Appendix N

WHY RADIOACTIVE WASTES SHOULD BE SEQUESTERED FOR THE FULL DURATION OF THEIR HAZARD: CONSIDERING THE "MACS EFFECT"

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Legal and Regulatory Background

One of the understated troublesome issues faced by all users and generators of radioactive materials, and particularly the proponents of nuclear power and nuclear weapons in their current efforts to revive those industries, is the maintaining of control over radioactive wastes. They encourage deregulation by the Nuclear Regulatory Commission (NRC) and unregulated disposal or recycling of the vast quantities of so-called "Low-level" Radioactive Wastes (LLRW).

In the United States, the federal Low-Level Radioactive Waste Policy of 1980 defined the term "disposal" as:

> The term "disposal" means the permanent isolation of low-level radioactive waste pursuant to the requirements established by the Nuclear Regulatory Commission under applicable laws, or by an agreement State of such isolation occurs in such Agreement State.

The 1980 law then states that "low-level radioactive waste" means radioactive material that –

> (A) is not high-level radioactive waste, spent nuclear fuel, or byproduct material (as defined in section 11e.2 of the Atomic Energy Act of 1954 (42 U.S.C. 201(e)(2)));

and

> (B) the Nuclear Regulatory Commission, consistent with existing law and in accordance with paragraph (A), classifies as low-level radioactive waste.

In the NRC's regulations governing LLRW disposal [10 CFR Part 61] adopted in 1982 and later modified,] the term "disposal" is defined, with more sophistication, as, "the isolation of radioactive wastes from the biosphere inhabited by man and containing his food chains by emplacement in a land disposal facility."

Waste disposal facilities were divided into Class A considered least hazardous, Classes B and C that were deemed more toxic requiring greater isolation from the environment. Thus, a wide variety of materials, radionuclides present, concentrations, and longevity of biological hazards were lumped together in these broad, "everything except," categories. A Class D category is deemed simply "Greater than Class C" and designated to be buried with highly irradiated "spent" reactor fuel and other high level wastes in a national repository.

There followed in the early 1980's much disagreement and national debate about the siting of LLRW disposal facilities and the number and contents of disposal facilities needed, with the public expressing health, safety and economic concerns that were heightened by the 1979 accident at Three Mile Island.

The costs for "disposal"--more accurately termed sequestration--have soared, as most of the initial six LLRW burial sites were found to be leaking or otherwise deemed unsafe or undesired, and were closed down in the 1970s.

In 1986, the Congress attempted to resolve this waste issue by passage of the Omnibus Low-Level Radioactive Waste Interstate Compact Consent Act. States were encouraged to form compacts for regional or other groupings of states and to select one state to host disposal of the commercial LLRW generated by the nuclear power industry and other generators from Compact member states.

Compacts were formed. Criteria for disposal sites were developed. But strong opposition to site selection soon surfaced everywhere. Of the many arguments that defeated potential locations, one of the most persuasive was the open-ended nature of the commitments. There appeared to be no conclusion to the generation of ever more radioactive wastes. Among other concerns were the continuing rise in disposal costs and uncertainties about the longevity of facility operations and responsibility for future post-closure controls. All siting attempts failed, primarily from popular opposition or, in some instances, litigation.

NRC simultaneously attempted in the late 1980s to develop regulations for release from control of certain

LLRW. They called this policy "Below Regulatory Concern" (BRC), and intended to allow release from regulation altogether of large amounts of certain low activity wastes, to be sold off and enter the marketplace for recycling into consumer products.

The levels of radioactivity remaining in the host of consumer products proposed for deregulation and recycle were presented as if they would be extremely low. The nuclear regulators and industry claimed that an individual's doses would be "too low to measure" and hence of no concern. They argued that those doses could be compared with normal naturally-occurring background radiation and therefore were to be deemed "harmless." The industry did not acknowledge that even natural background radiation has health consequences that are not trivial, resulting in a background level of "natural cancer."

