"LOW-LEVEL" RADIOACTIVE WASTE

IS NOT LOW RISK

Internationally, nuclear power waste is categorized as high, intermediate, or low-level waste. In the U.S. nuclear power waste is either high or so-called "low-level," with what other nations consider "intermediate" included in the "low–level" category.

In the US, "low-level" radioactive waste is defined in the Low Level Radioactive Waste Policy Act of 1980 and its 1985 amendments (P.L. 99-240) as radioactive material that is:

- not high-level radioactive waste or irradiated nuclear fuel
- not uranium, thorium or other ore tailings or waste from extraction and concentration for source material content
- classified as "low-level" radioactive waste by the US Nuclear Regulatory Commission.

"Low-level" radioactive waste is divided into four classes—A, B, C and Greater Than Class C (GTCC) —with A being the least concentrated and C being more concentrated and requiring longer institutional controls (10 CFR 61.55). Classes A, B and C are utility liabilities but states were intended to provide disposal.[1] As of the 1985 Low Level Radioactive Amendments Act, Greater Than Class C waste was designated a Department of Energy responsibility, and that waste is often stored with the high level irradiated fuel at nuclear power reactors, both awaiting a final repository.

In March 2009, the Nuclear Regulatory Commission classified depleted uranium (DU) as Class A "low-level" waste [1]. However, NRC Commissioner Jackzo admitted in his dissenting vote that DU does NOT belong in the Class A category due to its need for protective controls similar to those required for Class C waste [2]. So-called Depleted Uranium is uranium from which the Uranium-235 isotopes have been removed and concentrated for nuclear power and weapons production, leaving other uranium isotopes which are also long-lasting, chemically and radioactively hazardous.

Most of the radioactivity in so-called "low-level" radioactive waste comes from nuclear power.

THE "LOW"- AND HIGH-LEVEL CONNECTION

So-called "low-level" radioactive waste includes every radioactive element. In fact, radioactive elements that are high-level nuclear waste become "low-level" when they leak out of the irradiated fuel rod cladding [3]. So, plutonium, cesium, strontium, iodines, and hundreds of other radionuclides that are "high-level" become "low-level" simply by escaping from the irradiated fuel. Thus, both high- and "low"-level nuclear power wastes are **hazardous for literally millions of years.**

"Low-level" radioactive waste is one of the most misleading terms ever created. It is all nuclear waste that is **not** high-level waste, some transuranic waste, or mill tailings (P.L. 99-240).

High-Level Radioactive Waste is the irradiated fuel from the cores of nuclear reactors, the liquid and sludge wastes that are left over after irradiated fuel has been reprocessed (a procedure used to extract uranium and plutonium), the solid that would result from efforts to solidify that liquid and sludge from reprocessing (P.L. 99-240) [4]. (In 2004, to save money, the US Department of Energy cut political deals to allow some high level waste to be declassified so it could be left in tanks, not sent to a high level repository.)

Transuranic Waste is material contaminated with radioactive elements heavier than uranium, such as plutonium, neptunium, americium and curium. These elements have extremely long hazardous lives—hundreds of thousands to millions of years—and emit alpha radiation a type of radiation that is especially dangerous if inhaled or swallowed. **Some transuranic waste is allowed in the "low-level" radioactive waste category.** In 1983, when the US Nuclear Regulatory Commission (NRC) adopted regulations on land disposal of radioactive waste (10 CFR 61.55), it increased the allowable concentration of transuranics in "low-level" radioactive waste.

Uranium Mill tailings, resulting from mining and milling uranium for weapons and commercial reactors, are not usually included in the "low-level" waste category, but may be handled with it in some states. The large volumes of these wastes, which will emit radiation for centuries, pose serious health problems.

[1] In 1992 in NY v. US, the Supreme Court [505 *U.S.* 144 (*1992*)] overturned the provision of the Low Level Radioactive Waste Policy Amendments Act that would have required states to take title, liability and possession of commercially generated "low-level" radioactive waste generated within their borders. Many states continued to assist the nuclear waste generators to find dumps regardless, but without the unconstitutional requirement that taxpayers would own and be liable for the waste.

SO WHAT IS "LOW-LEVEL" RADIOACTIVE WASTE?

"Low-Level" Radioactive Waste includes [5]**:**

Irradiated Components and Piping reactor hardware and pipes that are in continual contact with highly radioactive water for the 20 to 30 years the reactor operates. The metal becomes "activated" or radioactive itself from bombardment by neutrons that are released when energy is produced. Also called Irradiated Primary System Components.

Control Rods from the core of nuclear power plants--rods that regulate and stop the nuclear reactions in the reactor core.

Poison Curtains which absorb neutrons from the water in the reactor core and irradiated fuel (high level waste) pool.

Resins, Sludges, Filters and Evaporator Bottoms from cleansing the water that circulates around the irradiated fuel in the reactor vessel and in the fuel pool, which holds the irradiated fuel when it is removed from the core.

Entire Nuclear Power Plants if and when they are dismantled. This includes, for example, from a typical 1,000 megawatt nuclear reactor building floor: over 13,000 tons of contaminated concrete and over 1,400 tons of contaminated reinforcing steel bar.

The highly radioactive and long-lived reactor wastes are included in the "low-level" waste category along with the much less concentrated and generally much shorter-lived wastes from medical treatment and diagnosis and some types of scientific research.

