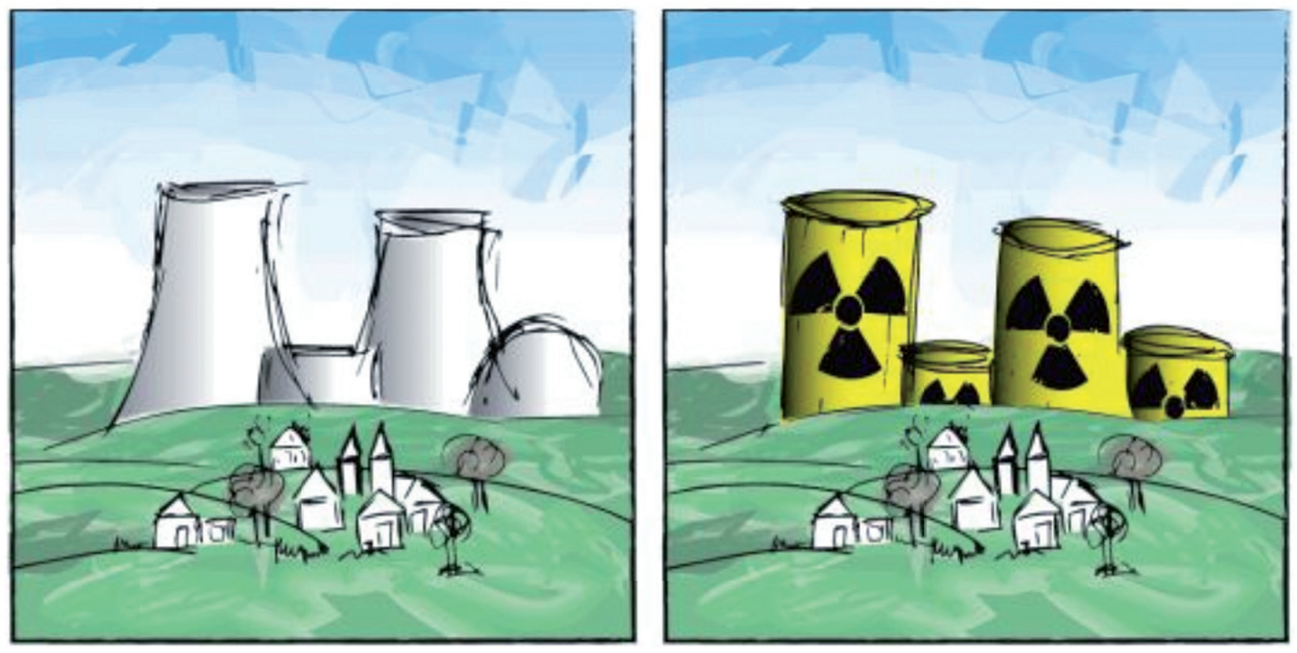


Graphics: *ausgestrahlt*

Nuclear waste – What are we talking about?

