Problems with Pelleting (BWXT Peterborough)

A Slide Show

Prepared for C.A.R.N.
Citizen Against Radioactive Neighbourhoods
Peterborough, Ontario
December 3, 2019

by Gordon Edwards, Ph.D., President,
Canadian Coalition for Nuclear Responsibility

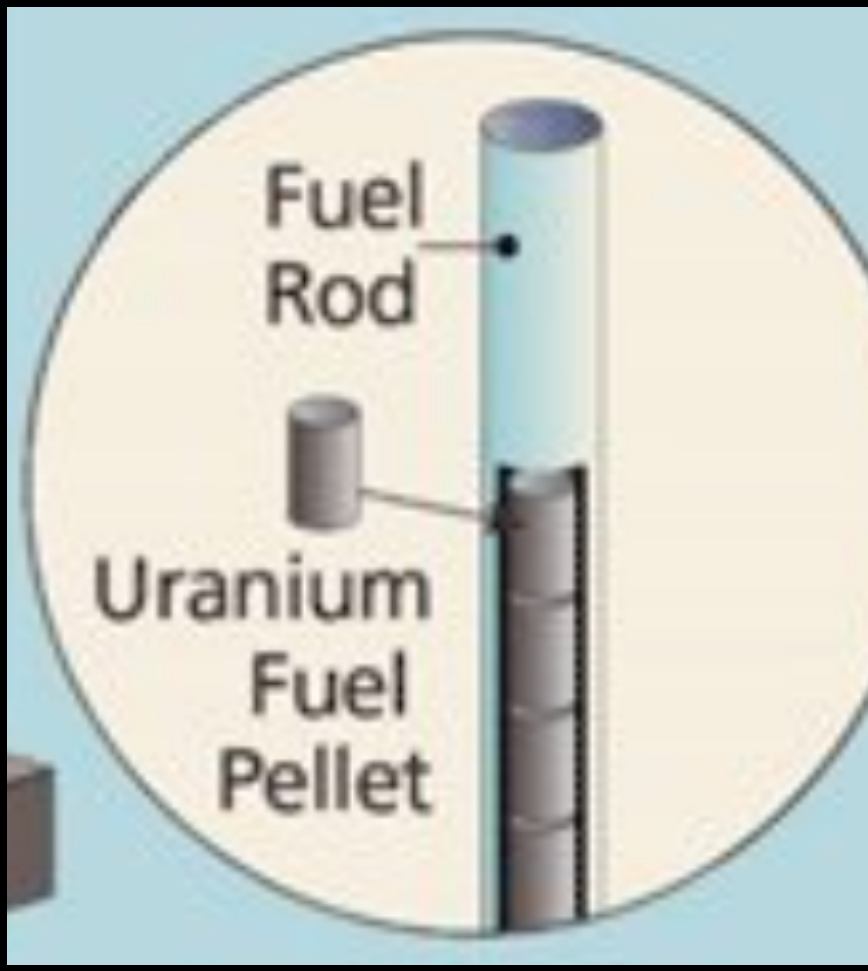
e-mail: ccnr@web.ca

www.ccnr.org

1. The Existing BWXT Peterborough Licence

Assembling the CANDU Fuel Bundles (BWXT Peterborough)

Ceramic nuclear fuel pellets are made from uranium dioxide powder



The uranium fuel pellets are stacked inside thin metallic “fuel rods” made from zirconium alloy

Fuel rods are assembled into CANDU fuel bundles

Beryllium is used to "braze" these outer appendages to the bundle

Figure 1. CANDU® fuel bundle showing brazed appendages. [1]


Some of the dangerous beryllium
Is exhausted into the atmosphere
Wolfe St
Beryllium Stack
BWXT Nuclear
Energy Canada Inc.
Monaghan Rd
Google

Health Effects Associated with Beryllium

While most commonly associated with diseases of the lungs, beryllium may also affect such organs as the liver, kidneys, heart, nervous system, and the lymphatic system.

Direct contact with beryllium fumes or dusts may injure the exposed areas of the body, such as the eyes or the skin. Skin sensitization may also occur.

Beryllium is also a known cancer causing substance, with higher levels of lung cancer being reported.

