Background Information on Depleted Uranium

The uranium fuel cycle begins by extracting and milling natural uranium ore to produce "yellow cake," a varying mixture of uranium oxides. Low-grade natural ores contain about 0.05 to 0.3% by weight of uranium oxide while high-grade natural ores can contain up to 70% by weight of uranium oxide. Uranium found in natural ores contains two principle isotopes – uranium-238 (99.3%) and uranium-235 (0.7%). The uranium is enriched in uranium-235 before being made into nuclear fuel. Uranium enrichment processes generate a product consisting of 3 to 5 percent uranium-235 for use as nuclear fuel and a product of depleted uranium (about 0.3 percent U-235). The depleted uranium has some commercial applications including counterweights and antitank armaments. However, the commercial demand for depleted uranium is currently much less than the amounts generated. For instance, the U.S. Department of Energy (DOE) has about 750,000 metric tons of depleted uranium in storage. Under the U.S. Enrichment Corporation Privatization Act, DOE is required to accept depleted uranium from a U.S. Nuclear Regulatory Commission (NRC) licensed uranium enrichment facility if the depleted uranium is determined to be low-level radioactive waste. If the depleted uranium has no commercial use, the licensee can transfer the material to DOE or dispose of it at a commercial disposal site if it meets the disposal site's requirements.

For more information on Depleted Uranium, see below:

Uses

DU is used in the manufacturing of ammunitions used to pierce armor plating, such as those found on tanks, in missile nose cones and as a component of tank armor. Armor made of depleted uranium is much more resistant to penetration by conventional anti-armor ammunitions than conventional hard rolled steel armor plate.

Armor piercing ammunitions are generally referred to as "kinetic energy penetrators". DU is preferred to other metals, because of its high density, its pyrophoric nature (DU self-ignites when exposed to temperatures of 600° to 700° and high pressures), and its property of becoming sharper, through adiabatic shearing, as it penetrates armor plating . On impact with targets, DU penetrators ignite, breaking up in fragments, and forming an aerosol of particles ("DU dust") whose size depends on the angle of the impact, the velocity of the penetrator, and the temperature. These fine dust particles, can catch fire spontaneously in air. Small pieces may ignite in a fire and burn, but tests have shown that large pieces, like the penetrators used in anti-tank weapons, or in aircraft balance weights, will not normally ignite in a fire.

TOP

Health effects

Uranium is introduced into the body mainly through ingestion of food and water and inhalation of air. When inhaled, uranium is attached to particles of different sizes. The size of the uranium aerosols and the solubility of the uranium compounds in the lungs and gut influence the transport of uranium inside the body. Coarse particles are caught in the upper part of the respiratory system (nose, sinuses, and upper part of the lungs) from where they are exhaled or transferred to the throat and then swallowed. Fine particles reach the lower part of the lungs (alveolar region). If the uranium compounds are not easily soluble, the uranium aerosols will tend to remain in the lungs for a longer period of time (up to 16 years), and deliver most of the radiation dose to the lungs. They will gradually dissolve and be transported into the blood stream. For more soluble compounds, uranium is absorbed more quickly from the lungs into the blood stream. About 10% of it will initially concentrate in the kidneys.

Most of the uranium ingested is excreted in feces within a few days and never reaches the blood stream. The remaining fraction will be transferred into the blood stream. Most of the uranium in the blood stream is excreted through urine in a few days, but a small fraction remains in the kidneys and bones and other soft tissue.

TOP

Toxicological and Radiological concerns

In sufficient amounts, uranium that is ingested or inhaled can be harmful because of its chemical toxicity. Like mercury, cadmium, and other heavy-metal ions, excess uranyl ions depress renal function (i.e., affect the kidneys). High concentrations in the kidney can cause damage and, in extreme cases, renal failure. The general medical and scientific consensus is that in cases of high intake, uranium is likely to become a chemical toxicology problem before it is a radiological problem. Since uranium is mildly radioactive, once inside the body it also irradiates the organs, but the primary health effect is associated with its chemical action on body functions.

In many countries, current occupational exposure limits for soluble uranium compounds are related to a maximum concentration of 3 µg uranium per gram of kidney tissue. Any effects caused by exposure of the kidneys at these levels are considered to be minor and transient. Current practices, based on these limits, appear to protect workers in the uranium industry adequately. In order to ensure that this kidney concentration is not exceeded, legislation restricts long term (8 hour) workplace air concentrations of soluble uranium to 0.2 mg per cubic meter and short term (15 minute) to 0.6 mg per cubic meter.

Like any radioactive material, there is a risk of developing cancer from exposure to radiation emitted by natural and depleted uranium. The annual dose limit set by the IAEA for a member of the public is 1 mSv, while the corresponding limit for a radiation worker is 20 mSv. The additional risk of fatal cancer associated with a dose of 1 mSv is assumed to be about 1 in 20,000. This small increase in lifetime risk should be considered in light of the risk of 1 in 5 that everyone has of developing a fatal cancer. It must also be noted that cancer may not become apparent until many years after exposure to a radioactive material.

TOP

Current Issues

Existing NRC regulations at 10 CFR 61.55, "Waste Classification," specify criteria for determining the classification of low-level radioactive waste for land disposal at a near-surface facility. The original development of 10 CFR 61.55 did not explicitly consider the impacts resulting from the disposal of unique waste streams such as significant quantities of depleted uranium from the operation of a commercial uranium enrichment facility. When 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste," was initially developed, there were no commercial facilities generating significant quantities of depleted uranium waste streams. As a result the analysis only considered the types of uranium-bearing waste streams being typically disposed of by licensees at the time. Additionally, the nature of the radiological hazards associated with DU presents challenges to the estimation of long-term effects from its disposal – namely that its radiological hazard gradually increases due to the ingrowth of decay products, eventually peaking after 1 million years, rather than decreasing significantly over a few hundred years like that of typical LLW.

The U.S. Nuclear Regulatory Commission (NRC) staff has identified several key issues for initial discussion with stakeholders on disposal of DU. These include defining key regulatory terms such as unique waste streams and significant quantities of depleted uranium as well as technical parameters of a site-specific analysis including a time period of performance, appropriate exposure scenarios for protection of the public and individuals from inadvertent intrusion. The NRC staff is also soliciting stakeholder views on technical issues for a site-specific analysis of near-surface disposal of significant quantities of depleted uranium. These technical issues include appropriate considerations for depleted uranium waste form(s), uranium geochemistry, and radon migration and exposure. These issues arose from the results of the NRC staff's technical analysis (SECY-08-0147) that was submitted to the Commission on October 7, 2008, in response to Commission Order CLI-05-20 regarding depleted uranium. Given those issues, the Commission's related Staff Requirements Memorandum (SRM-SECY-08-0147), dated March 18, 2009, instructed the staff to begin engagement with stakeholders and interested parties to initiate development of the technical basis for possible revision of the 10 CFR Part 61, "Licensing Requirements for Land Disposal of Radioactive Waste." Toward that end, the staff has scheduled public workshops to discuss the benefits and impacts of revising 10 CFR Part 61. In so doing, the staff hopes to identify potential conflicts and gain an understanding of any unintended consequences that may result from drafting and implementing related changes to the NRC's existing regulations.

TOP