Radiation

Presented to the Portsmouth Site Specific Advisory Board

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Agenda

1. RADIATION BASICS
2. BACKGROUND RADIATION
3. EXPOSURE
4. PORTSMOUTH COMPARISONS
5. RADIATION SAFETY

Radiation Basics

Radiation is energy (particles or rays) emitted from the nucleus of unstable atoms.

Radioactive atoms are unstable atoms that release excess energy (radiation) in order to become stable.

Radioactive Material is any material that contains radioactive atoms (unstable atoms that emit radiation.)

Radiation Basics

NON-IONIZING RADIATION

Electromagnetic radiation that does not carry enough energy to remove an electron from an atom (i.e., microwaves, radio waves, visible light, etc.).

IONIZING RADIATION TYPES

- Alpha
- Beta
- Gamma
- Neutrons

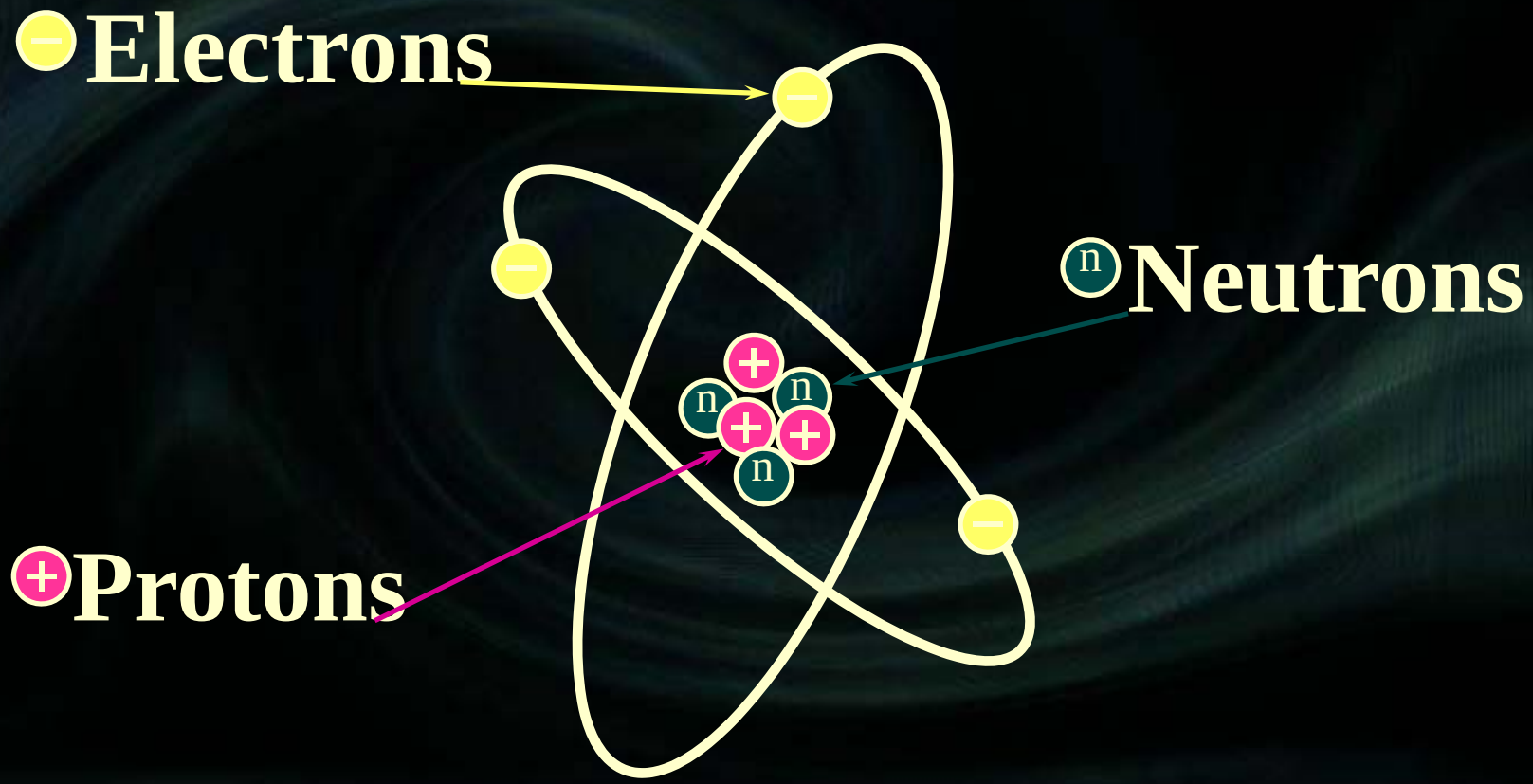
Radiation Basics

ATOMS

An atom is the smallest part of an element that still retains the chemical properties of the element.

