Findings on Uranium Tailings

Verbatim Quotations from Official Documents

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Excerpts from

A Race Against Time: The Porter Commission Report

The Expansion of the Uranium Mines in the Elliot Lake Area

FEARO Report on the Proposed Eldorado Refinery at Port Granby

Report to the President by the Interagency Review Group

"NRC Regulation of the Uranium Milling Industry: Problems and Prospects"

"Geologic Disposal of High-Level Radioactive Wastes"

Excerpts from:

A Race Against Time
Interim Report on Nuclear Power

Ontario Royal Commission on Electric Power Planning
~ commonly known as the Porter Commission Report ~

Toronto, September 1978.

- The mining and milling of uranium ore produces very large volumes of long-lived, low-level radioactive tailings which have leached into waterways in the vicinity of Elliot Lake, Ontario, thereby posing serious health and environmental problems. (p.64)

- The decommissioning and abandonment of depleted mines and the long term management of the very large volumes of environmentally hazardous tailings, perhaps in perpetuity, represent extremely difficult issues.... (p.147)

- Uranium mill tailings will constitute an increasing health and environmental problem. An independent review committee should be established to study the problem in depth and prepare a public report for the AECB and the Ontario Environmental Assessment Board. The future of the nuclear programme should be assessed in light of the committee's findings and progress in mill tailings containment technology. (Major Findings and Conclusions, p. xiii)

- At about two or three year intervals the nuclear power programme, and in particular the uranium mining and milling part of the fuel cycle, should be assessed in the light of the findings of this review committee. (p.73)

  [Such "an independent review committee, consisting of internationally recognized ecologists" (p.73) has never been established.]

Excerpts from:

The Expansion of the Uranium Mines in the Elliot Lake Area: Final Report

Ontario Environmental Assessment Board

Toronto, May 1979

- The Board finds that the long-term impermeability of tailings basins -- specifically dams containing the tailings -- cannot be guaranteed.

- The Board finds that the Ministries of Natural Resources and Labour have no definitive criteria for evaluating the construction, materials used, and stability of tailings dams.

- The Board finds that the potential for redissolution of radium from precipitation ponds after abandonment is of great concern.

- The Board finds that the process known as solidification has not undergone sufficient field trial to determine its applicability to the Elliot Lake tailings, its ability to withstand the climactic extremes, and its ability to be combined with other methods of contouring and stabilization as part of a long-term close-out process.

- The Board finds little evidence to give it confidence in the use of synthetic membranes, asphalt, cement or chemical means to cover tailings areas to inhibit water infiltration in the long term.

- The Board finds that the mill tailings have the greatest potential impact on the natural environment of all the activities related to the mines expansion.

- According to Mr. Dory, waste management is presently looked on by the AECB as a storage system which should not preclude additional action in the future to convert the present system into a disposal system allowing abandonment.... He also stated that at the present time "abandonment" without continuing monitoring is not seen as a possibility. Methods to ensure a continual monitoring program (such as the creation of a fund) have not yet been developed. (p.153)

Excerpts from:

Report of the Federal Environmental Assessment Panel on the Proposed Eldorado Refinery at Port Granby.

Federal Environmental Assessment Review Office (FEARO).

Ottawa, May 1978.

- The proposed [low-level] waste management system was designed for permanent waste disposal. This system would consist of trenches opened and filled when enough residue had accumulated at the plant. They would be closed immediately afterwards. The wastes would be covered with a bentonite-sand blanket which would absorb water and swell to form an "umbrella" over the trenches, thereby protecting the wastes from becoming wet. By making use of natural materials, it was proposed that such a system would be adequate, even allowing for the long time required for radioactive decay or for shore erosion to reach the disposal site.

- The AECB advised the Panel, however, that the system could only be considered as a storage method for a period of about 30 to 50 years.

- Nevertheless, even as a storage system, there remain a large number of unknowns that affect the acceptability of the proposal.

  Bentonite clay has been known as a sealant for at least ten years but has never been used routinely as a waterproof blanket anywhere in the world. It has been a successful sealant under municipal landfill sites, but it has only been used in this way for a few years. Scientific data on its use is sparse and pilot experiments have not yet been carried out. Eldorado proposed to modify the bentonite with the addition of sand. This mixture, it was indicated, would be a better sealant. No long-term tests are available to confirm this.

