Public Comment on NWMO's IPD for the DGR for Used Fuel

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INTRODUCTION

Herein are my comments on the: "Initial Project Description, Plain Language Summary – English, Deep Geological Repository (DGR) for Canada's Used Nuclear Fuel Project". My submission concentrates on the phrase I underlined in the first paragraph of "Why the Project is Needed", that follows:

> "Canada's nuclear power plants have provided, and are expected to continue providing, clean, reliable, and low-carbon energy for decades. However, used nuclear fuel remains radioactive for a very long time and therefore requires careful, permanent management to avoid placing a burden on future generations."

The risks of used nuclear fuel have been greatly exaggerated and the proposed waste site, as discussed on the NWMO website, would be safe. My comments will show that long-lived radioisotopes are known to be safe at dose levels that far exceed those from a used-fuel waste site that could be licensed, and so the risks are negligible after the first few hundred years when short-lived fission products like Cs-137 have decayed. In summary, this waste site will not place a burden on future generations.

In 1970 while investigating air pollution I read that 50,000 Americans died annually due to the burning of fossil fuels. In 1975 I started work at Chalk River Labs during the OPEC oil crisis. These experiences led to my interests in conservation, renewable energy, and associated environmental, strategic, and health issues. I left AECL in 1979 to obtain a post graduate degree in Applied Mathematics from Waterloo with a focus on solar energy. When I graduated, I worked in the environmental industry on air pollution and oil spill computer models. Eventually I realised that nuclear was the solution to many problems, so I returned to Chalk River Labs where I worked till retirement. I have been investigating the risks of radiation and have authored articles published in peer reviewed journals and given presentations on how the risks of radiation were over-estimated in the media and misunderstood by the public.

APPARENT THRESHOLD FOR ALPHA DOSES

This submission focuses on input into the risk of alpha radiation from Dr. John Boice, the past president of the National Council of Radiation Protection (NCRP), more recently its Director of Science, and a professor at Vanderbilt University. Boice is widely considered to be the authoritative expert on radiation epidemiology. For example, the U.S. Centers for Disease Control and Prevention had Boice produce eight YouTube videos on radiation epidemiology. Furthermore, Boice and the NCRP advocate

Linear No Threshold (LNT) and promulgate a risk averse approach to radiation protection. Boice's opinions are authoritative and do not underestimate risk.

The public, press, and politicians believe plutonium and nuclear waste to be extraordinarily dangerous because they are radioactive for a long time. However, plutonium's reputation as being extremely risky is not supported by evidence, as shown in Figure 1, which is Boice's Slide 56 in Reference [1]. Soviet workers were very heavily exposed to plutonium from the 1940's into the 1960's, but even those workers that ingested large amounts had very low levels of bone cancer. Figure 1 shows that the thousands of Soviet workers with body burdens under 7,400 Becquerel (Bq) did not get increased bone cancer (Relative Risk of 1) than the control group, however, those with higher body burdens had a Relative Risk of 7.9. This slide suggests a possible threshold dose for bone cancer, (bottom right-hand box) which is supported by the statement that: "Elevated risks for bone cancer were observed only for workers with plutonium doses exceeding 10 Gray (Gy)", Page 34 of Reference [2]. Comments in Figure 1 indicate that lung and liver cancer, which are the only other potential cancer sites, have the same "picture", i.e. an apparent threshold. This is supported by the Sokolnikov study, mentioned in Figure 1, that indicated no statistically significant evidence for liver cancer below 3 Gy and for bone cancer below 10 Gy. Also, there was no excess leukaemia and the workers with high dose had only 3 bone cancers as stated in Figure 1. The small number of excess cases is striking given that these thousands of Cold War workers had extremely high exposures. American workers with known internal plutonium did not have increased cancer risk [3], the abstract of which states: "Their effective doses range from 0.1 to 7.2 Sv with a median value of 1.25 Sv. As of the end of 1994, 7 individuals have died compared with an expected 16 deaths … Mortality from all cancers was not statistically elevated." [3].

