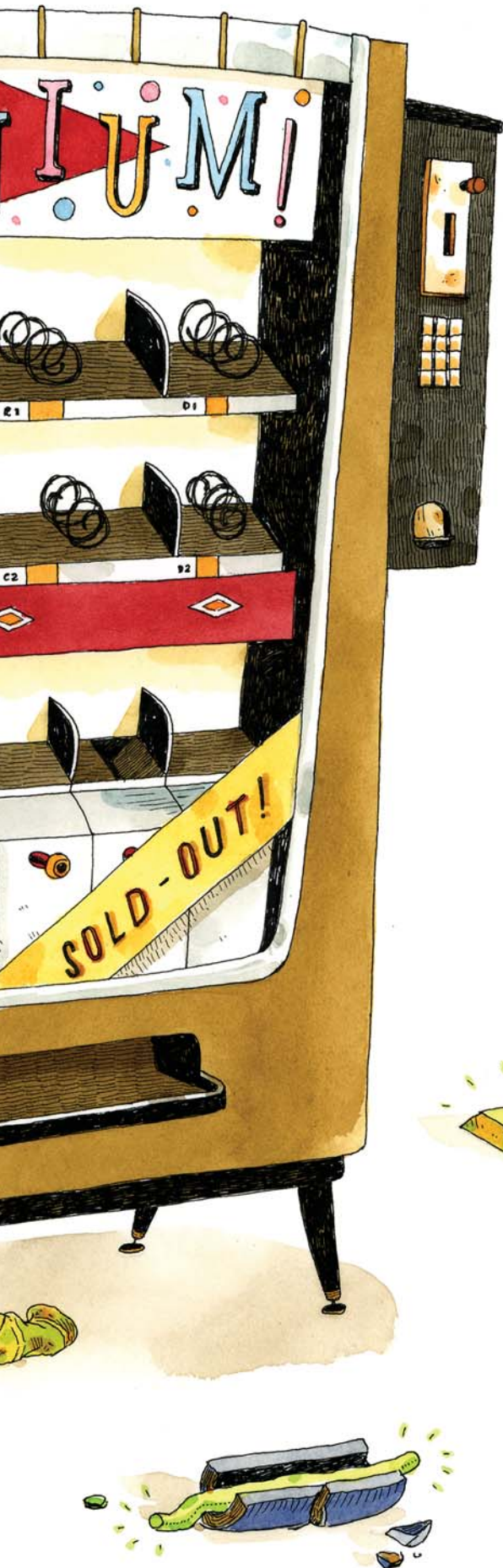


# BOMB- GRADE BAZAAR

How industry, lobbyists, and Congress weakened export controls on highly enriched uranium.

**By Alan J. Kuperman**





“THE RESPONSIBILITY FALLS TO US, TO TAKE NECESSARY ACTION TO PREVENT THE HORRORS OF 9/11 BEING REPLAYED, BUT ON A NUCLEAR SCALE,” DECLARED SPENCER ABRAHAM, THEN-U.S. ENERGY SECRETARY, AT A MEETING OF THE INTERNATIONAL ATOMIC ENERGY AGENCY IN MAY 2004.<sup>1</sup> TAKING UP THE CUDGELS, HE ANNOUNCED THAT WASHINGTON WAS ESTABLISHING A GLOBAL THREAT REDUCTION INITIATIVE (GTRI), “TO SECURE, REMOVE, OR DISPOSE OF AN EVEN BROADER RANGE OF NUCLEAR AND RADIOLOGICAL MATERIALS AROUND THE WORLD THAT ARE VULNERABLE TO THEFT . . . ENSURING THEY WILL NOT FALL INTO THE HANDS OF THOSE WITH EVIL INTENTIONS.” THE PLAN WAS APPLAUDED BY MANY WHO FELT THE UNITED STATES WAS NOT ACTING QUICKLY ENOUGH TO SAFEGUARD BOMB-GRADE HIGHLY ENRICHED URANIUM (HEU) FROM TERRORISTS.<sup>2</sup>

Yet, no sooner did the U.S. government take an important step forward than it took a giant leap back. Barely a year after Abraham’s announcement, President George W. Bush signed into law the Energy Policy Act of 2005, which includes an amendment that loosens restrictions on the export of HEU. Driven by a purported need to assure the domestic supply of medical isotopes, which was never actually at risk, the new statute retreats from more than a quarter-century of U.S. efforts to phase out HEU commerce and its catastrophic risks.

