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National Security Advisor Jake Sullivan
Secretary of State Antony Blinken
Secretary of Energy Jennifer Granholm
Administrator of the National Nuclear Security Administration Jill Hruby (nominated)
Chairman, Nuclear Regulatory Commission Christopher Hansen

13 US Nonproliferation Experts Request a Review of the Department of Energy's Promotion of Civilian Plutonium Separation

We write as US nuclear nonproliferation experts and former government officials and advisors to express our concern about the the Department of Energy's support of research and development on the reprocessing of spent fuel to extract plutonium, a nuclear weapon-usable material, for fueling civilian nuclear power reactors. This policy, which was launched under the Trump Administration, is inconsistent with a half-century of successful US nonproliferation policy but is apparently being accelerated without high-level review as part of the Administration's broad initiative to decarbonize the US economy. If implemented, the policy could greatly magnify risks of nuclear proliferation and nuclear terrorism by multiplying the number of countries with access to nuclear weapons-usable material, thereby reversing decades of U.S. progress in reducing the number of such countries. We therefore call for a National Security Council-led review of DOE's fuel cycle R&D program.

The current proposals of DOE's Office of Nuclear Energy are to spend billions to subsidize private developers of so-called 'advanced' reactor technology, including plutonium recycle in some cases. Any reactors using such technology will generate more expensive power than conventional reactors and are therefore unlikely to be built at a scale that would contribute to the goal of carbon-neutrality by 2050. Embracing plutonium recycle would, however, dramatically reverse nearly 50 years of US policy that has effectively tamped down the proliferation threat from the spread of plutonium separation to both US allies and adversaries.

Saving the world from climate disaster need not be in conflict with saving it from nuclear weapon proliferation. Plutonium separation and use in fresh fuel would have no benefits to nuclear power. Indeed, it would make nuclear power and the associated radioactive waste management problem more costly, complex and controversial.

Repeat of a proliferation debacle in the 1970s? Some of us are old enough to have participated in the Ford or Carter Administration reviews of the promotion of a global "plutonium economy" by DOE's predecessor agency, the US Atomic Energy Commission. These reviews were undertaken after India's first nuclear test in 1974, which used plutonium produced and separated with the AEC's help, intended to aid India's civilian nuclear energy program. India has today an estimated 150 plutonium warheads but still no operating plutonium-fueled reactor.

The Ford Administration discovered that the governments of Brazil, Pakistan, South Korea and Taiwan – all under military rule at the time – were going down the same track with similar assistance from France and Germany. The US largely halted these technology transfers, but

Pakistan ultimately was able to use design information from France to separate plutonium for its nuclear-weapon program.

No economic or environmental case for spent fuel reprocessing. The Carter Administration reviewed the AEC/DOE domestic programs to promote plutonium breeder reactors and reprocessing and concluded neither was economic or necessary. After the estimated cost of DOE's proposed demonstration breeder reactor increased five-fold, Congress agreed. US nuclear utilities decided that recycling the plutonium in their spent fuel would be too costly and Congress mandated that DOE build a deep-underground repository for direct disposal of their spent fuel.

Worldwide, about \$100 billion has been spent on developing liquid-sodium-cooled breeder reactors with meager results. Only two prototypes are online today – both in Russia. Rosatom judges that they are not competitive with its water-cooled reactors. Prototypes under construction in China and India are suspected of being intended to produce weapon-grade plutonium in addition to electrical power. Japan, which acquired plutonium-separation technology from France before the US policy change, is the only non-weapon state that still pursues reprocessing. It has enough separated plutonium to produce thousands of nuclear weapons.

When the site selected by Congress for the US national radioactive waste repository was blocked by political opposition in Nevada, in the early days of the G.W. Bush Administration, some proposed dealing with the US spent fuel problem by pyroprocessing, a reprocessing technology claimed to be “proliferation-resistant.” But a DOE-commissioned National Academy of Sciences study had already advised that reprocessing would not significantly reduce the hazards from buried radioactive waste.¹ Those conclusions have been confirmed by subsequent studies in the US, France and Sweden. And a study by experts from six DOE national laboratories found that pyroprocessing would be about as susceptible to proliferation as the standard reprocessing technology used worldwide.² Congress concluded that, pending the availability of a permanent geological repository, it would be much less costly to store spent power reactor fuel in air-cooled dry casks.