Other alpha emitters have similar dose responses. Boice's slide for the radium dial painters, Figure 2, shows the risk for radium up to 100 million Bq [4]. Boice states there is no leukaemia and suggests that 10 Gy is the practical threshold for bone cancer. This is in stark contrast with the claim of some activists that one alpha decay (a pico-Gy) can be lethal. Professor Nicholas Priest examined 22 studies of the risks of different alpha emitters (plutonium, radium, thorium, etc.) to different organs (lung, liver, bone, etc.), in different species (people, dog, mouse, etc.). He concluded that the overall threshold was 0.5 Gy [5]. The lower threshold of 0.5 Gy results from including lung cancer in this meta study, which is not relevant to a used-fuel waste site. The radium and Priest studies are presented to show that it is not surprising that plutonium has a much lower risk than is generally believed.

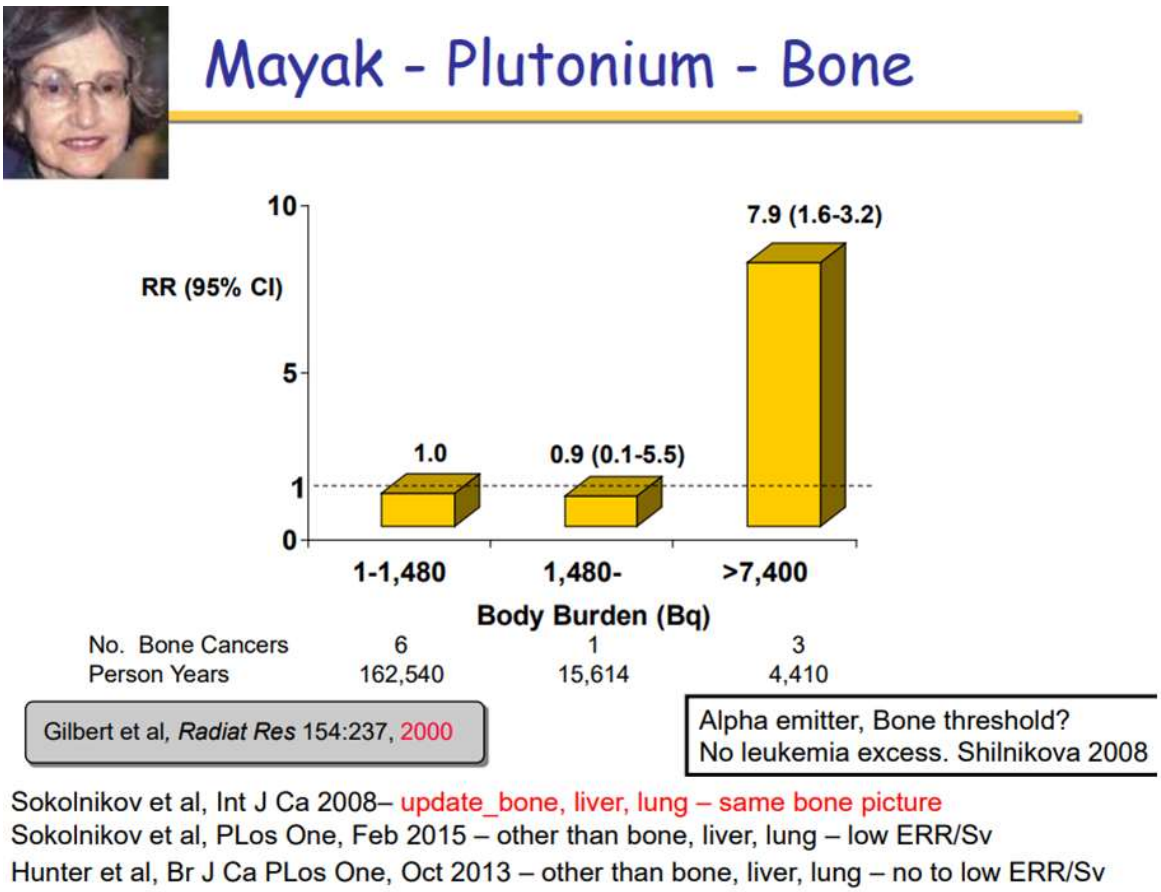

Figure 1: Bone cancer in Russian Mayak workers with high plutonium exposure [1] (Slide 56)

