Analysis: Weapons potential of high-assay low-enriched uranium fuel poses greater threat than publicly acknowledged

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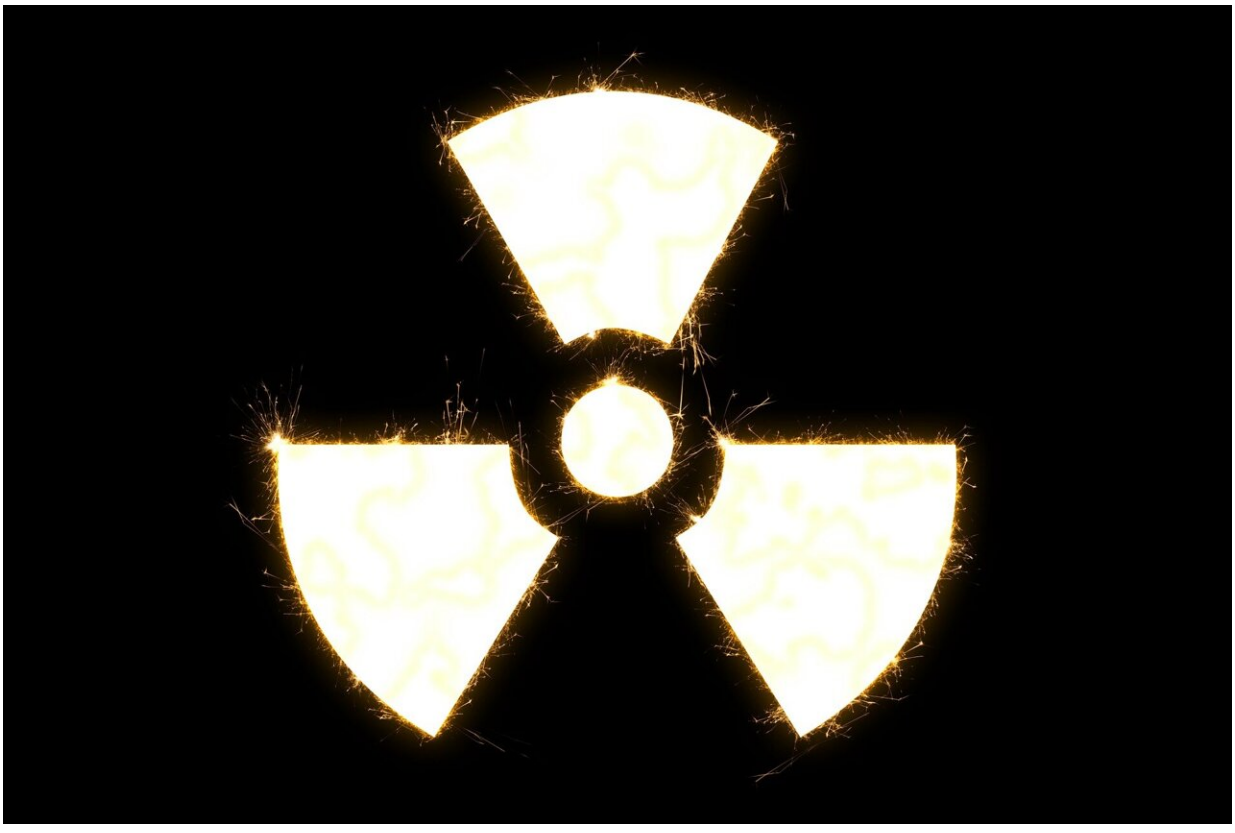

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An analysis published in the journal *Science* found that, contrary to a widely held assumption, the high assay low-enriched uranium (HALEU) now being produced with federal subsidies to fuel the next generation of small nuclear power reactors can be used directly to make nuclear weapons, and thus presents greater terrorism and nuclear proliferation threats than publicly acknowledged by the federal government and industry.

"Were HALEU to become a standard reactor fuel without appropriate restrictions determined by an interagency security review, other countries would be able to obtain, produce, and process weapons-usable HALEU with impunity, eliminating the sharp distinction between peaceful and nonpeaceful nuclear programs," according to the analysis conducted by five of the world's leading academic and independent proliferation experts.

"Such countries would be only days away from a bomb, giving the international community no warning of forthcoming nuclear proliferation and virtually no opportunity to prevent it."

The paper calls for additional measures to mitigate this risk as the United States and other countries pursue international deployment of HALEU-fueled reactors. "Given the stakes, we recommend that the US Congress direct the DOE's National Nuclear Security Administration to commission a fresh review of HALEU proliferation and security risks by US weapons laboratory experts."

Fuels for today's commercial reactors do not rely on HALEU, which is enriched to between 10% and 20% uranium-235, and instead typically use uranium enriched to below 5%. At those levels, the fuel cannot sustain an explosive chain reaction, which has prevented nations or

terrorists from repurposing commercial reactor fuel for weapons.

However, for technical reasons, many of the nuclear reactor designs that engineers want to build today would use HALEU. Since HALEU is below the 20% enrichment lower bound that defines highly-enriched uranium (HEU), which is understood to be directly usable in nuclear weapons, development of these reactors has not raised significant proliferation concerns.

But by reviewing information in the open literature to analyze the quantities and enrichment levels of HALEU that the new reactors would use, the authors of the *Science* paper concluded that HALEU above about 12% uranium-235 could be used to make practical weapons with yields comparable to the bombs that destroyed Hiroshima and Nagasaki. Many proposed reactors could contain enough HALEU to make a nuclear weapon and thus pose serious security risks, according to the article.

These risks are increasing because, although the quantity of HALEU in commercial use today is relatively small, the federal government is actively encouraging HALEU use and funding its production.

The U.S. Energy Department is covering half of the cost of deployment of two demonstration nuclear plants that plan to use multi-ton quantities of HALEU fuel, including the "Natrium" fast reactor that TerraPower, a company founded by Bill Gates, plans to build in Kemmerer, Wyoming.

Earlier this year, the federal government allocated $2.7 billion to subsidize production of enriched uranium, including HALEU, to fuel these and other reactor projects that are being considered for a range of applications, including powering data centers and oil and gas operations. Other countries are following suit.

Many HALEU-fueled reactors would use uranium enriched to just below

the 20% limit, which poses the highest risk. The researchers suggest that "a reasonable balance of the risks and benefits would be struck if enrichments for power reactor fuels were restricted to less than 10 to 12% uranium-235," which would allow many reactor designs to move forward with only modest economic consequences.

However, if higher enrichments continue to be used, the authors recommend that the security standards for protecting HALEU from theft be strengthened to the levels that apply for the weapon-usable materials HEU and plutonium.

More information: R. Scott Kemp, The weapons potential of high-assay low-enriched uranium, *Science* (2024). DOI: 10.1126/science.ado8693.
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