  Eldorado proposed to protect the integrity of the bentonite blanket with an overlay of 1.7 metres of fill to reduce the risk of penetration by roots and by burrowing animals. There was no evidence that this would ensure the integrity of the blanket. Furthermore, the effects of freak weather conditions such as prolonged drought, freezing, or wet conditions cannot be determined without extensive field testing. It was indicated by ENL (Eldorado Nuclear Limited) that, eventually, the bentonite blanket probably would break down, but that any resultant escape of pollutants would be insignificant. The area's complex hydrogeology casts further doubt on the validity of the waste management proposal.

- Difficulties have arisen with waste management at existing storage sites in the area, which led to polluted streams and the death of cattle. Fill from past Port Hope refinery operations, used around buildings in the town, caused excessive radon gas buildup. These problems have been transposed into concerns about the Port Granby proposal.

- The Panel found the proposed waste management system unsuitable as a means of storage because of unknown reliability, costs, engineering difficulties and the need to retrieve the stored material.

Excerpts from:

Report to the President by the Interagency Review Group on Nuclear Waste Management

Washington D.C.
October 1978.

- The central scientific fact about radioactive material is that there is no method of altering the period of time in which a particular species remains radioactive, and thereby potentially toxic and hazardous, without changing that species.

- This potential hazard results from the fact that exposure to and/or uptake of radioactive material can cause biological damage. In man, it can lead to death directly through intense exposure, and a variety of diseases, including cancer, which can be fatal. In addition, radioactive material can be mutagenic, thereby transmitting biological damage into the future.

- Only with time will [a radioactive] material decay to a stable (non-radioactive) element. The pertinent decay times vary from hundreds of years for the bulk of the fission products to millions of years for certain of the actinide elements and long-lived fission products. Thus, if present and future generations are to be protected from potential biological damage, a way must be provided either to isolate waste from the biosphere for long periods of time, to remove it entirely from the earth, or to transform it into non-radioactive elements.

- Compared with other types of nuclear waste, uranium mill tailings are generated in large volumes, about 10 to 15 million tons annually. Although tailings are a natural product of mining and milling, they are hazardous because they contain long-lived radio-isotopes and because they have been left in waste piles where humans may come in contact with them. Radon and radium are two radioactive elements in these wastes that are of particular environmental concern. Radon is a noble gas that escapes easily into the atmosphere from unstabilized mill tailings, whereas radium, its parent, is a potential pollutant of surface groundwaters. Due to the long half-life of thorium-230, the parent of radium, the quantity of radon and radium in the tailings will diminish by only one-half in roughly 80,000 years.

- The relative magnitudes of actinide elements in mill tailings, HLW [high level wastes], and TRU [plutonium-contaminated] wastes, per unit of energy generated, suggest that all these waste streams may present problems of comparable magnitude for the very long term, that is, beyond a period of a thousand years. By virtue of their presence at the surface, the actinide elements in mill tailings may constitute a greater potential problem than those in deeply buried HLW [high level wastes], and TRU [plutonium-contaminated] wastes. Thus, disposal of these tailings must be managed as carefully as that for HLW and TRU wastes.

- Past control of mill sites has been poor, with little or no attention to the problem of proper disposal of tailings upon completion of milling operation. Tailings have been removed from disposal sites for use in construction of homes and commercial building. Two general methods have been proposed for future containment of the tailings at old and new mill sites. The first involves covering the tailings with one of a variety of materials to reduce erosion and radon release. The second involves placement of the tailings below ground level in mines or in open pits.

- Considerable R&D remains to be done to evaluate these measures. Moreover, the long-half-life of thorium-230 dictates that R&D on tailings stabilization must consider the effects of geologic processes, operating over geologic time, upon the transport of radon and radium through the biosphere and hydrosphere surrounding the tailings. The ultimate objective should be to dispose of the tailings in such a manner that emissions of radon and radium are reduced to or as near background levels as can be reasonably achieved, and that no active institutional care be required to keep the tailings isolated from people following disposal.

Excerpts from:

"NRC Regulation of the Uranium Milling Industry: Problems and Prospects"

by Victor Gilinsky, Commissioner
U.S. Nuclear Regulatory Commission

Washington DC
May 2, 1978

- As long as the uranium ore is undisturbed deep underground not much radon diffuses to the surface. But when the uranium ore is brought to the surface, radon is released into the atmosphere where it can be inhaled.

