Fissile Materials Health & Environmental Dangers

The production of plutonium and highly enriched uranium (HEU) for nuclear weapons over the past fifty years caused enormous environmental damage and posed risks to the health of workers and communities. Plutonium and HEU are located at many sites throughout the United States, some of which are significantly contaminated. The Department of Energy recently estimated that cleaning up the U.S. nuclear weapons production complex will cost $200 billion to $500 billion and will take up to seventy-five years.

The dangers posed by plutonium and HEU are three-fold: they can be used to make nuclear weapons, they are radioactive and toxic, and their production processes involve other hazardous substances.

The Health and Environmental Dangers of the Materials

Outside the body, plutonium and uranium pose minimal risks to human health unless exposure is on a sustained basis. This is because the main type of radiation from both materials, alpha radiation, is very short-range and is stopped by the outer dead layer of skin. However, if plutonium or uranium gets into the body, the high-energy alpha radiation can damage cells and cause cell mutations that can lead to cancer. The main health concern for plutonium is inhalation of small particles or absorption through cuts or wounds. While the amount of data is limited, animal studies suggest that as little as one millionth of an ounce of plutonium lodged in the lung is highly likely to cause cancer.

Like plutonium, uranium is a health hazard when small particles are inhaled or absorbed through wounds. But uranium is also more easily absorbed than plutonium though the gastrointestinal tract. Animal studies suggest that uranium may damage reproductive organs, may harm a developing fetus, and may increase the risk of leukemia and soft tissue cancers. Uranium is far less radioactive than plutonium, and uranium can cause acute damage to the kidneys by heavy metal poisoning well before radiation effects are manifest.

When in the form of small pieces of metal, plutonium and HEU can ignite upon exposure to air. There have been two major plutonium fires at the Rocky Flats plutonium processing plant near Denver — one in 1957 and one in 1969. The fires significantly contaminated parts of the facility. The amount of exposure to nearby populations is still being studied.

Under certain conditions, the accumulation of plutonium or HEU (such as in ventilation ducts or in solutions) can lead to a criticality, a chain reaction of fissioning atoms. The energy release from a criticality can be high enough to cause threats to worker safety and damage the container holding the materials.

The Health and Environmental Effects of Obtaining Plutonium

Plutonium must be chemically separated from spent nuclear fuel in order to get it into a form usable for nuclear weapons or nuclear reactor fuel. This process, called reprocessing, produces highly radioactive liquid wastes as well as huge volumes of low-level radioactive waste.

The Department of Energy estimates that a little over half of the costs of cleaning up the nuclear weapons production complex will be due to reprocessing — more than all other steps in the weapons production process combined.

After reprocessing and chemical dilution, the liquid wastes are hundreds of times more radioactive than the separated plutonium, and safely storing these wastes is a difficult and expensive task.

In the U.S., one hundred million gallons of high-level reprocessing waste are being stored in large holding tanks at Savannah River Site, South Carolina, and Hanford Site, Washington.

There is a potential that tanks containing reprocessing wastes could explode. In 1957, a reprocessing waste tank at Chelyabinsk in Russia exploded due to a cooling system failure, spewing a plume of radioactivity 1,000 meters high and contaminating 15,000 to 23,000 square kilometers. In the U.S., the risk of explosions derives from factors such as the build up of hydrogen and the reactions of chemicals dumped into the tanks. At the Savannah River Site there have been two documented cases of hydrogen accumulating in reprocessing waste tanks over the explosive limit. Explosion risks at Hanford are more difficult to evaluate because of the poor management of high-level waste at the site.

Over the past fifty years, 800 billion liters of low-level radioactive waste have also been discharged directly into the ground at Hanford.

Plutonium has contaminated inhabited areas near reprocessing sites and plutonium handling facilities in the U.S. It has migrated into groundwater at Savannah River and at Hanford.

Little is known definitively about the impact of weapons production and resulting contamination on the health of workers and surrounding communities, though numerous health studies have been undertaken. This is due partly to faulty radiation dose record-keeping, secrecy, a focus on deaths rather than disease, the lack of long-term follow-up, and the difficulties of drawing conclusions from a relatively small number of subjects.

An independent evaluation of radiation doses to workers at the Fernald uranium processing facility showed that workers in the 1950s and 1960s were exposed beyond the allowed limit, contrary to assurances provided to the workers by the Department of Energy.

The Health and Environmental Effects of Producing HEU

One of the most serious health hazards associated with producing HEU is uranium mining. A study of uranium miners conducted by the U.S. Public Health Service between 1948 and 1982 showed significant excesses of respiratory cancers; by 1978, white underground miners in the study suffered five times the expected rate of such cancers. The cancer risk from uranium mining is mainly due to exposure to the decay products of radon, which is itself a decay product of uranium-238.

Uranium used to produce HEU for U.S. nuclear warheads was mined before the mid-1960s. Mines operating since then have produced uranium for commercial purposes and to a lesser extent for the reactors that propel some naval vessels.

Most uranium mines in the U.S. have been shut down, but the radioactive wastes from uranium processing still pose a health risk to segments of the U.S. population. These wastes, called mill tailings, contain long-lived radioactive isotopes. As of the late 1980s, some 220 million metric tons of mill tailings had accumulated from uranium production for nuclear weapons and nuclear power. According to the Environmental Protection Agency, groundwater has become contaminated at virtually all mill tailings sites.

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