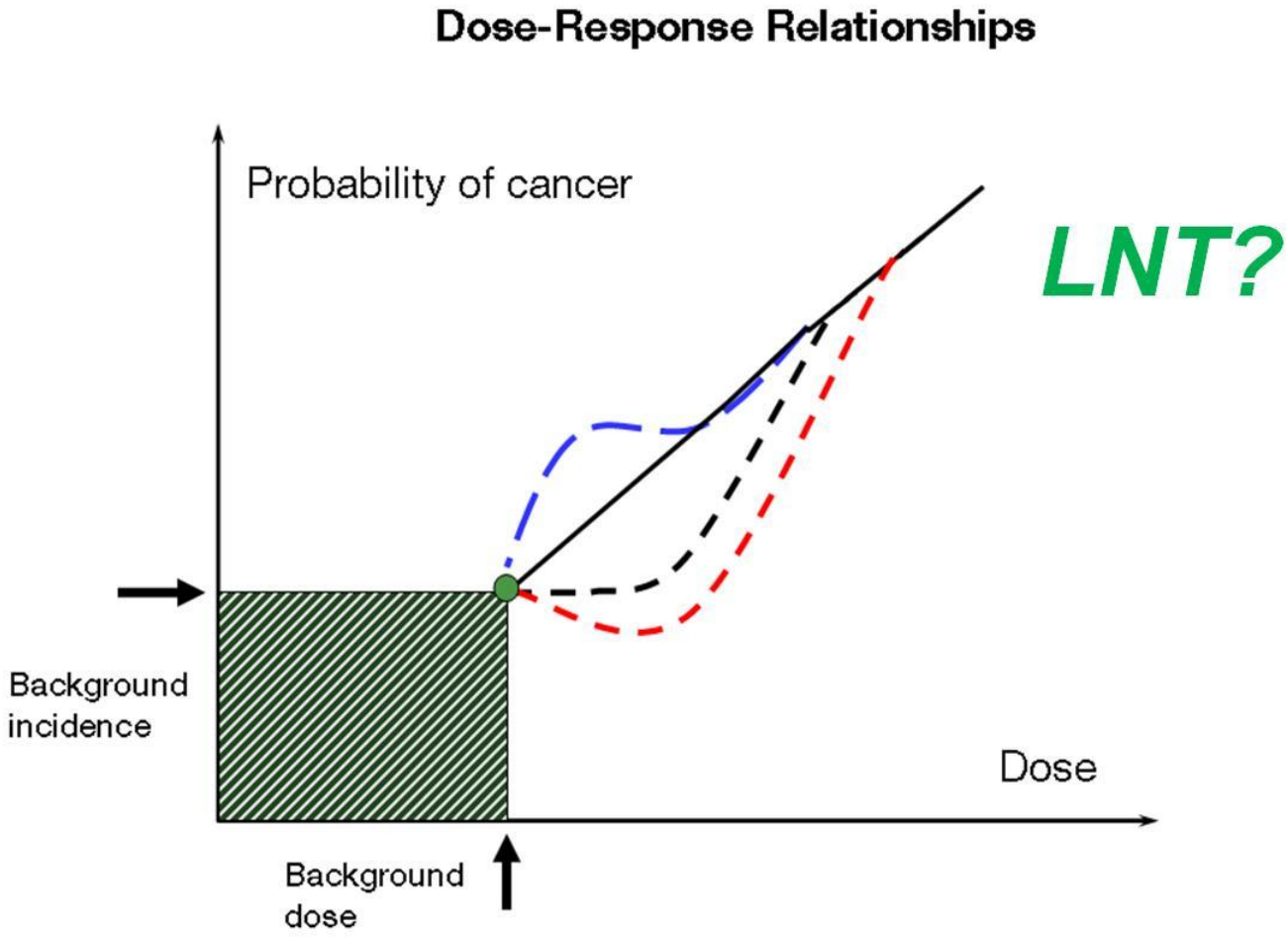
*** **Emergency Workers** *** 5-25 rem (>25 rem, if planned for life saving or protection of major property or key infrastructure)

Linear Non-threshold (LNT) Model

Figure on page 25 in the UNEP – UNSCEAR Publication "Relationship of Radiation Doses and Effects."



Dose, Dose Rate & Bio Effects



See NCRP Report No. 136 (2001) for a detailed description of the contrasting types of dose-response relationships.