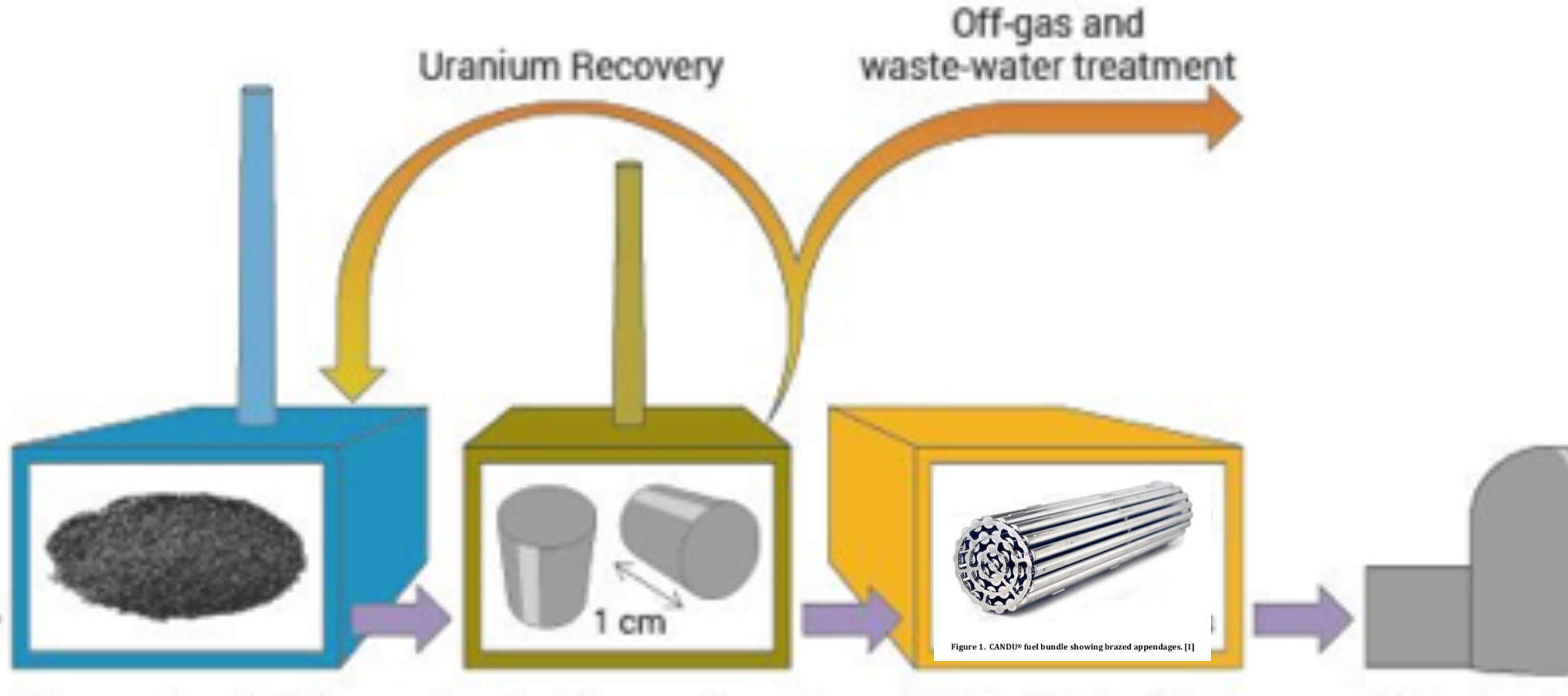
Beryllium disease is a notifiable occupational disease in some Canadian jurisdictions (Northwest Territories, Nunavut, Saskatchewan, and Newfoundland and Labrador).

HOW MANY CANDU REACTORS?

Historic Total	*25 reactors*
Current	*19 reactors*
By end of 2024	*13 reactors*

2. Proposed Addition to The Existing BWXT Peterborough Licence

Fabricating the CANDU Fuel Pellets (BWXT Peterborough)



BWXT Toronto

BWXT Peterborough

Cameco uranium conversion plant on Port Hope harbor.

Photo:
Robert Del Tredici

Uranium Dioxide powder from Port Hope is much finer than flour

Pellets are formed from the fine powder by using a pressure of about 12 to 15 tons per square inch. These pellets are called “green” because they haven’t been sintered [baked] yet.

Next, pellets are sintered at 1650 degrees C (3000 F) in a **hydrogen atmosphere** to prevent oxidation.