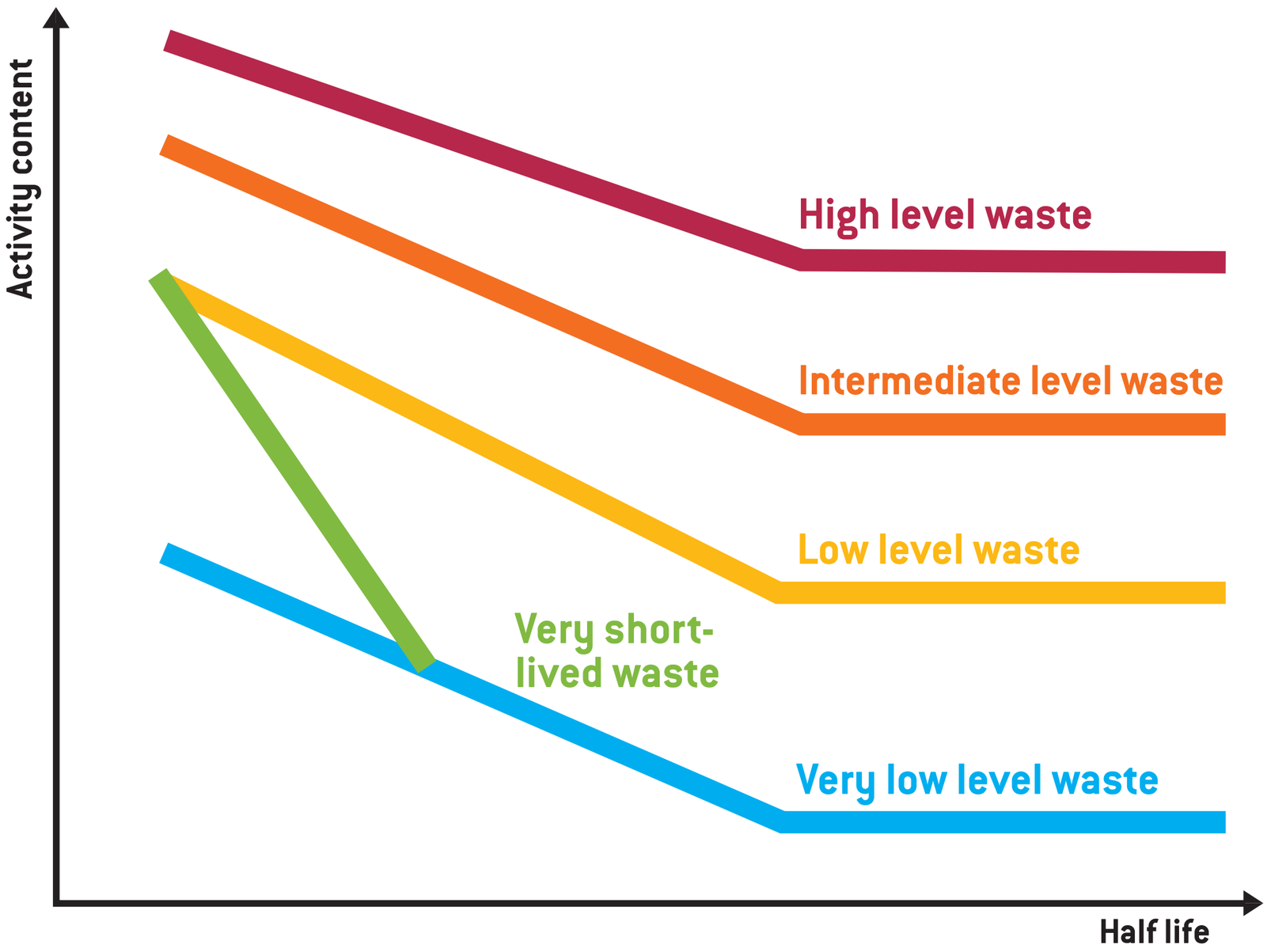
High level waste (HLW) consists of spent or damaged fuel rods. This type of waste generates significant amounts of heat for many centuries and contains large amounts of long lived radionuclides. It is generally considered that this type of waste requires very long-term deep geological disposal.

Intermediate level waste (ILW) contains long lived radionuclides in quantities that require shielding, containment and isolation for long periods of time but requires limited or no provisions for heat dissipation. Examples are ion-exchange resins, used to clean contaminated water from the reactor and certain parts of a decommissioned reactor. It is generally considered that this type of waste requires long-term underground disposal.

Low level waste (LLW) contains limited amounts of long-lived radionuclides, but may contain high activity levels of short lived radionuclides. It usually does not require significant shielding, but robust isolation and containment for hundreds of years. This is usually contaminated equipment from the nuclear plant, such as protective shoe covers and clothing, rags, mops, filters, sheeting, maintenance equipment, pipes, etc.

It is generally considered that this type of waste requires long-term near-surface or underground disposal. There is no clear line between ILW and LLW, which is why they are often referred to together.

Very low level waste (VLLW) usually consists of contaminated construction materials such as steel, concrete or plastic and does not need high levels of containment or isolation due to its very limited concentration of longer lived radionuclides. It is generally considered that this type of waste requires disposal in special surface landfills.



Very short-lived waste (VSLW) contains only radionuclides with short half lives (< 100 days). This is usually material from research or medical facilities. It is generally considered that this type of waste can be stored for a few years and then cleared from regulatory control.

Exempt waste (EW) refers to materials that meets politically defined criteria for clearance, exemption or exclusion from regulatory control from the perspective of radiation protection. It is generally considered that this type of waste can be disposed of in conventional landfills or recycled, as long as the effective dose to individuals in the general public does not exceed 10 mSv per year.

IPPNW – International Physicians for the Prevention of Nuclear War / Physicians in Social Responsibility e.V., Dr. Alex Rosen
rosen@ippnw.de, Körtestrasse 10, 10967 Berlin, Germany,

Why should doctors worry about nuclear waste?

Photo: Fouth Australian Community History / CC by-nc-nd/2.0

URANIUM MINING IN RADIUM HILL, AUSTRALIA

Photo: Dierk Schäfer / CC BY 2.0

THE CLEARING OF LOW-LEVEL WASTE POSES SIGNIFICANT HEALTH RISKS.

Photo: Michaela Mügge / CC BY NC 3.0

FUTURE GENERATIONS WILL BE REQUIRED TO PAY FOR THE DISPOSAL OF NUCLEAR WASTE.

Uranium mines

Around the globe, there are hundreds of uranium mines, most of them decommissioned, some still in operation. At all these sites, radioactive waste accumulated in form of tailings and waste rock, in most cases under the open sky, in landfills, rivers or lakes. This radioactive waste needs to be safely deposited in permanent storage sites, the countryside decontaminated and proper health and safety regulations implemented. This is already challenging for industrialized countries like Germany or the US, but poses an almost insurmountable problem for developing countries like South Africa or India.