RADIOACTIVE CONCENTRATION vs. VOLUME

The nuclear industry and government commonly describe "low-level" waste in terms of volume although there can be a tremendous concentration of radioactivity in a small package and a small concentration in a big package. The amount of radioactivity, measured in CURIES, indicates how much radioactive energy is being emitted by the waste. (1 Curie = 37,000,000,000 or 37 Billion disintegrations or radioactive emissions per second from a radioactive material [6].) Each emission could initiate a cancer.

The medical waste from diagnosis and treatment shipped in one year from most states usually gives off a fraction of one curie of radiation. In contrast, each nuclear reactor generates hundreds and thousands of curies in "low-level" waste every year. Table 1 outlines the “low-level” waste that was received at the Barnwell radioactive waste disposal facility during the year 2008.

Table 1: Low-Level Radioactive Waste Sent to Barnwell Disposal Site by All States in 2008 (Information provided by MIMS database[2])

Waste Generator	*Volume (ft^3)*	*Activity (Curies)*
Utility	17,977.59	747,606.71
Medical	76.96	30.38

Note that utility waste (aka that produced by nuclear power plants) sent to Barnwell contains hundreds of thousands of curies of radioactivity, while the medical waste only contains about 30 curies of radioactivity. That means that, on average, each state is disposing of **LESS than ONE curie of medical radioactivity**, but is disposing of **THOUSANDS of curies of radioactivity from nuclear power!**

Nuclear reactor waste is concentrated:

- **Solidified liquid** emits about 2 curies per cubic meter
- **Filter/Demineralizer sludges** emit about 10 curies per cubic meter
- **Cartridge filters** emit about 20 curies per cubic meter
- **Demineralizer resins** emit about 160 curies per cubic meter
- **Primary Components** average 1000 to 5000 curies per cubic meter

All of this material is legally considered “low-level.”

STATES' AUTHORITY

States have the right and responsibility to protect their citizens' health. In 1980, Congress gave states the responsibility for "low-level" radioactive waste (P.L. 99-240). States can join Compacts which have the right to bring in waste from states outside the compact or to keep it out. How and whether states choose to take on that responsibility will be reflected indefinitely into the future.

[2] In 2004, the accuracy of the MIMS database was questioned by GAO in document GAO-04-604; however, the problems have been addressed since then (see MIMS homepage for more information). The MIMS database can be accessed at http://mims.apps.em.doe.gov/.

HALF-LIFE AND HAZARDOUS LIFE

Radioactive elements decay by emitting energy in the form of radioactive particles and rays. As radiation is given off, other elements (some radioactive and some stable) are formed.

The **Half-Life** is the time it takes for HALF of the radioactive element to decay (give off half of its radioactivity) [6]. Different radioactive elements have different half-lives.

The **Hazardous Life** of a radioactive element is about 10 or 20 Half-Lives. It is the time it takes for the radioactivity to decay to a thousandth or millionth of its original amount….there is no truly "safe" level. (It is best to measure the amount of radiation after 10 or 20 half-lives before releasing waste from active controls.)

Reactor waste remains hazardous for a very long time**.** Most **medical waste** from treatment and diagnosis is hazardous for a very short time**.** Research and industrial waste can contain small amounts of some long-lived radioactive materials.

Among the radioactive elements commonly found in **nuclear reactor** "low-level" waste are:

- **Tritium**, half-life[3] of 12 years, hazardous life of 120-240 years
- **Strontium-90**, half life of 28 years, hazardous life of 280-560 years
- **Nickel-59**, half life of 76,000 years, hazardous life of 760,000-1,520,000 years
- **Iodine-131**, half-life of 8 days, hazardous life of 80-160 days
- **Iodine-129**, half-life of sixteen million years, hazardous life of 160-320 million years

By contrast, common **medical** waste elements include:

- **Technetium-99m**, half-life of 6 hours, hazardous life of 2.5-5 days
- **Galium-67**, half-life of 78 hours, hazardous life of 1-2 months
- **Iodine-131**, half-life of 8 days, hazardous life of 80-160 days

The vast majority of medical waste is hazardous for less than 8 months. Yet, it is in the same category as reactor waste that will be hazardous for hundreds of thousands to millions of years.

Clearly, the definition of "low-level radioactive waste" must be changed**.** It would make sense to redefine the more concentrated and/or longer-lived waste as high-level. Instead the trend by the US agencies (NRC and DOE) is to try to downgrade some high level waste to so-called "low-level." Active recontainerization and operational control must be provided for the entire hazardous life of the waste, yet the regulations require only 100 years of passive institutional control (10 CFR 61.59). Thus, waste hazardous longer than 100 years could be forgotten. Retrievability is essential.

PLANNED LEAKAGE AND "ACCEPTABLE" RISK

Waste containers and waste forms will not last as long as some waste remains hazardous. Therefore, waste should be placed in a manner which will facilitate recontainerization and make continued isolation from the environment possible in the future. If the waste is "disposed of" as the NRC currently requires, it will not be isolated from the environment. "Planned leakage" will occur at (what NRC considers) an "acceptable" leak rate leading to "acceptable" public radiation exposures and health risks. The allowable leak rates and exposure levels are determined by federal agencies, not those experiencing the risk.

To avoid leakage, above-ground, engineered storage at or near the source of generation could allow responsible routine monitoring and repair.

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[3] See General Electric *Chart of the Nuclides*, Twelfth Edition (Revised), 1977, for half lives of radioactive elements.

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[2] United States. NRC. *Commissioner Jaczko's Revised Comments on SECY-08-0147 Response to Commission Order CLI-05-20 Regarding Depleted Uranium*. By Gregory Jackzo. 15 Apr. 2009 http://www.nirs.org/radwaste/llw/jaczko_ducomments.pdf

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