BWXT Toronto
Hydrogen tank
1025 Lansdowne Avenue
St Clarens Ave
Google

Closeups of Hydrogen tank

“W A R N I N G : LIQUID HYDROGEN”

3. Health Hazards of Uranium Oxide Powder

Uranium is a radioactive heavy metal – it is both a chemical & radiological hazard

"During the fabrication of fuel pellets, uranium dioxide dust particulates may be produced. About a few micrometers in diameter, these dust particulates may be inhaled if they become airborne.

"Inhalation of uranium dust may result in internal dose to lung tissue from the alpha particles, as well as chemical toxicity if it is absorbed in the bloodstream and transported to sensitive tissues, notably the kidneys.

"It is precisely for this reason that the CNSC mandates stringent worker health and safety programs at BWXT to eliminate or limit exposure to uranium particulates inside the facility."

Jenna Hartviksen
Canadian Nuclear Safety Commission
September 29, 2019

HEAVY METALS

Non-Radioactive

Lead, Mercury
Arsenic, Cadmium

Radioactive

Radium, Plutonium,
Polonium, Thorium
Uranium

Relative sizes

Diameter of Flour particulate	110 to 570 microns
Diameter of Human Hair	17 to 181 microns
Diameter of Uranium Oxide particulate	1 to 10 microns
Diameter of Particulate escaping HEPA filter	0.5 to 2 microns

"According to their self-reported estimates in the 2018 Annual Compliance Report, the company . . . released 46.2 grams of uranium into the air, and 3,620 grams of uranium in the water over the past five years.

This is compared with the less than one gram into the air and sewer in Peterborough over the same time period."

Zach Ruiter

November 28, 2019

article in Trent Arthur

One gram of uranium oxide contains over
7 trillion particles of size 0.3 microns

7,800,000,000,000

46.2 grams of uranium oxide contains over
360 trillion particles of size 0.3 microns

360,900,000,000,000

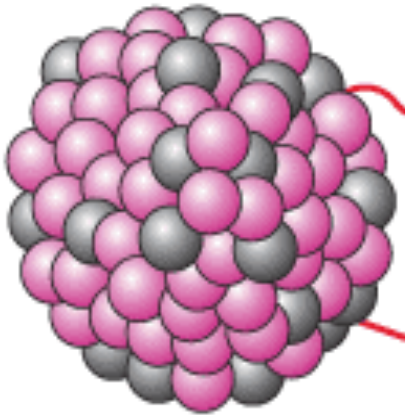
4. Radioactivity : a form of Nuclear Energy . . .