Factors That Impact Bio Effects

- Genetics
- Tissue Type
- Cell Turn-over Rate
- Total Dose
- Dose Rate
- LET of Radiation
- Species
- Age
- Sex

RP Professionals Need a Uniform and Practical RP System to Implement…

UNSCEAR

From the plain language UN Publication "Radiation: Effects and Sources"

Section 2.3 on the "Relationship of Radiation Doses and Effects" - "When summarizing the relationship between radiation doses and health effects, UNSCEAR has stressed the importance of distinguishing between observations of existing health effects in exposed populations, and theoretical projections of possible future effects…

Where the level of radiation exposure was low or very low - more typical of environmental and occupational radiation exposure - changes in the occurrence of delayed health effects have not been confirmed, given the statistical and other uncertainties. Nevertheless, such effects cannot be ruled out."

See - http://www.unscear.org/unscear/en/publications/booklet.html

UNSCEAR

From: Report of the United Nations Scientific Committee on the Effects of Atomic Radiation (2010)

On page 10, paragraph 31 states: "This type of complex DNA damage is difficult to repair correctly, and even at low doses of radiation it is likely that there is a very small but non-zero chance of the production of DNA mutations that increase the risk of cancer developing. Thus, the current balance of available evidence tends to favor a non-threshold response for the mutational component of radiation-associated cancer induction at low doses and low dose rates."

See - http://www.unscear.org/docs/reports/2010/UNSCEAR_2010_Report_M.pdf

NAS BEIR VII Report

From the conclusion of the BEIR VII report summary for cancer risk estimates at very low doses: "At doses of 100 mSv (10 rem) or less, statistical limitations make it difficult to evaluate cancer risk in humans. A comprehensive review of available biological and biophysical data led the committee to conclude that the risk would continue in a linear fashion at lower doses without a threshold and that the smallest dose has the potential to cause a small increase in risk to humans…

The report concludes that the preponderance of information indicates that there will be some risk, even at low doses, although the risk is small."

See – https://www.nap.edu/resource/11340/beir_vii_final.pdf

ICRP

From Low-dose Extrapolation of Radiation-related Cancer Risk ICRP Publication 99, Annals ICRP 35 (4), 2005.

This report considers the evidence relating to cancer risk associated with exposure to low doses of low linear energy transfer radiation, and particularly doses below current recommended limits for protection of radiation workers and the general public. The focus is on evidence regarding linearity of the dose–response relationship for all cancers considered as a group, but not necessarily individually, at low doses [the so-called linear, non-threshold (LNT) hypothesis]. It looks at the possibility of establishing a universal threshold dose below which there is no risk of radiation-related cancer.

Although cells have a vast array of damage response mechanisms, these mechanisms are not foolproof, and it is clear that damaged or altered cells are capable of escaping these pathways and propagating... Current understanding of mechanisms and quantitative data on dose and time-dose relationships support the LNT hypothesis.

See - http://www.icrp.org/publication.asp?id=ICRP%20Publication%2099

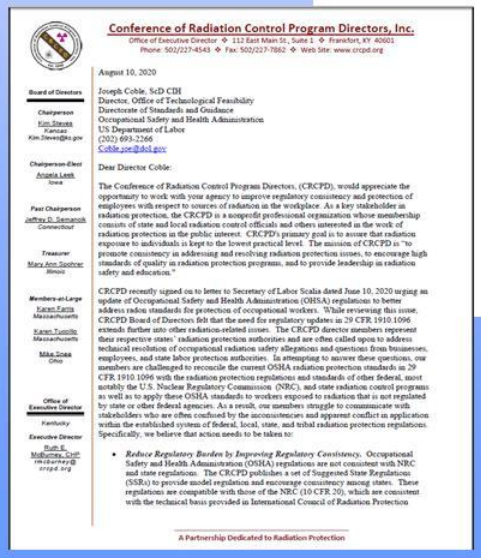
Radiation Regulatory Jigsaw Puzzle

*** External Radiation ***

ICRP: 20 mSv/a [Pub. No. 103] (2 rem/yr)

NRC: 50 mSv/a [10CFR20] (5 rem/yr)

OSHA: up to 120 mSv/a [29CFR1910.1096] (12 rem/yr)



Conference of Radiation Control Program Directors, Inc.

Office of Executive Director ❖ 112 East Main St., Suite 1 ❖ Frankfort, KY 40601
Phone: 502/227-4543 ❖ Fax: 502/227-7862 ❖ Web Site: www.crcpd.org

August 10, 2020

Joseph Coble, ScD CIH
Director, Office of Technological Feasibility
Directorate of Standards and Guidance
Occupational Safety and Health Administration
US Department of Labor
(202) 693-2266
Coble.joe@dol.gov

Dear Director Coble:

The Conference of Radiation Control Program Directors, (CRCPD), would appreciate the opportunity to work with your agency to improve regulatory consistency and protection of employees with respect to sources of radiation in the workplace. As a key stakeholder in radiation protection, the CRCPD is a nonprofit professional organization whose membership consists of state and local radiation control officials and others interested in the work of radiation protection in the public interest. CRCPD's primary goal is to assure that radiation exposure to individuals is kept to the lowest practical level. The mission of CRCPD is "to promote consistency in addressing and resolving radiation protection issues, to encourage high standards of quality in radiation protection programs, and to provide leadership in radiation safety and education."

