

Nuclear Waste Isolation Means Zero Release of Radioactivity

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Abstract

New understandings of our planet require redefinition of our assumptions about nuclear waste. Isolation of radioactive waste from the biosphere and zero release of radioactivity is discussed in the context of a critique of current radiation standard-setting practices. Zero release requires the end of the nuclear fuel chain. Recommendations toward this goal are offered.

Isolation

The term "disposal" can no longer be applied to radioactive wastes from the nuclear fuel chain and nuclear weapons production. Disposal implies that you put something somewhere and walk away. We do not have a proven method to insure that radionuclides will stay where we put them. Experience over the last 50 years shows that to date, every type of nuclear waste "disposal" has leaked and done so faster and at higher rates than were projected by either dumpers or regulators (NIRS).

Our planet is a system of interlocking cycles that move materials. Nuclear materials are not special, they move in these cycles too. The Nuclear Age was launched before the acceptance of plate tectonics, now a cornerstone of geophysics. Today we have a much more dynamic model of Earth than the previous view of a static world that was created once, a long time ago. It is time to update our views of radioactive waste and reject the concept of disposal. Thus I start by reframing the goal:

We must attain radioactive waste isolation from the biosphere. The biosphere is all of life and the materials and energy that interact with life processes. Isolation must be effective for the period of hazard posed by the waste.

The only way to achieve this goal is by adopting a zero release policy and zero incremental dose and risk standards. Zero release must apply to all types of radioactive waste, all practices, and all releases. This policy precludes the deregulation and release of radioactively contaminated materials in so-called "recycling."

Some will dismiss this and what follows. It may be a loss of hope for the world. Alternately, those with a deep investment (financial, ideological or otherwise) in activities which depend upon irradiation of others and contamination of the environment will say either that zero release is not possible, or that it would too much. This sort of conflict of interest is reflected in nuclear policy which has, over the last half century resulted in tens of millions of people, as well as other species being exposed, involuntarily, to ionizing radiation over and above Earth's ambient radiation levels. Many of those who reject this message are themselves radiation victims already, but they do not, or cannot, acknowledge this fact.

Why We Won't Settle for "Just A Little Bit."

There is no safe dose of ionizing radiation. In the words of Dr Helen Caldicott (1994), all it takes is one cell and one radioactive decay for the possibility of cancer, or a genetic defect. No one can say that there will be damage and harm, but no one can guarantee that there will not.

Reports of increased incidence of human cancers and diseases, particularly in children, as well as reproductive impacts in the effluent pathways of nuclear facilities undercut conclusions drawn primarily from study of external doses of gamma radiation. We are still in the process of describing the effects of chronic low doses of ionizing radiation on diverse populations. A number of new studies that sound an alarm about low doses of radiation were reviewed by Resnikoff and Fairlie (1997) and also Gofman (1997).

Epidemiological studies, including the work of Wing et al (1991), Morgenstern et al (1997), Burlakova (1996) and others deliver findings that low doses of ionizing radiation cause more harm per unit of dose than higher exposures, calling into question standard dose-response ratios. These findings were anticipated by an independent analysis of data from Japanese atomic bomb survivors by Gofman (1990).

Genetic impacts are discussed less frequently than cancer. A recent review by Edwards (1997) reports that ionizing radiation can cause genetic impacts that are not displayed for several generations. This genomic instability is an issue for all forms of life. Latent genetic damage not yet displayed, is like a time bomb. We should think of this as the committed dose to the biosphere, and our job as limiting the total body-burden of Earth.

Each time some relatively low dose is approved, it allows levels of radiation or release of radioactivity that may become persistent. Radionuclides with a long half-life are cumulatively loaded into the environment and may result in impacts on health or long-term damage to the gene pool. Both entail loss and cost not only to the individual, but also to the systems they are part of. Genetic effects may be persistent within the population generation after generation. It is interesting to note that non-persistent radionuclides may also engender persistent effects within a population this way. Exposure standards which allow the release of radioactivity are based on the Law of Concentrated Benefit Over Diffuse Injury (Gofman 1993). This is not sustainable.

What matters biologically is the sum of all these relatively small doses. The "just a little" paradigm does not remember that it is the straw that breaks the camel's back. The loading of the environment with releases of radioactivity from multiple sites - in the US alone, it is thousands of sites - violates the principle of precaution. Altering the collective gene pool of life on Earth is not an experiment that is reversible. In this case we can't wait until we are sure adverse effects are attributable to this cause and then adjust our programs. We must, from now on decide that zero is the only acceptable level, and allow no further increase in background radiation levels.