OTHER LONG-LIVED RADIOISOTOPES

The risks from other long-lived fission product radioisotopes have also been exaggerated. For example, Iodine-129 (I-129) is a radioisotope with a very long half-life. Iodine concentrates in the thyroid and experience from Chernobyl showed I-131 can be dangerous for children eating dairy products containing it, especially if they were already iodine deficient, Slide 50 in Reference [1]. However, I-131 has a half life of 8 days versus the I-129 half life of 16 million years, which means there is a 4 billion times reduction in dose rate for I-129 compared to an equal amount of I-131. Those children who were Iodine deficient before the accident, could only absorb enough I-131 for a peak monthly dose of about 1 Gy to the thyroid. If it had been I-129, then the reduction in dose-rate of 4 billion would have meant that monthly doses would be measured in nano-Gy and lifetime doses in micro-Gy, which is obviously benign. These Long-lived radioisotopes produce very low dose-rates and are not a health risk since the body cannot store much, even if large amounts could conceivably be ingested.

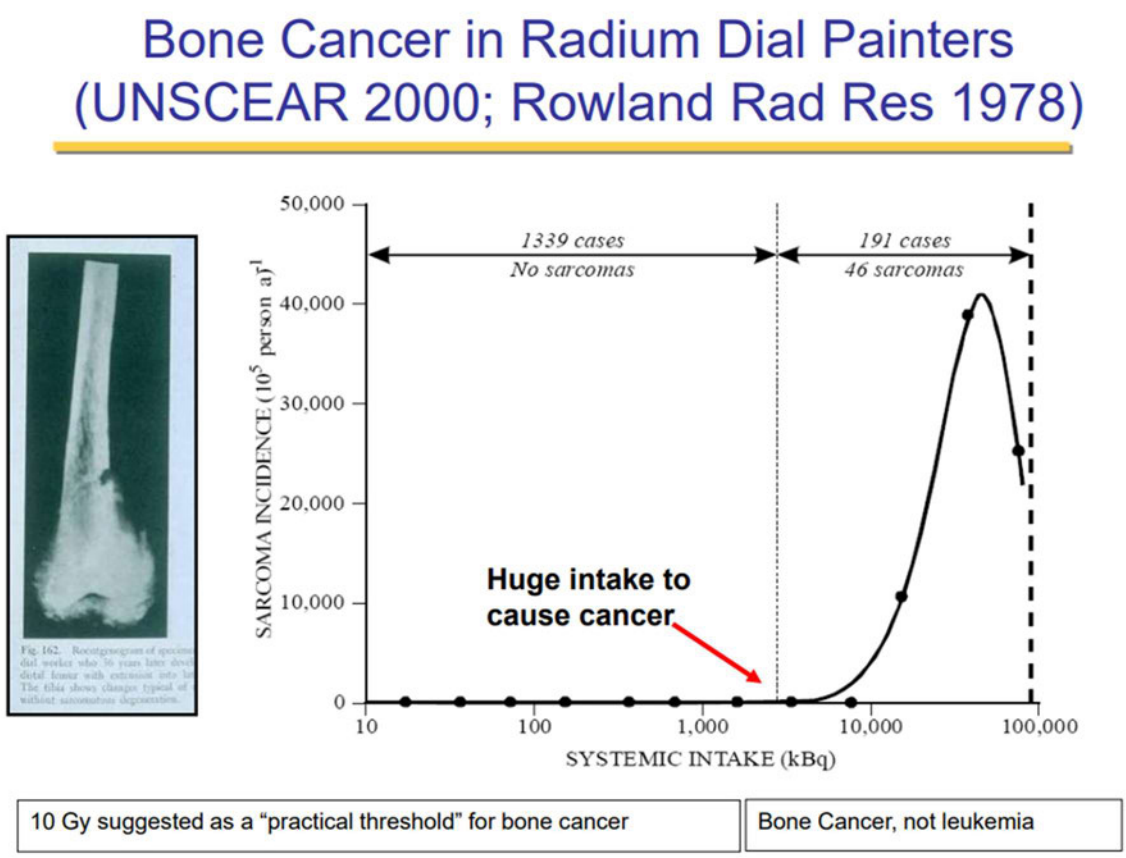

Figure 2: Bone cancer in radium dial painters [4] (Slide 12)

WHY WE ARE SO AFRAID

Important people have repeatedly exaggerated the risks of plutonium and used-fuel leading to today's exaggerated public fears. Ralph Nader, four times US presidential candidate, claimed that one pound of plutonium could kill 8 billion people. This was very far from the truth, and he was talking specifically of airborne plutonium, which is not relevant to this discussion. Walter Cronkite, trusted news broadcaster, said "plutonium is the most dangerous substance known to man". Weinberg, past head of Oak Ridge Nuclear Labs, discussed a nuclear priesthood required to maintain knowledge of disposal sites for thousands of years. John Gofman worked for the Atomic Energy Commission as its Director of the Biomedical Research Division from the early 1960's with a mandate to study radiation health effects. A chapter in John Gofman's book, "Population Control Through Nuclear Pollution: was "Undisposable Nuclear Waste". These highly visible and influential people have caused unnecessary anxiety to this day by their repeated exaggerations of risk.

SUMMARY