The individuals responsible for this legislative debacle comprise a sweeping cast of characters, including foreign producers of medical isotopes, their U.S.-based lobbyists, gullible sectors of the American medical community, and the compliant lawmakers who spearheaded efforts on Capitol Hill. It is a cautionary tale of how a single foreign company can weaken U.S. national security through misleading scare tactics and cold cash.

---

*Alan J. Kuperman is an assistant professor at the LBJ School of Public Affairs, University of Texas at Austin, and senior policy analyst at the Nuclear Control Institute, Washington, D.C. He worked as Charles E. Schumer’s legislative director when the Schumer amendment was enacted in 1992. This article is based on a paper presented to the Twenty-Seventh Annual International Meeting on Reduced Enrichment for Research and Test Reactors.*

## LIMITING RISK

The United States began exporting HEU in the 1950s under the Atoms for Peace program, which provided countries with research reactors and other technologies if they foreswore the development of nuclear weapons. The exported uranium was enriched to 93 percent, identical to that in U.S. nuclear weapons.

Some two decades later, U.S. national security officials belatedly awoke to the fact that such exports posed unacceptable risks: The HEU could be diverted to construct relatively easily designed, gun-type fission weapons similar to the atomic bomb dropped on Hiroshima. Accordingly, in 1978, the United States started phasing out HEU exports by developing substitute research reactor fuel of low-enriched uranium (LEU)—which was unsuitable for bombs—through its new Reduced Enrichment for Research and Test Reactors (RERTR) Program at Argonne National Laboratory. By increasing the density of LEU fuel, the program's scientists managed to preserve reactor performance while sharply reducing the risk of diversion for bombs.

Over the years, the program expanded repeatedly to phase out ever more HEU commerce. In 1986, the U.S. Nuclear Regulatory Commission (NRC) applied the principle domestically, ordering all NRC-licensed research reactors to convert from HEU to LEU as soon as suitable fuel was

the NRC order, and initiated bilateral programs to convert reactors in and supplied by China and the former Soviet Union. Following the terrorist attacks of September 11, 2001, the Energy Department created the GTRI, which incorporated and expanded funding for the RERTR Program, enabling conversion even of reactors with “lifetime cores” that did not require fresh fuel.<sup>3</sup>


Another crucial factor in limiting HEU commerce was an amendment to the Energy Policy Act of 1992, sponsored by New York Democratic Cong. Charles E. Schumer (who is now a senator). The amendment established incentives for foreign recipients of U.S. HEU exports to convert to LEU and barred further HEU exports unless three conditions were met: the recipient could not use existing LEU; the recipient pledged to convert as soon as a suitable LEU fuel or target was developed; and the recipient was actively working with the United States to develop such a substitute.

The Schumer amendment, in combination with LEU fuel development and a drop in the construction of new reactors, facilitated a rapid decline in U.S. HEU exports from an annual peak of nearly three tons in the late 1960s to a few tens of kilograms or less by the early 1990s—a reduction of 99 percent.<sup>4</sup> Since the United States had been by far the world's largest exporter of bomb-grade uranium, the global level of HEU commerce

sion of 23 remaining reactors.<sup>5</sup>

The sharp decline in the use of HEU as reactor fuel has spotlighted its growing use as targets to produce medical isotopes—molybdenum 99 and its decay products, including metastable technetium 99—that are utilized mainly in diagnostic procedures but also for cancer treatment. Indeed, the only U.S. HEU exports over the last few years have been to Canada for isotope production. Worldwide, the top four isotope producers—MDS Nordion in Canada, Mallinckrodt in the Netherlands, Institut National des Radioéléments in Belgium, and NECSA/NTP in South Africa—annually require a total of approximately 85 kilograms of HEU, which constitutes a significant portion of global HEU commerce and enough for several nuclear weapons.<sup>6</sup> Nordion already has a stockpile of more than 45 kilograms of unirradiated HEU, sufficient for one nuclear bomb of the simplest type or more using a sophisticated design.<sup>7</sup>