People of the future have an equal right to a sustainable biosphere. They deserve the chance to continue to isolate our wastes. Anything we do with our radioactive waste must not preclude the possibility for them to maintain radioactive waste containment.

Reflections on Radiation Standard Setting

The International Committee on Radiological Protection (ICRP) makes recommendations to regulatory bodies for radiation standards. ICRP advocates defining a justification for radioactive practices. This is then used to justify the exposures that the standard will allow.

However, the exact opposite is what happens today (at least in the U.S.). If a set of assumptions can be given to show that a radioactive practice will meet the set regulation, it is automatically justified. The affected parties have little or no recourse. We must note that the vast majority of the involuntarily affected parties can't intervene because they have not yet been born, or they are not homo sapiens. There is also a large group of people out there now who would be banging down the door if they knew what was happening. They simply do not know because their governments and schools do not tell them. The informed public does not tolerate any level of involuntary and uninformed radiation dose. The only real cure for radiation health effects is prevention, and informed people know this.

In examining the "permissible dose" levels recommended by the ICRP for practices which result in the wastes we are concerned with, it is easy to see that ICRP privileges radioactivity when compared to the regulation of other harmful materials.

The recommended standard of 100 millirems annual exposure for the public translates, using ICRP's dose - response assumptions, to a risk of 3.5 fatal cancers in 1000 people exposed annually over a lifetime of 70 years. ICRP uses a linear, quasi-no-threshold model. Doing the math, this is a lifetime fatal cancer risk of 1 in 286.

By comparison, the regulation of toxic substances in the U.S. looks very protective. These also permit a lethal risk to those exposed, but the limit is set at only 1 fatal cancer in 1,000,000 or in some cases, 1 in 100,000 or 1 in 10,000.

The nuclear industry is enjoying a tremendous privilege. That's a nice way to say it. The honest way to say this is that the nuclear industry has been granted a generous "bag limit" on the local populations. This bag limit is 35 times higher than the least protective toxic standards.

Some think that these numbers don't mean anything. They share a collegial assumption that the linear, no-threshold model is conservative, designed to err on the side of safety. This is based on the idea that we have no data about low-dose exposures. Indeed we do. If ICRP were only to incorporate conclusions from the Hiroshima survivors (Preston 1987), they would multiply the risk factor by 3.4 --substantially increasing the acknowledged risk associated even with 100 mr dose levels to a 1 in 84, lifetime risk of fatal cancer. Other studies already cited place this factor even higher.

Permissive radiation standards result in a subsidy to the nuclear industry. Those subject to lax regulation don't have to spend as much to prevent exposures and environmental contamination, or reduce waste production. Instead, the real cost is born by those who receive the "allowable" dose. In fact, many of these people get a higher dose, since standards set an average allowable dose, but radioactivity is not known to distribute itself evenly in the environment. Communities in the effluent pathways suffer far more than the projected average.

It is important to note that ICRP and national regulators who adopt their recommendations are under attack for the use of a linear, no-threshold model. Boosters for an industry that depends upon irradiating people, are saying that there is a huge threshold of exposure before any harm occurs. Some take the radical position that radiation is healthful. Decades of data do not support this, to the contrary, there is no safe dose.

Nonetheless, ICRP's model, is not truly a linear, no-threshold equation. The use of the Standard Man, the ICRP's non-conservative Dose, Dose-Rate Effect Factor, adoption of "effective dose equivalent," and the use of averages create an effective threshold in their model. The public, and certainly other species, do not fit ICRP's assumptions in calculating the risk. There are layers of impact that are invisible to this model stemming from the greater sensitivity of the fetus, children and elders to radiation, and other factors.

The resulting underestimation of harm becomes yet another cost to society and bonus to the nuclear waste generators. Those who suggest that these more sensitive groups might "skew" the results of study of low-dose radiation health effects are signing a death warrant for our species, and others as well. After all, Standard Men are not known to reproduce alone.

"Effective dose equivalent" is a pernicious revision to radiation regulation. Any mechanism that permits a regulator to say that a dose has gone down while allowing radioactivity releases to go up is clearly serving those who contaminate the biosphere, not those that work to protect it.

In my work with communities in the path of discharges from nuclear facilities that are ostensibly in compliance with so-called acceptable limits, it is clear that there is already a level of sacrifice of health and life that is not acceptable. One is reminded of other societies (who we might view as bizarre) sacrificing humans to their Sun God. Yet, here we are in the 20th century, living with regulations that condone the deaths of people who are in the communities that host nuclear sites.