CRCPD recently signed on to letter to Secretary of Labor Scalia dated June 10, 2020 urging an update of Occupational Safety and Health Administration (OHSA) regulations to better address radon standards for protection of occupational workers. While reviewing this issue, CRCPD Board of Directors felt that the need for regulatory updates in 29 CFR 1910.1096 extends further into other radiation-related issues. The CRCPD director members represent three respective states' radiation protection authorities and are often called upon to address technical resolution of occupational radiation safety allegations and questions from businesses, employees, and state labor protection authorities. In attempting to answer these questions, our members are challenged to reconcile the current OSHA radiation protection standards in 29 CFR 1910.1096 with the radiation protection regulations and standards of other federal, most notably the U.S. Nuclear Regulatory Commission (NRC), and state radiation control programs as well as to apply these OSHA standards to workers exposed to radiation that is not regulated by state or other federal agencies. As a result, our members struggle to communicate with stakeholders who are often confused by the inconsistencies and apparent conflict in application within the established systems of federal, local, state, and tribal radiation protection regulations. Specifically, we believe that action needs to be taken to:

- *Reduce Regulatory Burden by Improving Regulatory Consistency.* Occupational Safety and Health Administration (OSHA) regulations are not consistent with NRC and state regulations. The CRCPD publishes a set of Suggested State Regulations (SSRs) to provide model regulation and encourage consistency among states. These regulations are compatible with those of the NRC (10 CFR 20), which are consistent with the technical basis provided in International Council of Radiation Protection

A Partnership Dedicated to Radiation Protection

> *OSHA FRN RFI May 3, 2005*

> *2020 CRCPD Letters to OSHA regarding outdated regulations*

www.ecfr.gov

eCFR – Code of Federal Regulations

Need Uniform National Radiation Protection Regulations

Specifically – NRC, States, DOE, DOT, EPA, OSHA and Other Agencies

Other related issue:

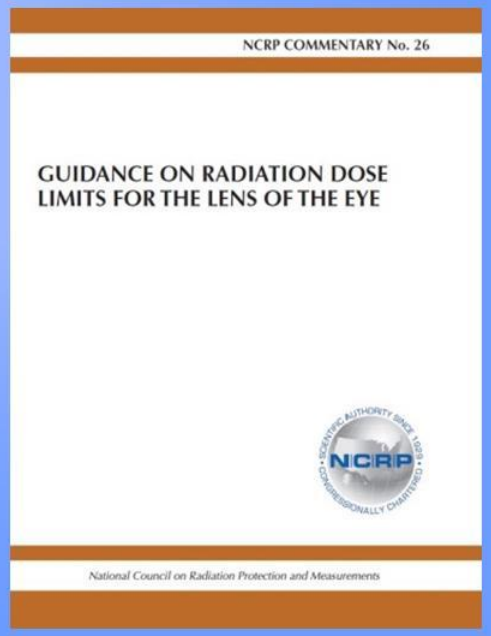
New Lens of the Eye Dose Limit in 10CFR20?

15 rem/yr (0.15 Sv/a)

vs.

5 rad/yr (50 mGy/a)

NCRP Com. No. 26



www.ecfr.gov

eCFR – Code of Federal Regulations

Need Uniform National Radiation Protection Regulations

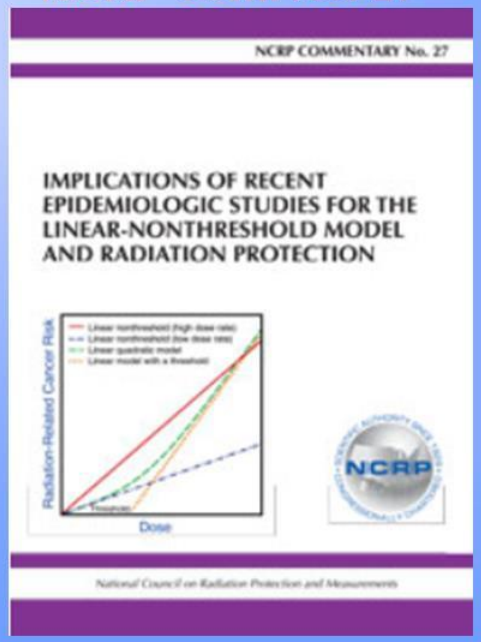
And – should NRC, States, et al. Continue to use LNT?