Repeating past mistakes? The US currently has 93 operating nuclear power reactors – still the world's largest fleet – but aging. Construction on the newest began more than four decades ago. Construction on four new conventional reactors was launched in 2013 but two were cancelled after cost overruns and delays. DOE supported the other two with \$12 billion in loan guarantees, but the construction time doubled as has the estimated cost (currently projected at \$27 billion).³

Following this failure, DOE turned to promoting “advanced small modular reactors” (SMRs). This resulted in many proposals from nuclear startups. Some of these proposals are scaled up versions of the Idaho National Laboratory's liquid sodium-cooled, fast-neutron Experimental Breeder Reactor II (EBR II), which the Clinton Administration shut down in 1994. DOE is supporting a partnership of Bill Gates' Terrapower and GE-Hitachi to build their liquid-sodium-cooled “Natrium” reactor and plans to contract with Terrapower and GE-Hitachi to build a \$2.6-5.8 billion plutonium-fueled, sodium-cooled “Versatile Test Reactor” at its Idaho National Laboratory (INL) to test fuels and materials for future fast-neutron reactors.⁴

DOE's Office of Nuclear Energy is promoting the ability of SMRs “to burn plutonium [and] be more effective at dispositioning plutonium while minimizing the wastes requiring disposal”⁵ and DOE's ARPA-E recently put out a request for proposals for R&D on reprocessing the spent fuel from the reactor projects that the DOE is supporting.⁶ Meanwhile, INL is mired in a hugely costly effort to pyroprocess EBR II's spent fuel into stable wastefoms.⁷ The nuclear startups

hope to export the reactors. The importing countries would naturally also require the technology to recycle the plutonium, which would greatly increase risks of its misuse for nuclear weapons.

Canada's nuclear energy R&D establishment, encouraged by DOE's example, is also supporting fast-neutron reactor proposals, including from a UK startup, Moltex, which proposes to build molten-salt-cooled reactors fueled with plutonium extracted by pyroprocessing Canadian spent fuel. Moltex promises to make Canada an export hub for these reactors and their associated small reprocessing plants. Some of us have written to Canada's government, urging it to review the proliferation and radioactive-waste implications of this project.⁸

In 2020, INL completed a 10-year Joint Fuel Cycle Study with the Korea Atomic Energy Research Institute (KAERI) on the "feasibility" of South Korea pyroprocessing its spent fuel. Both INL and KAERI wish to continue this collaboration. The benefits of pyroprocessing to South Korea's nuclear energy program are doubtful but it would have considerable value if South Korea decided to pursue nuclear weapons. More than half of South Korea's public favors the country acquiring nuclear weapons. If South Korea elects a conservative president next year, it is likely that the new president, like former President Geun-hye Park (2013-17), will demand US agreement to a South Korean pyroprocessing program.⁹

The situation is rapidly spinning out of control. We are concerned that DOE's consequential proliferation-relevant decisions should be reviewed by the White House and State Department. The disastrous consequences of the AEC's unsupervised promotion of reprocessing five decades ago provides a warning of the proliferation and costly waste cleanup problems that could result from DOE backing these failed technologies.

We would be pleased to offer our expertise in support of a White House-led review.

Signatories to this letter follow with former US government positions and current affiliations for identification only. Contact: Frank N. von Hippel, Princeton University, fvhippel@princeton.edu

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¹ *Nuclear Wastes: Technologies for Separations and Transmutation* (National Academies Press, 1996).

² R. Bari et al, "Proliferation Risk Reduction Study of Alternative Spent Fuel Processing," Brookhaven National Laboratory, 2009, <https://www.bnl.gov/isd/documents/70289.pdf>.

³ Russell Gold, "Vogtle Nuclear Plant in Georgia Faces More Construction Delays," *Wall Street Journal*, 8 June 2021.

⁴ Department of Energy, *FY 2022 Congressional Budget Request*, Vol 3.2, \$137 million for Sodium (p. 82); \$145 million for the Versatile Test Reactor, (p. 91).

⁵ DOE Office of Nuclear Energy, <https://www.energy.gov/ne/benefits-small-modular-reactors-smrs> (under "safeguards & security/nonproliferation").

⁶ "DOE Announces \$40 Million to Reduce Fuel Waste From Advanced Nuclear Reactors,"

<https://www.energy.gov/articles/doe-announces-40-million-reduce-fuel-waste-advanced-nuclear-reactors>

⁷ Ed Lyman, "The pyroprocessing files," Union of Concerned Scientists, 12 August 2017,

<https://allthingsnuclear.org/elyman/the-pyroprocessing-files/>.

⁸ <https://sgs.princeton.edu/pdf/Open-Letter-to-Prime-Minister-Letter-Trudeau-May-2021.pdf>

⁹ Toby Dalton and Ain Han, "Elections, Nukes, and the Future of the South Korea-U.S. Alliance," Carnegie Endowment for Peace, 26 October 2020, <https://carnegieendowment.org/2020/10/26/elections-nukes-and-future-of-south-korea-u.s.-alliance-pub-83044>.