These communities are becoming aware of what the deal is. That the effects of radiation are thought to occur at random across a population does not make our society more honorable in their eyes. Just because the victims are anonymous losers in a cancer roulette does not make their suffering more acceptable than the Aztec's approach. It is interesting to note that over 95 % of the radioactivity in nuclear waste generated to date, is from energy production. Perhaps our sacrifices are to the same god after all. The bottom line is that this is not acceptable. We do know that radiation causes disease, and it must stop.

The End of the Nuclear Fuel Chain.

The isolation of radioactive waste from the biosphere is the end of the nuclear fuel chain.

Again, it is time to update our concepts. The old thinking of waste disposal as throw-it-away conceptualizes "the end of the nuclear fuel chain," as the moment when each unit of fuel waste is disposed. Indeed, the clean up, containment and isolation of the messes that generators have already made will look a little like this.

However, if nuclear waste generation continues, we cannot reach our goal of isolating radioactive waste from the biosphere. Every step in the nuclear fuel chain results in new waste, new releases of radioactivity in air, water, soil, new exposures to workers and the public. To avoid this would probably be prohibitively expensive, and maybe impossible.

Isolation of radioactivity for the duration of hazard will carry a price tag. The cost is likely to continue at some level over the time that isolation is needed. Therefore it is obvious that part of limiting these costs and attaining isolation is putting a limit on the source term. Given that there is no ultimate guarantee that isolation will be maintained, it is vital that the total number of curies be as small as possible. In other words, the goal of all standard setting must be to contribute to the global containment of source term, in all the senses of the word 'containment.'

The current model for radioactive waste disposal at Yucca Mountain is sustained radioactive release (illustration). With this approach it matters a great deal how many curies are placed in the hole. For Engineers who look only at the next decades in considering their job, it is easy to say it doesn't matter how much waste there is, "just dig a bigger hole." For Life Scientists concerned about limiting the body burden of Earth, a leaky hole is not worth putting the waste in. Such "disposal" must be seen for what it is: a false solution intended to give the appearance of an end to the nuclear waste problem, while in fact making it worse.

All practices known today to treat or process waste only result in more contamination, releases, exposures and usually a more caustic waste form.

Disposal standards and false "solutions" which allow release of radioactivity to the biosphere enable the nuclear fuel chain to continue. Further, standards are used to justify other radioactive practices, as well as inactivity. A disposal standard that allows release of radioactivity creates a precedent which makes it difficult to get a currently contaminated site cleaned to a more stringent standard. Dump standards which allow any level of exposure open the door for any place, and over time, everywhere, to become or stay contaminated to the release level for the dump. This one more reason why we will not settle for "a little bit," and certainly not a lot!

The only way for radioactive waste isolation to be the end of the nuclear fuel chain is to **end the fuel chain**. Local communities around the world are determined and making headway in doing just that. I invite the standard setters to think very carefully about whom they want to help.

Conclusions

Our goal is nuclear waste isolation from the biosphere for this generation and all to come, over the duration of hazard posed by the waste. Isolation is defined as zero incremental dose and zero release.

Radioactive waste isolation is the end of the nuclear fuel chain since nuclear activities depend upon further expansion of the waste source term, and all known activities seeking to transmute or recycle the source term will result in more releases and more exposures.

We must respect the rights of other species and future human generations to continue the isolation of our wastes, so we must not do anything that precludes the possibility of their accomplishing this.

Recommendations

In order to accomplish these goals, steps that could be taken now, include:

- Investment in containment technology and exploration of institutional components needed to succeed at intergenerational, inter-millennial waste isolation.
- All radioactive waste should immediately be made subject to a zero release, zero dose requirement wherever it is, now.
- All new radioactive waste facilities be subject to a zero release, zero dose standard and designed for long-term sustainable isolation which future generations can also maintain.
- All new licenses of any sort should have a zero release, zero exposure, zero new source term stipulation and existing licenses should be renegotiated with a date certain by which the same stipulations shall apply (exemptions for medical practices should be only for the consenting client, but involuntary exposure to the public).
- In a bridging step recommended by Dr. Rosalie Bertell for currently licensed practices and in the clean-up of sites, standards should be adjusted to bring radiation risks into line with those allowed for toxic substances (1 in 100,000 risk of fatal cancer for the public, with new worker standards as well), as part of transition to zero release and zero incremental dose.
- Full disclosure to the public about radioactive releases, operating history and contamination of nuclear facilities and surrounding areas in an easily accessible form. Those in the effluent pathways of nuclear facilities should be directly informed.
- As a society we need to acknowledge these harmful practices and make this visible so we can learn, heal and make new decisions. One step in that process might be to make memorials to those who have lost their lives and to those who still will, since there are effects that are still latent in our communities and the biosphere, even if we stop further radioactive releases today.

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