Fundamental issue:

Linear No-Threshold (LNT) Model for Radiation Protection?

Note: 2/3 of recent epi studies support LNT.

NCRP Com. No. 27



NRC Petition

Federal Register
Vol. 80, No. 120
Tuesday, June 23, 2015

NUCLEAR REGULATORY COMMISSION

10 CFR Part 20

[Docket Nos. PRM–20–28, PRM–20–29, and PRM–20–30; NRC–2015–0057]

Linear No-Threshold Model and Standards for Protection Against Radiation

AGENCY: Nuclear Regulatory Commission.

ACTION: Petition for rulemaking; notice of docketing and request for comment.

SUMMARY: The U.S. Nuclear Regulatory Commission (NRC) has received three petitions for rulemaking (PRM) requesting that the NRC amend its "Standards for Protection Against Radiation" regulations and change the basis of those regulations from the Linear No-Threshold (LNT) model of radiation protection to the radiation hormesis model. The radiation hormesis model provides that exposure of the human body to low levels of ionizing radiation is beneficial and protects the human body against deleterious effects of high levels of radiation. Whereas, the LNT model provides that radiation is always considered harmful, there is no safety threshold, and biological damage caused by ionizing radiation (essentially the cancer risk) is directly proportional to the amount of radiation exposure to the human body (response linearity).

LNT Petitions Submitted to NRC in 2015

Proposed Rules

Federal Register
Vol. 86, No. 156
Tuesday, August 17, 2021

NUCLEAR REGULATORY COMMISSION

10 CFR Part 20

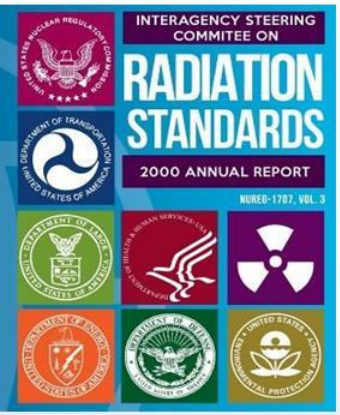
[Docket No. PRM–20–28, PRM–20–29, and PRM–20–30; NRC–2015–0057]

Linear No-Threshold Model and Standards for Protection Against Radiation

AGENCY: Nuclear Regulatory Commission.

ACTION: Petition for rulemaking; denial.

The NRC docketed these petitions on February 20, 2015, February 27, 2015, and March 16, 2015, and assigned them Docket Numbers PRM–20–28, PRM–20–29, and PRM–20–30, respectively. The NRC is denying the three petitions because they fail to present an adequate basis supporting the request to discontinue use of the LNT model. The NRC has determined that the LNT model continues to provide a sound regulatory basis for minimizing the risk of unnecessary radiation exposure to both members of the public and radiation workers. Therefore, the NRC will maintain the current dose limit requirements contained in its regulations.



ISCORS and NCRP

Available to Support Federal Agencies…

National Council on Radiation Protection and Measurements

The EO 14300, Section 5(b) Regarding the LNT Model and ALARA…

Look for NRC proposed regs in late April 2026!

Federal Register / Vol. 90, No. 102 / Thursday, May 29, 2025 / Presidential Documents 22587

Executive Order 14300 of May 23, 2025

Sec. 5. *Reforming and Modernizing the NRC's Regulations*. The NRC, working with its DOGE Team, the Office of Management and Budget, and other executive departments and agencies as appropriate, shall undertake a review and wholesale revision of its regulations and guidance documents, and issue notice(s) of proposed rulemaking effecting this revision within 9 months of the date of this order. The NRC shall issue final rules and guidance to conclude this revision process within 18 months of the date of this order. In conducting this wholesale revision, the NRC shall be guided by the policies set forth in section 2 of this order and shall in particular:

The EO 14300, Section 5(b) Regarding the LNT Model and ALARA…

Look for NRC proposed regs in late April 2026!