- The possible health significance of these [radon] releases were not immediately recognized. You may recall that during the 1950's mill tailings were used as fill material under and around new buildings in Grand Junction [Colorado], and that later surveys identified hundreds of buildings with excessive radiation levels. Remedial actions are still underway to replace the original fill material.

- Since radon is a gas it is also possible for large populations thousands of miles from the source to be exposed, albeit to an extremely low dose. If no steps are taken to control them the tailings can be blown about, further spreading the source.

- The extent of the radioactive releases from the so-called "front end" of the nuclear fuel cycle has been persistently underestimated in official reports until quite recently. In 1975 a public interest group petitioned the Commission to amend its standard table of such releases prepared in 1974 because, it said, the NRC neglected mining releases and greatly underestimated the long-term releases associated with radon gas emitted from tailings piles. The Commission has now agreed that the current table is incorrect and is going to provide new estimates.

- But even with the right numbers, assessing the health significance of radon releases from uranium tailings is not simple. On the one hand, the relative increase to the existing natural level of radioactivity, at least away from the tailings pile, is exceedingly slight. On the other hand, the tailings continue to release radon for over 100,000 years; and if the tailings are not isolated from the atmosphere the sum of the exposures for all those years could be large in absolute terms -- in fact, it becomes the dominant contribution to radiation exposure from the nuclear fuel cycle.

- Because the tailings associated with uranium milling were not regarded as material that posed significant health risks no special provision was made in the Atomic Energy Act for their direct regulation. In view of this situation, after a mill's useful life there is now no legal basis for NRC regulatory control over the tailings whatever the health and environmental concerns. There are about 26 million tons of tailings in this category at twenty-two abandoned mills in eight Western states (Arizona, Colorado, Idaho, New Mexico, Texas, Utah, Wyoming).

- A Department of Energy assessment of this problem has been performed and published. It shows that none of the sites can be considered to be in satisfactory condition from the long-term

standpoint. At some sites, no stabilization of the tailings had been carried out. At others the site conditions were found to require continued surveillance and maintenance.

Excerpts from:

"Geologic Disposal of High-Level Radioactive Wastes -- An Earth-Science Perspective"

by Bredehoeft et al.
U.S. Geological Survey Circular 779

Washington, DC., 1978

- The toxicities, during periods as long as 10 million years, computed for radium and selected actinide elements and actinide daughters in high-level waste from reprocessing, are shown in Figure 1 [Pigford and Choi, 1976].

- Figure 1 also calls attention to the hazard from uranium mill tailings, which, although more than an order of magnitude more toxic than high-level waste, have customarily been treated in much more cursory fashion.

Whether the hazards from high-level waste and uranium ore bodies and their derivative tailings are comparable is not clear. The high-level wastes are in highly concentrated forms. This means that a breach of a repository and a direct short- circuit to the biosphere could have serious consequences. On the other hand, the relatively low volumes of high-level waste should help to ensure that it can be more easily handled and placed in a more secure geologic environment than the more voluminous and dispersed ore and mill tailings.

[Uranium Sub-Directory] [COMPLETE DIRECTORY]

How Toxic is Nuclear Waste Over 10 Million Years?

The following chart is taken from a very interesting circular published by the US Geological Survey on the subject of High Level Radioactive Wastes (HLW). In order to compare the toxicity of HLW with (for example) uranium mill tailings, it is necessary to have a crude measure of the toxicity of radioactive materials in general. This is provided by using drinking water standards, which specify -- for each radioactive substance -- the maximum concentration that is permissible in drinking water. Thus a crude measure of toxicity can be obtained by calculating the amount of water needed to dilute a given quantity of radioactive material to the maximum permissible level of radioactive pollution that is legally permitted for drinking water. When this is done, it can be seen that -- after the first thousand years or so -- uranium mill tailings are in fact more hazardous than the HLW.