. . . that cannot be shut off

Three types of emissions: Alpha, Beta and Gamma

Photon
of energy

Gamma R



Unstable atom disintegrates giving off 1 or 2 projectiles

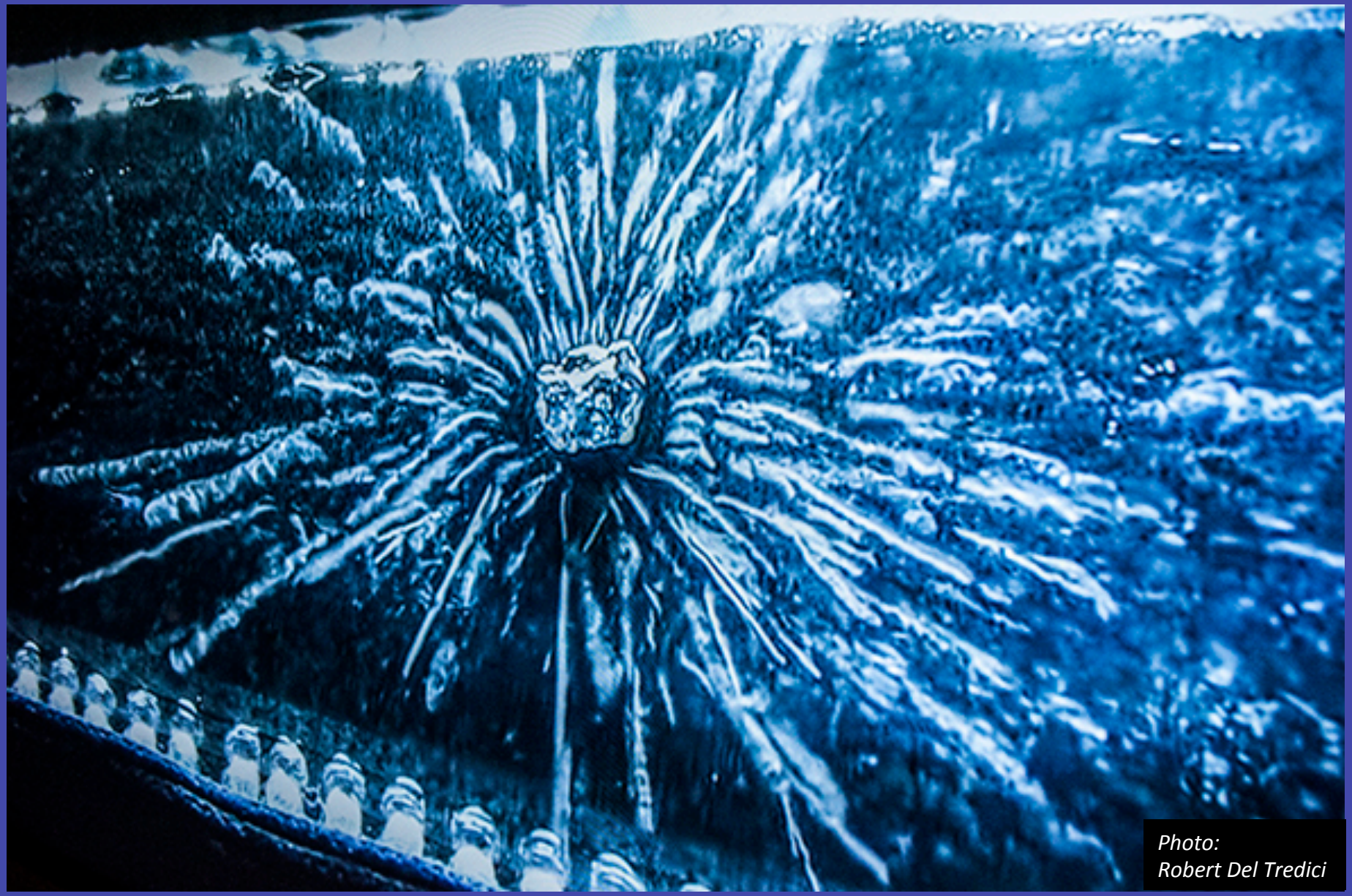
"Atomic Radiation"