Radiation Basics

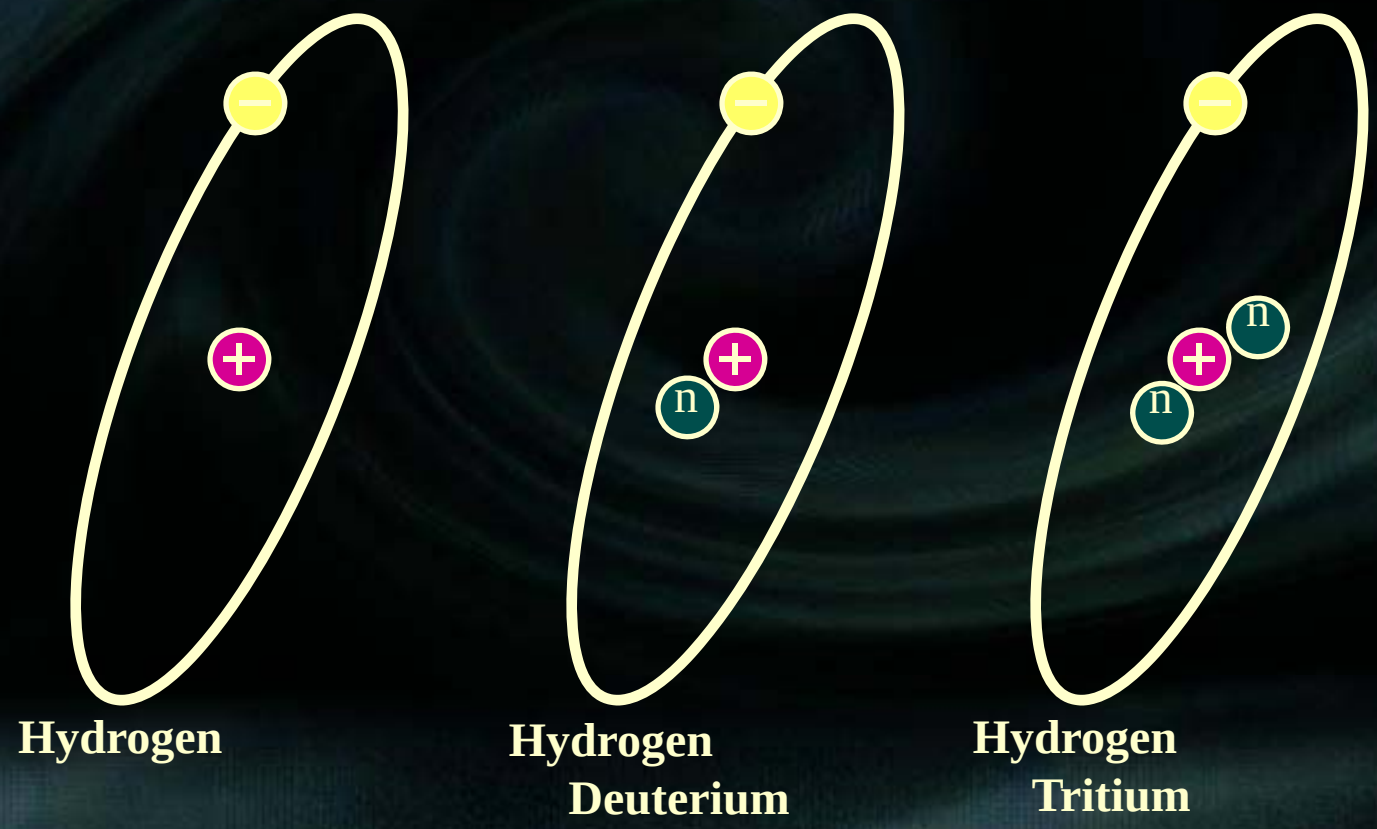
ATOMS



Radiation Basics

ISOTOPES

Atoms of the same element that have different numbers of neutrons are called isotopes.