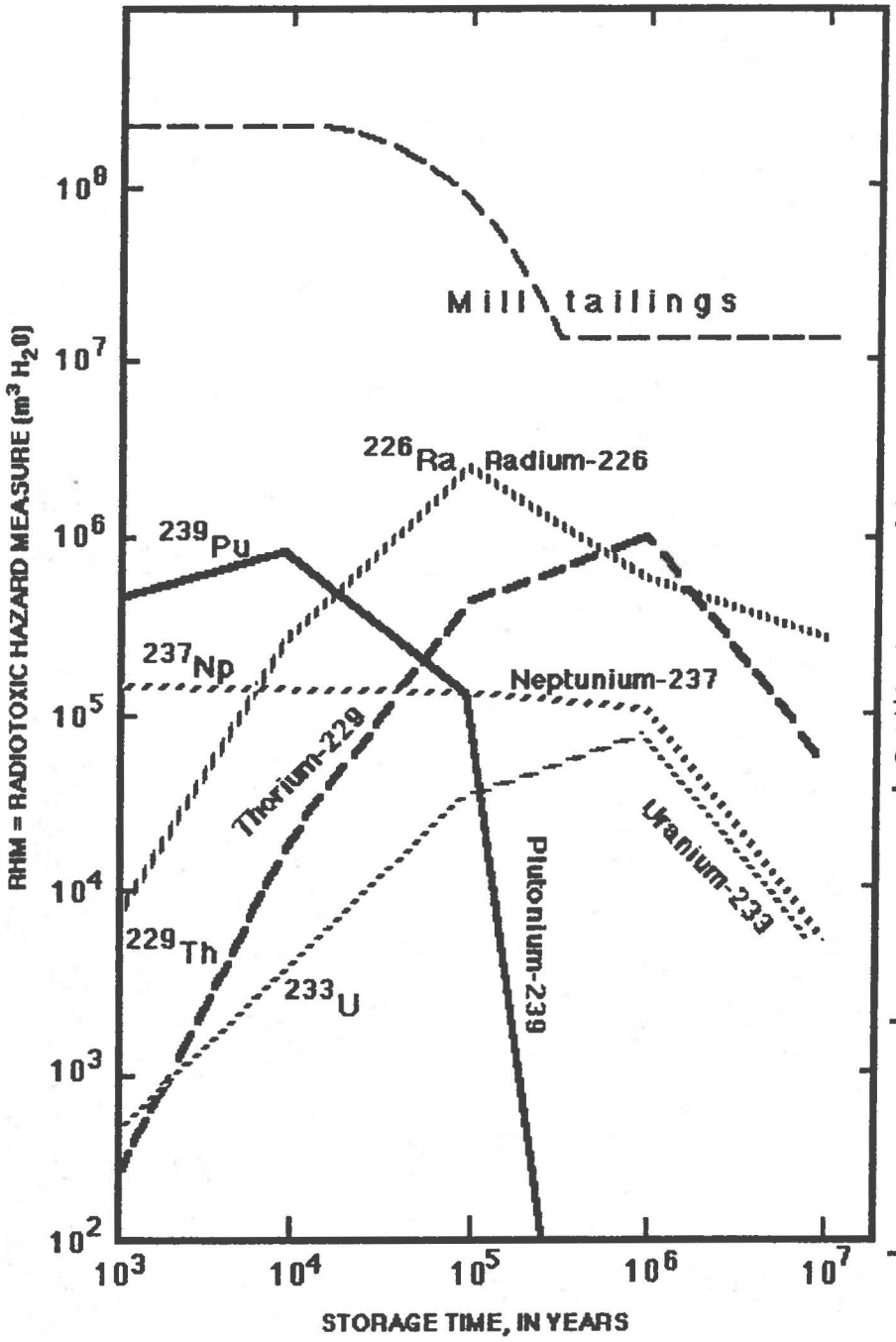

Figure 1 *

Ingestion hazard of selected radionuclides in high-level waste during ten million years. The radiotoxic hazard measure is obtained by dividing the number of curies present for a given nuclide by the number of curies produced by the maximum permissible concentration of that nuclide in a cubic meter of drinking water. Data are normalized for one metric ton of light-water reactor fuel. The nuclide curves are plotted from data in table 2 of Hamstra (1975); the curve for uranium mill tailings was derived from figure 2 of Hamstra (1975) and figure 7 of Pigford and Choi (1976).

* from Geologic Disposal of High-Level Radioactive Wastes -- Earth-Science Perspectives
U.S. Geological Survey
Circular 779
by J.D. Bredehoeft et al (U.S. Gov't Printing Office, 1978)

^{239}Pu = Plutonium-239
^{226}Ra = Radium-226
^{237}Np = Neptunium-237
^{229}Th = Thorium-229
^{233}U = Uranium-233

[Findings on Uranium Tailings]

[Findings on High-Level Waste]

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REFERENCES