In 1990, when the NRC was preparing to adopt its BRC regulation, the National Academy of Sciences Committee on the Biological Effects of Ionizing Radiation issued its BEIR V Report. In it, the BEIR Committee recognized for the first time the Linear No-Threshold Hypothesis (LNT)--and concluded that all ionizing radiation exposures carried risk of biological damage to the recipient. The conclusion of these experts was clear: that there is no safe level of radiation dose. This conclusion was restated in the Committee's recent BEIR VII document.

In the Energy Policy Act of 1992, the Congress revoked the NRC's BRC policy statement. But the public had begun to grasp the implications of the NRC's BRC policy. It meant that those unlabeled consumer products could include essentially any radioactive materials released from regulatory control: contaminated steel, copper, nickel, other metals, plastics, concrete, fabrics, wood, and many others. Contaminated consumer products could range from cooking pots to furniture to children's toys, zippers, jewelry, coins, belt buckles, building construction products, road beds, automobile bodies and parts, and many others. None of the slightly contaminated products would carry warning labels. Most people do not own highly sensitive radiation detection equipment. Therefore individuals would have no way to measure additional doses they were receiving–nor to determine the total extra doses received–absent any benefit to the recipient of the added dose, a violation of a basic tenet of radiation protection philosophy: First, to do no harm.

Contact by members of the public with each slightly contaminated object would result in a small exposure, probably a very small dose. But each dose would be an additive and uncounted dose to the total **multiple** exposures of that individual. The damage might be long delayed, with years or even decades passing before the delayed response appeared in the form of a cancer or leukemia, or other damage. The potential for radiation harm from multiple doses would be both **additive** and, over time, **cumulative**.

Recent advances in the field of radiation microbiology have now clearly established that alterations and injuries at the cellular, molecular, and DNA levels may occur at very low radiation doses. They include a variety of previously unanticipated effects, including but not limited to:

- Phenomena such as delayed mutational responses, whereby a cell may appear to reproduce normally with a mutation manifesting itself numerous cell generations later;
- Adaptive responses that may be genetically either positive or negative in their impacts on the exposed organism;
- Faulty cellular repair with potential subsequent adverse impacts on other organs;
- Bystander effects, with information transfer from one cell to another noncontiguous cell.

As scientific understanding of the complexities of radiation injury have advanced, questions have also arisen about the interrelationships between and among other contaminants that are routinely released into the biosystem from industrial plants and pollutants, from agricultural poisons, from herbicides, pesticides, and other substances that negatively affect recipients of exposures to one or many of these contaminants. The lessons taught by Rachel Carson and others began to be applied to the consequences of **synergies** between and among these many sources of exposures with their adverse consequences to the individual exposed. Very little research has been undertaken on these highly variable and complex biological relationships and consequences.

The Meaning of MACS: MULTIPLE, ADDITIVE, CUMULATIVE, and SYNERGISTIC impacts of our exposures to low-level radiation, chemicals and other somatic and genetic health hazards in our environment.

Of increasing concern among specialists in public health and environmental protection are the adverse impacts from repetitive undetectable low dose irradiations, both from the increasing sources of radioactive exposures that are released into the biosphere and the interactions between and among the multitude of other sources of biological damage that may be combined with increased radiation sources.

In the absence of certainty about the MACS impacts, the wise course of societal response would be the exercise of the Precautionary Principle that advises prevention in the absence of certainty about impacts. For, once either the somatic or genetic injury has occurred, the damage has been done, not only to the affected individual but also to future generations of her or his descendants, far into the future beyond just the gross genetic defects in the first two generations in the standards employed by the governmental regulators.

The present time is crucial for these issues of the MACS consequences. The demands of economic globalization are causing encouragement of trade in radioactive materials, as well as the multitudes of chemical and other contaminants in commerce. New worldwide recommendations of the International Commission on Radiological Protection (ICRP) that have just been adopted will result in relaxation of many of the dose standards, will continue the use of inappropriate "Standard (Reference) Man" as the basis for allowable radiation exposure levels for the sensitive fetus, and for rapidly growing young children, pregnant women, the elderly and others with impaired health. If the nuclear industries expand, there will be more exposures causing Multiple, Additive, Cumulative, and Synergistic injuries--MACS means damage to all.