Radioactive Waste Disposal and Protection of the Future Public

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ABSTRACT

Much of humanity’s solid waste will outlast the human race, and the waste generated by one generation must be endured and managed by future societies. Radioactive wastes are unique in that their regulation explicitly considers the protection of future generations. But radioactive waste management faces a serious quandary: how to balance the substantial expense of waste isolation against the uncertain mitigation of risks to hypothetical future humans. Most of this uncertainty stems not from natural processes, or from the projected performance of engineered materials, but rather from social actions and human behaviors. Given that these uncertainties become overwhelming when considering the future only a few centuries from now, how far into the future is it useful for us to attempt to assess risks? Government regulators are currently grappling with this question as they rewrite regulations in order to accommodate radioactive wastes that have the potential for unacceptable and perpetual human health risks. This paper discusses the issues surrounding the period of performance expected from radioactive waste management practices, and outlines central conditions for soundly addressing controversial problems.

Keywords: Civil Engineering, Depleted Uranium, Future, Garbage, Generational Ethics, Hazardous Waste, Nuclear Waste, Policy, Public Health, Radioactive Waste, Radioactivity Radionuclide, Risk Assessment, Uranium

No better record of past civilizations exists than its trash heaps. Garbage is more interesting than you might first imagine. It is considered to be mundane and yet is the focus of academic study, as exemplified in the Garbage Project, the brainchild of William Rathje at the University of Arizona’s College of Social and Behavioral Sciences (Rathje, 1992; Rathje, 1996). For a few years, there was an excellent independent magazine devoted to the subject: GARBAGE (Poore, 1989).

Garbage is also a primary focus of civil engineering—that is, the branch of engineering that makes civilization possible. A prerequisite to a successful civilization is the management of its wastes. Without it, disease and pestilence reign. The field of environmental engineering grew out of what was called sanitary engineering. This explains why at the University of North Carolina the environmental engineering program is part of the School of Public Health. Municipal solid waste, as your ordinary garbage

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is called in the waste management community, is managed principally through simple collection, transport, and burial, providing fodder for future archeology dissertations, or perhaps theses in garbology.

With the industrial revolution, particularly the smelting and processing of metals, humanity’s waste stream has become more toxic. Metals, specialized organic chemicals, and other hazardous substances have leached from landfills and contaminated water supplies and the surrounding environment introducing new threats to the social welfare.

Engineers, in their role of fixing such problems, improved hazardous waste management by redesigning landfills—prohibiting the disposal of liquids, and segregating waste streams, among other tactics. Hazardous waste, as defined specifically by the U.S. Environmental Protection Agency in the Resource Conservation and Recovery Act (RCRA), is “a waste with properties that make it dangerous or potentially harmful to human health or the environment” (EPA, 2012). Hazardous wastes are to be managed in a variety of ways, including, as a last resort, burial in a landfill of prescriptive design. This helps to reduce the immediate hazards, but in the fullness of time, all attempts at containment will fail—nature is like that, and this is why the permanent solution of hazardous waste destruction (e.g. by incineration) is preferred to burial. Entropy rules, and all we can do is try to slow it down. Containment is imperfect, and from the geologic perspective, temporary. However, slowing down the release of a hazardous substance actually can render it less hazardous, so attempts at containment are not for naught.

The harnessing of the atom presented a new waste management challenge: radioactive wastes. Unlike some hazardous wastes, radioactive substances cannot be treated to remove their hazard, so we are left with various methods of encapsulation, containment, and isolation. This special category of waste garners an amount of attention arguably out of proportion to the hazard it poses. Nuclear waste has a special place in society’s imagination. If garbage is interesting, radioactive waste is fascinating. It is a technically, socially, and politically rich problem. It is also a rewarding field of study and practice, because it involves so many diverse disciplines, from the natural sciences and engineering to public policy, psychology, economics, anthropology, and even philosophy.

Radioactive waste management is also an opportunity for socially-minded engineers to serve the public, and to address a real need. In terms of public health, it is not the pressing issue that is food safety, access to safe drinking water, tobacco use, and our industrialized diet. Properly disposed radioactive waste has never killed anyone. Nevertheless it is potentially dangerous, and it does register in the public mind. People generally are eager to talk about it.

Most people are vaguely concerned, and glad to know that someone is working on the problem. They are curious about what happened to Yucca Mountain, Nevada as a possible repository for radioactive wastes known as high-level waste and spent nuclear fuel—or more properly used nuclear fuel, as it is not spent by any means. And while the Yucca Mountain Project and the disposal of fuel from commercial power reactors is a popular topic, it is actually not so much a technically difficult problem as a politically insurmountable one. Every country in the world must find solutions, and very few have. Most are in the situation identified by the Blue Ribbon Commission on America’s Nuclear Future, which begins its report: “America’s nuclear waste management program is at an impasse.” (BRC, 2012)

In Los Alamos, New Mexico, my brilliant physicist neighbors who work at our friendly neighborhood nuclear weapons lab have only a vague idea of where their radioactive trash goes. As long as it is taken out of their workspace and they can pass responsibility on to someone else, they are satisfied. They think of the waste products of the nuclear weapons enterprise the same way as most of us think of our household municipal waste, or sewage: Out of sight; out of mind. Just take it away.