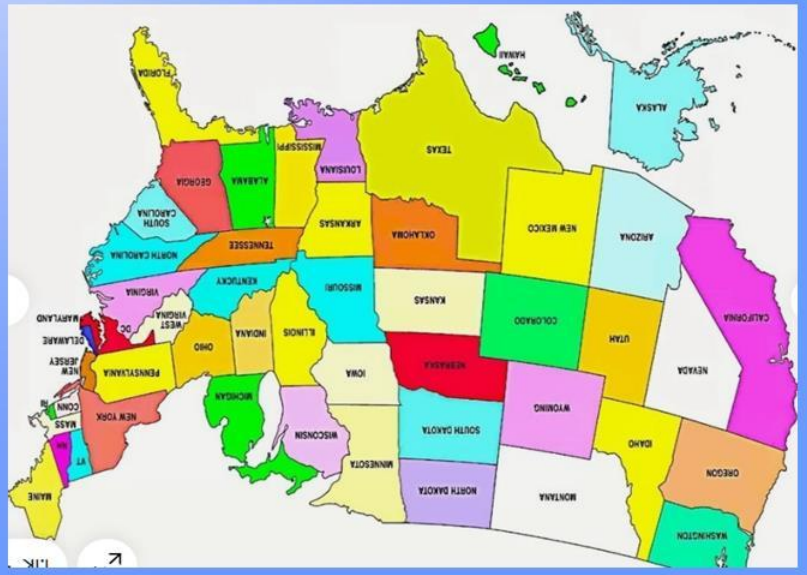
(b) Adopt science-based radiation limits. In particular, the NRC shall reconsider reliance on the linear no-threshold (LNT) model for radiation exposure and the "as low as reasonably achievable" standard, which is predicated on LNT. Those models are flawed, as discussed in section 1 of this order. In reconsidering those limits, the NRC shall specifically consider adopting determinate radiation limits, and in doing so shall consult with the Department of Defense (DOD), the Department of Energy (DOE), and the Environmental Protection Agency.

A Regulatory RP System without the LNT Model and ALARA…

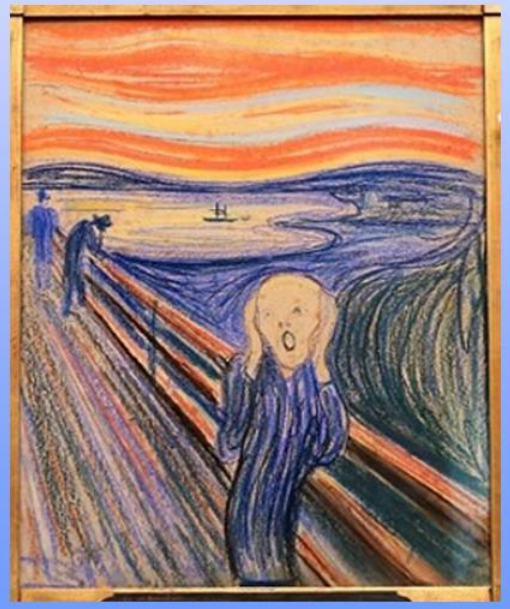
What will the NRC do?

Be truly independent?

Or, turn the RP System and regs upside down?



A Regulatory RP System without the LNT Model and ALARA…

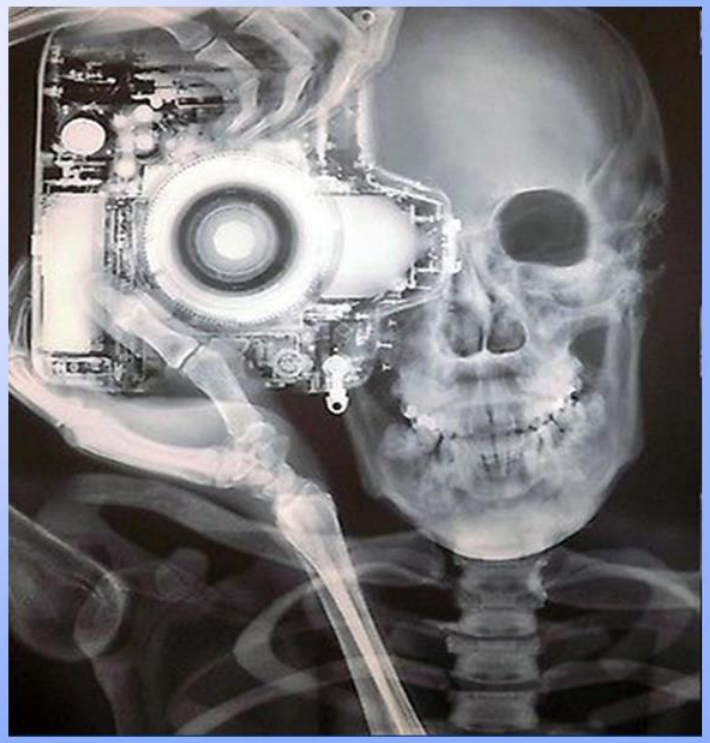


What would that look like?

It wouldn't be pretty!

Thus, we need uniform and practical RP Standards!

Thank you… questions?



David J. Allard, CHP

Email: allradcon@comcast.net