Radioactive Nucleus

subatomic Particle

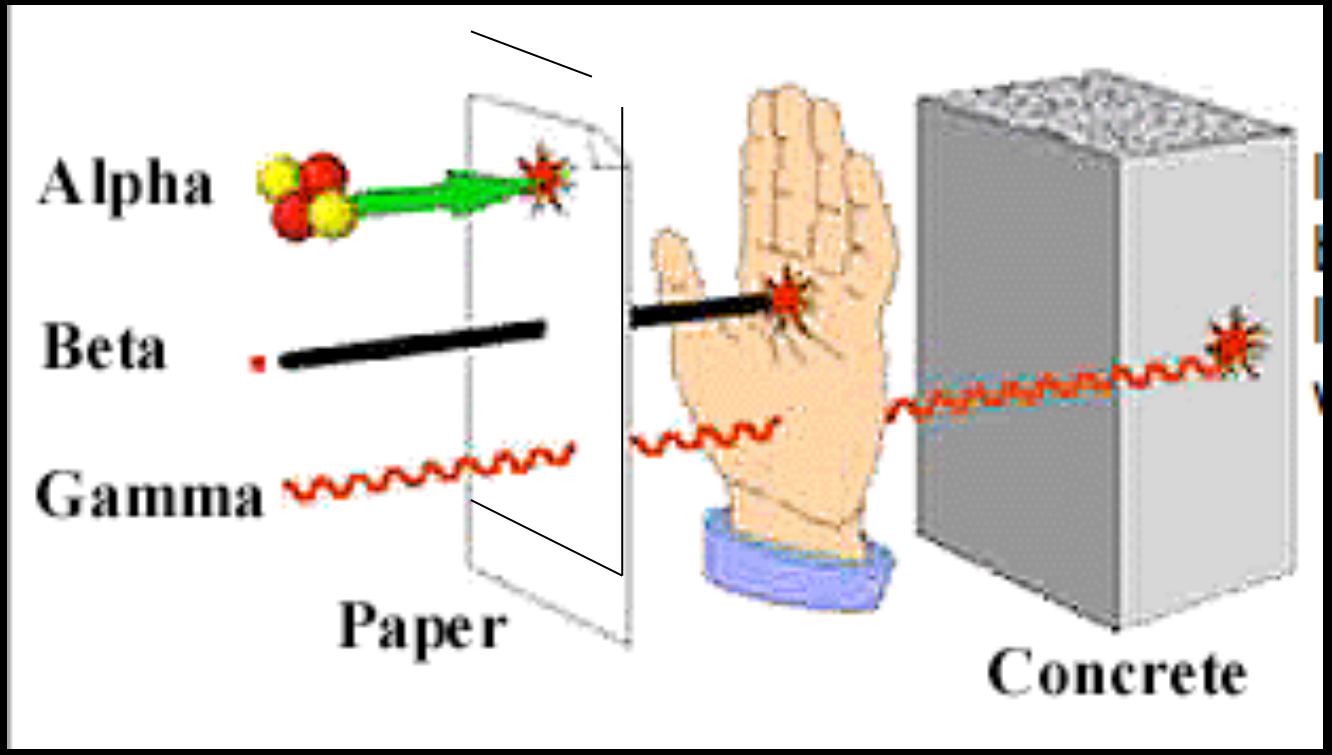
Alpha Par
or
Beta Part

Every radionuclide emits either an alpha or a beta particle.
Such particles are electrically charged and move very fast.
In some cases a powerful gamma ray is also given off.
All three forms of atomic radiation damage living cells.



Invisible radioactive emissions leave visible tracks in a “cloud chamber”

Alpha particles can be stopped by a sheet of paper. Alpha emitters are harmless outside the body, but exceedingly dangerous when ingested or inhaled.



Beta particles penetrate only part-way. They can damage eyes or skin externally. But the main danger is internal exposure.

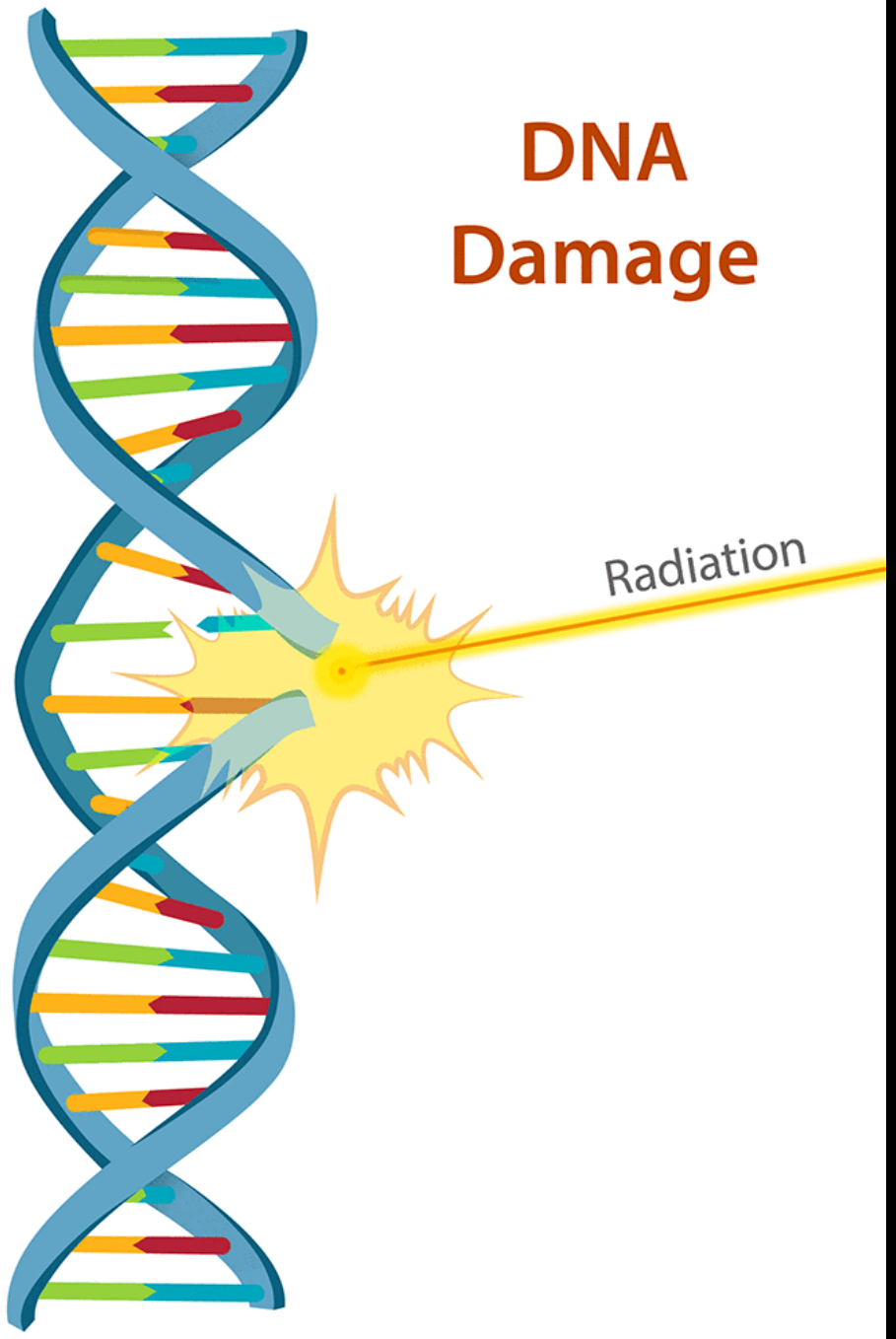
Gamma rays are highly penetrating. They give "whole body" radiation. Heavy shielding is often needed.