Decommissioning nuclear plants

Of the approximately 440 nuclear power plants operating worldwide, over 160 will be decommissioned by 2030. This will lead to large amounts of high, intermediate and low level nuclear waste that need to be safely stored for thousands of years. In addition, demolition of nuclear power plants will result in millions of tons of radioactively contaminated construction material that have to be dealt with. Clearance of this "very low level nuclear waste" could lead to radioactive materials accumulating in household appliances, construction materials or on normal landfills without any regulations or radiation protection measures. Even low levels of additional exposure to radiation cause increased risks to public health.

Enrichment and reprocessing sites

At enrichment and reprocessing facilities like La Hague in France or Tokaimura in Japan, high level radioactive waste poses not only a safety problem, but also a proliferation risk. Hundreds of tons of plutonium are accumulating in above-surface storage facilities, ill-equipped to handle natural catastrophes, attacks by terrorists or regular armies or acts of cyber warfare. In addition, this material could be used to produce nuclear warheads or dirty bombs.

Long-term storage of nuclear waste

Storage and disposal sites for nuclear waste pose a significant public health risk. Surface facilities could be a target for conventional or cyber terrorists as well as parties in armed conflicts, essentially turning such a facility into a dirty bomb. Natural catastrophes or human error could cause leaks, spills and radioactive contamination of the environment. The most sensible option would therefore be deep geological repositories in formations with a high probability of remaining stable for tens of thousands of years. Engaging in a transparent and inclusive process to find such locations, preparing the sites for storage, transferring the waste and sealing the sites for good would most likely confront any state with serious challenges, take many decades, cost billions of US dollars and bring with it a host of political conflicts. At the same time, the issue raises questions pertaining to generational justice, as future societies will be required to pay for the disposal of waste from a technology they never experienced – or face its environmental and public health hazards.

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rosen@ippnw.de, Körtestrasse 10, 10967 Berlin, Germany,

Clearance of radioactive waste

Radioactivity is distributed very unevenly in a nuclear power plant. When a plant is decommissioned, almost all of the total radioactive inventory is contained in 1 % of the total waste: the reactor pressure vessel, parts of the biological shield, sluices and contaminated pipelines. Meanwhile, 99 % of the total waste contain no or very low levels of radiation.

The concept of "Clearance"

In order to reduce the amount of waste slated for long-term disposal, companies try to "clear" the vast majority of this very low-level waste from regulatory control. For this purpose, politicians are asked to define an acceptable dose level for public exposure and waste with radioactivity below this dose level can then be stored on general domestic waste dumps, burnt up in waste incinerators or recycled without further monitoring or restrictions. This waste is by no means free of radioactivity. It is simply no longer legally considered radioactive waste and therefore does not fall under regulatory control or surveillance of radiation protection agencies. Through these measures, a lot of money could be saved, as long-term storage of radioactive waste is very expensive. At the same time, irradiated material would appear in our daily life, undetected and without our knowledge – in pots and pans, heaters, orthodontic brackets, play-grounds, pavements or gravel.

International clearance levels for demolition material were established with the aim of not exceeding a maximum individual dose of 10 µSv per person per year. Considering the background radiation of 2-4 mSv per year, as well as exposure to other risks and noxious agents in a modern society, an additional radiation dose of 10 µSv per year is supposed to be irrelevant, according to the nuclear industry. However, numerous epidemiological studies have shown that background radiation causes measurable adverse health effects and that every additional radiation exposure can lead to the development of cancer and other diseases.

Ionizing radiation is always harmful

There is no threshold below which radiation is not harmful. If many people are exposed to low levels of radiation, there will be a noticeable increase in the absolute incidence of certain diseases. In addition, the 10 µSv concept is based on outdated and systematically flawed ICRP risk estimations from 1977. Even the publicly accessible calculations underestimate the radiation risk by a factor of 13, when compared to more recent publications such as the BEIR VII report of the US National Academy of Sciences. Newer scientific research even suggests an underestimation of the health effects of ionizing radiation by a factor of up to 24.

At the same time, there is concern about the health risks of the decontamination procedures required for clearance measurements. Besides activities like disassembly and transportation of contaminated materials, additional materials like water or cleaning agents have to be brought into the plant. These materials become liquid radioactive waste themselves, which have to be properly disposed of as well.

There would be no need for disassembly of nuclear plants

There is an alternative to clearance of contaminated materials from a decommissioned nuclear power plant: First, nuclear fuel assemblies and all highly contaminated material is removed from the plant. After this "core removal", the nuclear power plant is not to be dismantled, but instead "sealed" and guarded permanently – provided the local geologic conditions can guarantee an appropriate stability. There would be no need for disassembly, no danger of radioactive materials reaching the public and the danger of a terrorist attack or theft is extremely low, as the structure would only contain very low level radioactive waste.

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