Annual HEU usage for radiopharmaceutical production is increasing to satisfy the rising medical demand for isotopes. In addition, the production facilities typically store the waste from processed targets, which contains hundreds of kilograms of slightly irradiated HEU that is still enriched to about 90 percent and also useable in bombs.<sup>8</sup> But the radiopharmaceutical facilities are often not as well-secured as military ones, leaving some of them prime



The radiopharmaceutical facilities are often not as well-secured as military ones, leaving some of them prime targets for terrorists.

available. Three years later, research started on LEU substitutes for HEU “targets,” which are irradiated in nuclear reactors to produce medical isotopes. Then, in the 1990s, the U.S. government explored the feasibility of converting its own unlicensed reactors, which were not covered by

dropped almost as precipitously. To date, 42 research reactors worldwide have converted to LEU or are in the process of doing so, with another 41 poised to convert to existing LEU fuel. The RERTR Program is continuing to develop ultra-high density LEU fuel that will enable the conver-

targets for terrorists. As the U.S. government recently emphasized about HEU stocks stored by isotope producers: “These are proliferation-attractive materials.”<sup>9</sup>

The good news is that medical isotopes can be made with LEU targets, which would eliminate the terrorist

threat. Smaller producers in Australia and Argentina already produce isotopes using LEU targets, developed indigenously or by the RERTR Program. The Energy Department recently confirmed that “conversion from HEU to LEU targets is technically feasible for all current processes.”<sup>10</sup> Indeed, when Argentina recently converted, the purity of its medical isotopes actually improved.<sup>11</sup> But the four major producers stubbornly reject the inconvenience and one-time cost of converting their production lines. They continue to rely on targets of HEU—and in doing so, they needlessly endanger us all.

## CHANGING THE LAW

The primary agitator for weakening U.S. export controls on bomb-grade uranium was Canada’s Nordion, the world’s largest producer of medical isotopes and the main supplier to the United States, which lacks a domestic producer. Nordion sought to escape from the conversion requirement of the 1992 Schumer amendment. Although Nordion’s parent company had committed in 1990 to phase out HEU use by 2000, Nordion later deviated from this pledge by designing a new facility based on HEU targets.<sup>12</sup> To assuage U.S. criticism, Canadian government officials in 1997 signed diplomatic notes pledging to convert to LEU targets, but Nordion dragged its feet on developing them while the facility was being built.<sup>13</sup>

Finally, in 2003, Nordion halted cooperation with the RERTR Program’s LEU target development effort, on the grounds that conversion would be too expensive and would interrupt operations of the soon-to-open facility.<sup>14</sup> In reality, the facility could have been converted prior to start-up because it still has yet to begin commercial operation due to unrelated technical problems with the two new reactors that would irradiate the targets and the plant that would process them. Meanwhile, Nordion

continues to produce isotopes with a decades-old reactor and processing facility, which rely on targets of HEU supplied by the United States.<sup>15</sup>

The 1992 U.S. law appeared to give Nordion only two choices in the long run: resume cooperation with the United States on conversion to LEU targets or halt production of isotopes. But Nordion devised a third option, which was to change U.S. law to water down the antiterrorism export restrictions. To sponsor this amendment in Congress in 2003, Nordion enlisted Republican Richard Burr of North Carolina (then a congressman and now a senator), who had been lobbied by radiologists at Wake Forest University’s medical school in his district at the behest of groups representing the medical isotope industry.<sup>16</sup> Doctors and officials at the school had also donated \$30,000 to his campaigns over the preceding six years.<sup>17</sup> In addition, Burr was a well-known supporter of the nuclear industry, which had contributed \$66,500 to his campaign in the previous election cycle, making him the seventh-highest recipient from the industry among all 435 members of the House of Representatives.<sup>18</sup>