Delayed Health Effects from chronic radiation exposure

Genetic instructions are altered by damage to DNA

Thus radiation damage may make things grow wrong; the effects are not immediately felt

Embryos, foetuses, children, and women are more vulnerable to radiation damage than men.



Chronic radioactive exposures at low doses increases the incidence of cancer, leukemia, genetic damage, strokes, heart attacks, other blood diseases and low intelligence in young children

…but there is a "latency period"; the onset of disease will occur years or decades after exposure.

Dr. Alice Stewart (MD) showed embryos are very vulnerable to radiation damage.

Photo:
Robert Del Tredici

Dr. Karl Morgan (Ph.D.) found there is no safe level of radioactive exposure.

Marie Curie 1898

discovered radium and polonium in uranium residues

Radium Dial Painters 1920

radium-226

Girls hired to use radioactive paint to make numerals on watch dials glow in the dark …

… ingested minute amounts of radium when they licked the tips of their brushes to get a very fine point .

deaths from
Fatal anemia
Bone cancer
Head cancer

CANADA

DEPARTMENT OF MINES

INVESTIGATIONS IN ORE DRESSING AND METALLURGY

1931

OTTAWA

PRECAUTIONS FOR WORKERS IN THE TREATMENT OF RADIUM ORES

W. R. McClelland

Recent investigations in the field of radium poisoning have led to the conclusion that precautions are necessary even in the handling of substances of low radioactivity. The ingestion of small amounts of radioactive dust or emanation over a long period of time may have serious consequences: lung cancer, bone necrosis and rapid anemia are possible diseases due to deposition of radioactive substances in the cell tissue or bone structure of the body.