Hydrogen

Hydrogen
Deuterium

Hydrogen
Tritium

Radiation Basics

MEASURING RADIATION

- Roentgen: A unit for measuring exposure in air only for gamma rays or X-rays.
- Radiation Absorbed Dose (RAD): A dose absorbed in any material.
- Roentgen Equivalent Man (REM): Correlates RAD to dose equivalence as it relates to biological damage.
- Millirem: 1,000 Millirem = 1 REM.

Exposure

Background radiation is present in our lives every day, including various natural sources:

- Cosmic
- Earth's crust
- Internal/human body
- Radon

Man-made radiation includes:

- Medical sources (i.e., x-rays, nuclear medicine)
- Consumer products (i.e., smoke detectors, lantern mantels, tobacco products)
- Other sources (i.e., fallout from nuclear weapons testing)

Exposure

Other common sources for radiation exposure include:

- Air Travel
- Domestic Water Supply
- Building Materials

Exposure

- The average annual dose to the general population from background and man-made sources is about *620 Millirem*.
- The accepted level for safe workplace exposure to radiation is 5 REM (5,000 Millirem) per year.
- The highest annual dose for any Portsmouth worker in 2009 (the most recent statistical data) was 158 Millirem.
- The average dose received by Portsmouth workers in 2009 was 1.3 Millirem.

Exposure

COMMON EXPOSURES

- One Banana - .007 Millirem
- One Enchilada - .03 Millirem
- Annual Dose from Dentures - .07 Millirem
- Annual Dose from Wearing Glass Lenses - .4 Millirem
- One Day Visit in Denver – 1 Millirem
- Atlanta to Los Angeles Airline Flight – 2 Millirem
- Chest X-Ray – 8 Millirem
- Annual Dose from Masonry Home – 13 Millirem