Nordion also flexed its legislative muscle through the U.S.-based Committee on Isotope Supply, sponsored by the Council on Radionuclides and Radiopharmaceuticals (CORAR), Inc. The committee is nominally based in California but is chaired by Grant Malkoske, a Nordion vice president in Canada.<sup>19</sup> It retained a former NRC and Energy Department official, Washington, D.C., attorney James Glasgow, as a “consultant—legislative language.” But apparently Glasgow did more than just consult. An early electronic draft of the Burr amendment, which sought to waive the HEU export restrictions, reveals Glasgow as the “author” in its properties section.<sup>20</sup>

The committee also paid more than \$2 million to a Washington,

D.C.-based lobbying firm, the Alpine Group, Inc., which in turn donated more than \$25,000 to the members of the congressional energy committees overseeing the HEU export-control legislation.<sup>21</sup> Two of Alpine’s founding partners, James D. Massie and Richard C. White, are each listed by CORAR as a “congressional lobbyist” for Nordion’s U.S.-based committee.<sup>22</sup> White also was connected to a lobbying letter to U.S. legislators signed by members of the American College of Nuclear Physicians (ACNP). His hidden hand came to light when ACNP members forwarded the letter to Congress as a word-processing file but neglected to change the file’s properties section, which lists the “author” as “Rich White.”<sup>23</sup> The lobbyists also recruited help from the Virginia-based Society of Nuclear Medicine, which posted three template letters for its members to send to Congress. These letters’ properties sections likewise indicate the author as either the Alpine Group or one of its employees.<sup>24</sup>

Nordion was joined in its lobbying effort by Mallinckrodt, which is headquartered in Missouri but produces isotopes in the Netherlands. Mallinckrodt’s facility has not recently depended on U.S. HEU exports, instead drawing down its own small stock of HEU. Although Mallinckrodt has investigated conversion to LEU targets and found no technical obstacle, the company has sought to ensure its continued ability to use HEU targets to avoid the cost of conversion.<sup>25</sup> Accordingly, in 2003, it successfully encouraged its home-state senator, Republican Christopher “Kit” Bond, to sponsor the amendment in the Senate.<sup>26</sup>

Nordion garnered the support of many U.S. physicians based on the alarmist claim that unless the Burr-Bond amendment were adopted, the 1992 law could interrupt the supply of medical isotopes in the United States. This was a misleading scare tactic on several grounds. First, in 13

years under the 1992 law, the United States had never rejected a single license application to export HEU for use as targets to produce medical isotopes.<sup>27</sup> Second, the 1992 law explicitly permitted such exports so long as the recipient cooperated toward eventual conversion of its production process to LEU targets. Third, the current peak capacity for global isotope production is 250 percent of current demand, and Nordion is the only major isotope producer in recent years to rely on U.S. exports of HEU.<sup>28</sup> Thus, even if the United States were to halt HEU exports to Nordion for refusing to cooperate on conversion to LEU, other global producers could ramp up production temporarily to prevent an interruption in the U.S. supply of isotopes, while longer-term solutions were arranged. Fourth, Nordion maintains a stockpile of HEU sufficient for targets to produce isotopes for at least two years, so even if U.S. exports of HEU were halted, the other producers would have at least two years to arrange to satisfy the U.S. demand for isotopes without interruption.<sup>29</sup>

Yet the scare tactic appeared to work. In 2003, Burr successfully attached the amendment to the House energy bill, and Bond attached it to a separate Senate environment bill. When a House-Senate conference attempted to forge consensus on the energy bill, it substituted a “compromise” version of the Burr amendment that did not differ substantially from the original because it was negotiated by two legislators who supported the original amendment’s intent—Burr and Republican Sen. Pete Domenici of New Mexico. Both versions of the amendment waive the 1992 law’s restrictions as they pertain to HEU exports for isotope production in five countries: Canada, Belgium, France, Germany, and the Netherlands.

The revised version of the Burr amendment does have a few minor differences.<sup>30</sup> For starters, it does not

permit the NRC to expand the list of states subject to the waiver. Also, the National Academy of Sciences must report on the feasibility (including cost) of producing isotopes without HEU. The energy secretary must then report if any companies will supply the U.S. market with isotopes produced without HEU. If production of isotopes without HEU is feasible but not occurring, the energy secretary must then investigate options for domestic production of isotopes without HEU. Finally, when U.S. isotope requirements can be met by producers without HEU, the Burr amendment becomes inactive, which should bar any further HEU exports for targets to produce isotopes.