Underground Miner (Navajo)
with lung cancer

Radon Gas

Photo:
Robert Del Tredici

radioactive **radon gas** is produced when radium atoms disintegrate

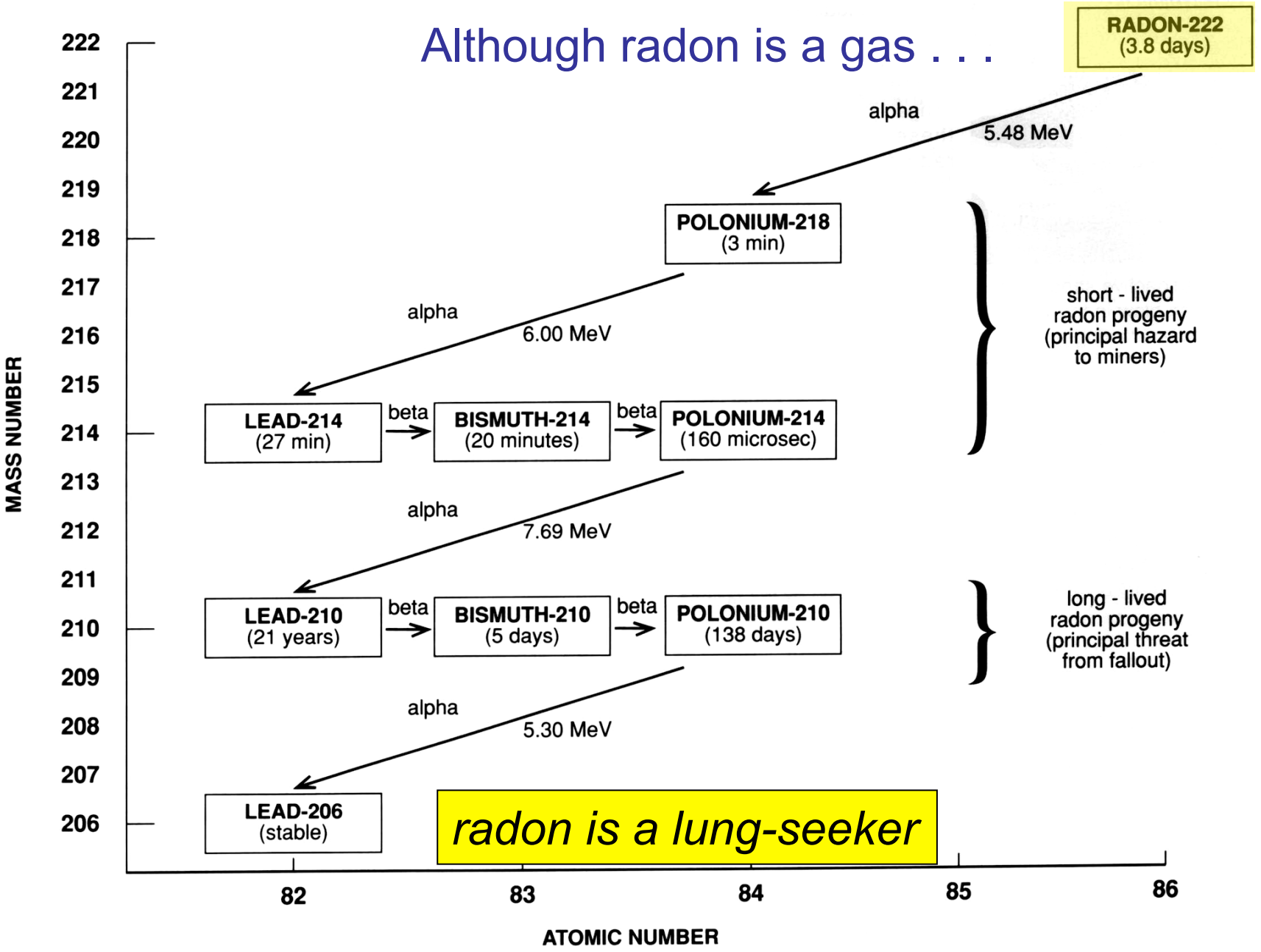
radon is the leading cause of **lung cancer** among non-smokers

radon causes lung cancers and other lung diseases in **uranium miners**

radon gas deposits solid **radioactive materials** in lung tissue

radon is eight times **heavier than air** and travels great distances …

Although radon is a gas . . .



Alexander Litvinenko 2006

polonium-210

murdered by polonium poisoning in London England
(a tiny amount of polonium added to a cup of tea)

polonium is chemically similar to potassium – it attaches itself to the **red blood** corpuscles …

polonium travels throughout the body damaging **soft organs** …

polonium is 250 billion times **more toxic than hydrogen cyanide** …

polonium is the only material that can deliver a dose of **whole-body alpha radiation**…

polonium is produced by the **disintegration of radon** atoms …

American Health Physics Society

polonium-210

is probably the cause of

up to 90 percent of the deaths

attributed to tobacco

(lung cancers, heart attacks, strokes)

polonium is a blood-seeker

radon gas from soil and uranium-rich fertilizer builds up under a canopy of tobacco leaves …

radon disintegrates to form radioactive **lead-210 that sticks to the resinous hairs on tobacco leaves** …

harvested tobacco has very minute amounts of radioactive lead-210 …

lead-210 disintegrates to form polonium-210 that is inhaled by smoker …

polonium-210 **damages the lung** to cause cancer and **enters the blood** to cause strokes and heart attacks…