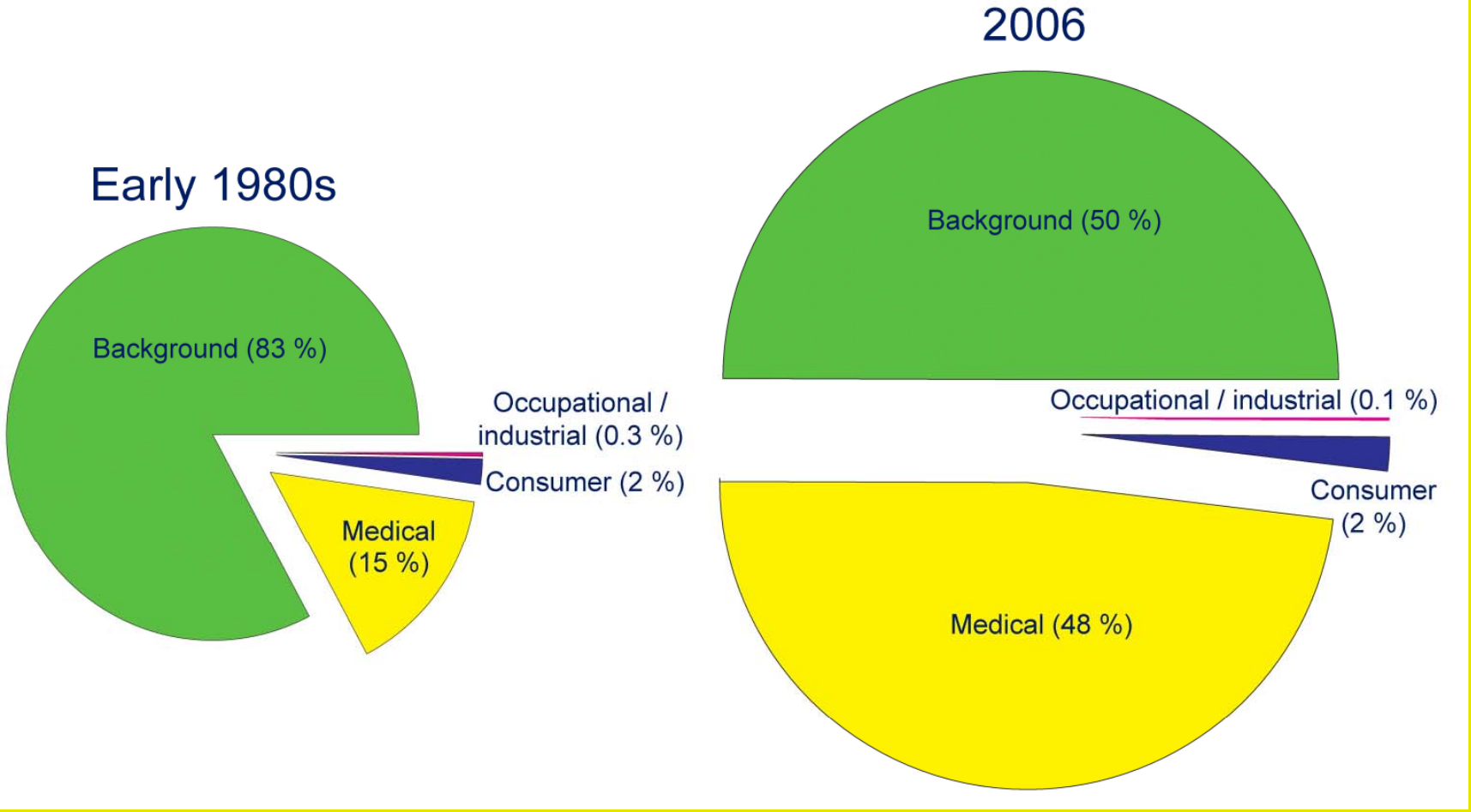
Exposure

NATURAL BACKGROUND RADIATION

Radiation Category	Annual Radiation Dose (NCRP 160)
Background	311 mrem
Medical	300 mrem
Consumer Products	1.3 mrem
Industrial Products, Security, Educational and research	0.3 mrem
Occupational	0.5 mrem
Total Annual dose from natural background radiation (rounded)	620 mrem

Exposure

DOSE DISTRIBUTION



Radiation Safety

RADIOLOGICAL CONTROLS

- Radiological controls are established to protect individuals from unplanned or uncontrolled exposures to radiation and from ingestion, inhalation, or absorption of radioactive material.
- These controls include, but are not limited to, a unique system for identifying radioactive materials.
- This system includes the use of certain colors and/or symbols and radiological postings, implementation of controls to maintain radiation exposures As Low As Reasonably Achievable (ALARA), and training on radiation safety and emergency responses.

Radiation Safety

RADIOLOGICAL AREAS

- Radiography Areas
- Radioactive Material Areas
- Underground Radioactive Material Areas
- Fixed Contamination Areas
- Soil Contamination Areas
- Contamination Areas
- High Contamination Areas
- Airborne Radioactivity Areas

Radiation Safety

RADIATION DOSE CONTROL LEVEL

- As outlined in 10 Code of Federal Regulations (CFR) 835, *Occupational Radiation Protection*, the regulatory control level for the general employee (non-radiological worker) or visitor to the site from occupational exposures is 100 mrem/year.

Radiation Safety

DOE ALARA CONCEPT

- Exposures below regulatory limits
- No exposure without benefit

Radiation Safety

ALARA RESPONSIBILITIES

Management

- Create and support review and approval committees
- Investigate unusual exposure events
- Review personnel exposure data for workload plans
- Provide tools, equipment and other materials
- Establish training requirements
- Encourage ALARA suggestions to reduce exposures

Radiation Safety

RADIOLOGICAL CONTROL ORGANIZATION (RCO)

Health Physics

- Implementing ALARA program
- Provide radiological information
- Specify protective measures
- Provide an interface point
- Maintain and provide records of exposure
- Maintain calibrated instrumentation
- Evaluate need for temporary shielding

Radiation Safety

MONITORING (DOSIMETRY)

- Radiation cannot be detected with the human senses, therefore special detection devices must be used. Monitoring is required only if you are likely to receive a dose in excess of 100 mrem/year or if an area is posted “TLD required for entry.”
- A TLD (thermoluminescent dosimeter) is a device that measures radiation by the amount of visible light from a heated crystal.

Radiation Safety

RADWORKER ESCORT

- If someone requires access to a radiologically restricted area, they may enter the area with an escort.
- Escorting must be approved by the RADCON Manager before entry.
- Radworker escorts must be current on Radiation Worker training. A General Employee Training does not qualify a worker to be a “Radworker Escort.”