Obviously used-fuel must be carefully handled, in particular, for the first century after reactor removal when radiation levels are high. However, there are 75+ years of practical experience, from hundreds of reactors around the world, successfully handling extremely radioactive fresh used-fuel. Once the used-fuel is disposed of in the planned long-term storage we can virtually guarantee safety due to the low mobility, low uptake, apparent threshold for alpha emitters, and the extremely low activity rates of I-

129 and other radioisotopes. There has been harm from long-lived radioisotopes when people ingested large quantities. Children drank I-131 laced milk from Chernobyl. Radium dial painters repeatedly licked their brushes. Lax safety measures for Soviet workers in the early years meant they ingested (or inhaled) substantial quantities of plutonium. We have adopted LNT because of evidence from external gamma dose. Society then extrapolated LNT to a very different kind of radiation, alpha, because we do not want to underestimate risk. Then we multiply the dose by 20 to estimate risk even for very low doses below the apparent thresholds when risk is zero. The apparent plutonium lifetime threshold of 10 Gy is equivalent to a lifetime threshold of 200 Sv. Since the waste site would not be licensable if doses to the public was estimated to be one milli-Sv per year, then lifetime doses to the public would not ever approach this threshold making the waste site safe.

The evidence showing no harm below huge doses means that any DGR that can be licensed will have an enormous safety margin. In conclusion, used fuel can be safely disposed of and the NWMO website shows one way this can be done.

REFERENCES

[1] John D. Boice, “Radiation Studies and Concepts II”, Radiation Studies and Concepts II - Dr. John Boice, Radiation Epidemiology and Dosimetry Course - NCI Produced May 2015.

[2] “Toxicological Profile For Plutonium”, U.S. Department of Health and Human Services, Public Health Service Agency for Toxic Substances and Disease Registry, November 2010.

[3] George L. Voelz, et al., “Fifty Years of Plutonium Exposure to the Manhattan Project Plutonium Workers: An Update”, Health Physics 73(4):611-619; 1997.

[4] John D. Boice, ”Radiation Studies and Concepts I" Presented by John Boice, Radiation Studies and Concepts I - Dr. John Boice, Radiation Epidemiology and Dosimetry Course - NCI

[5] Nicholas Priest, “Dose-thresholds for alpha-radiation induced cancer risk: absence of risk following small alpha-emitting radionuclide intakes”, IAEA, 2014.