Los Alamos National Laboratory's Chemistry Division

http://periodic.lanl.gov/elements/84.html

Polonium-210

Weight by weight

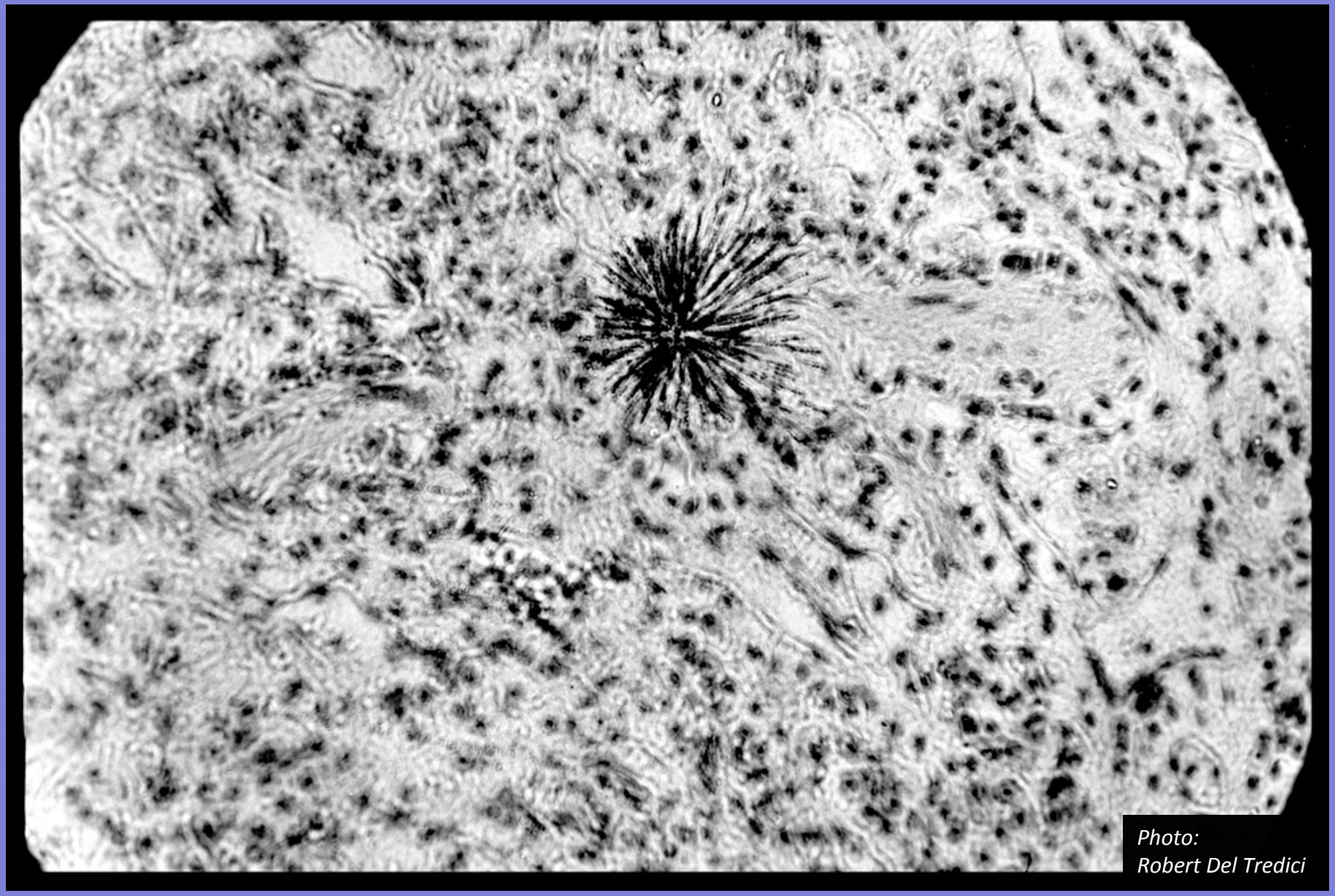
it is about 250 billion times

as toxic as hydrogen cyanide.

Non-Penetrating

Alpha Radiation

Radon, Radium, Polonium, Plutonium, Thorium, Uranium



"Alpha Radiation" from a tiny radioactive particle in lung tissue

Radiation Dose to a tiny volume of tissue with One Particle Lodged in the Lung

Size of Particle (Diameter)	Range of Alpha Radiation	Radiation Dose per year
0.3 microns	12 microns	191 milliSieverts
0.3 microns	11 microns	248 milliSieverts
1 micron	12 microns	7,000 milliSieverts
1 micron	11 microns	9,000 milliSieverts
2 microns	12 microns	44,410 milliSieverts
2 microns	11 microns	57,660 milliSieverts
2.5 microns	12 microns	75,855 milliSieverts
2.5 microns	11 microns	98,480 milliSieverts

NRC/CNSC Public Radiation Dose Limit = 1 milliSievert / EPA airborne limit 0.1 mSv

The End

This backgrounder prepared by Dr. Gordon Edwards
on behalf of CARN, Citizens Against Radioactive Neighbourhoods.

Peterborough December 3 2019

Canadian Coalition for Nuclear Responsibility

www.ccnr.org