Although the revised Burr amendment appears to create a path toward phasing out HEU exports, it is riddled with loopholes that could perpetuate HEU exports indefinitely—even facilitating their increase. Four of the specified recipient countries are part of the European Union (EU), so the amendment opens the door for U.S. HEU to be retransferred to 21 other EU member states without notification, under the terms of the U.S.-Euratom nuclear cooperation agreement, and to additional states as the EU expands. Ironically, the United States has expended considerable resources to remove HEU from some of these countries, including Romania, Bulgaria, Latvia, Serbia, and the Czech Republic, to reduce risks of nuclear terrorism.<sup>31</sup>

The amendment also contains at least four loopholes under which conversion of isotope production to LEU would be deemed “unfeasible,” so that HEU exports could continue: if producers refuse to cooperate in testing LEU targets at their facilities; if conversion would increase costs by more than 10 percent; if the process of converting the facilities would temporarily interrupt the supply of isotopes; or if the industry cannot already satisfy the entire U.S. isotope requirement without HEU. These

provisions eliminate the incentives in the 1992 law for producers to cooperate on conversion to LEU targets.

The energy bill stalled in Congress in 2003 for reasons unrelated to the HEU provision and was revived two years later with the revised Burr amendment intact. But then, on June 23, 2005, in the first separate vote by either house on the provision, the full Senate voted 52–46 to delete the Burr amendment—the result of a bipartisan initiative sponsored by Schumer and Republican Sen. Jon Kyl of Arizona. In the House, which had already passed the energy bill without a separate vote on the Burr provision, Republican Cong. Joe Barton of Texas, the chair of the energy committee, likewise expressed concern and worked with Democratic Cong. Ed Markey of Massachusetts to develop a substitute amendment in the House-Senate conference to restore the intent of the 1992 export restrictions. But Domenici blocked this possibility and strong-armed his Republican Senate conferees into supporting the Burr provision, against the expressed vote of the Senate.<sup>32</sup> The energy bill, including the Burr amendment, was passed by Congress on July 29, 2005, and signed into law by President Bush on August 8.

## EXPORTING DANGER

Enactment of the Burr amendment threatens to undermine the long-standing U.S. goal of phasing out commerce in bomb-grade uranium, thereby undermining the war on terror. At a minimum, the legislation will perpetuate U.S. HEU exports to Nordion. Under the 1992 law, these exports were to terminate as soon as Nordion could convert to LEU targets, or sooner if Nordion refused to cooperate. Now, the United States will continue to export approximately 20 kilograms of HEU to Nordion annually—and, unless Nordion converts to LEU targets, that amount

will likely grow as the demand for medical isotopes increases.

The Burr amendment will also foster U.S. HEU exports to isotope producers in Belgium and the Netherlands that previously were ineligible because they refused to cooperate on conversion to LEU targets. These

Al Qaeda to acquire and use such weapons, the specter of increasing HEU commerce raises grave concerns. The extent of damage to U.S. interests will depend on how Congress follows up this shameful performance.

There are several plausible trajectories for U.S. policy on HEU

domestic capacity to produce medical isotopes using LEU. One option is the proven technology of irradiating LEU targets in a research reactor, then processing them to recover the isotopes. No new reactor would be needed, because several are available at U.S. universities and national

## The Burr amendment threatens to undermine the long-standing U.S. goal of phasing out commerce in bomb-grade uranium.



companies had been expected to face strong incentives to convert to LEU targets in the near future, as they consumed their existing HEU stocks. But the Burr amendment has removed the foreign companies' main incentive to convert because they now qualify for U.S. HEU exports. As a result, U.S. exports of bomb-grade uranium for isotope production could more than double.<sup>33</sup>

In addition, new isotope producers that had planned to use LEU targets may now demand U.S. HEU exports on the grounds of nondiscrimination, citing Burr's erosion of the norm against HEU commerce. Similarly, operators of research reactors that have converted, or are in the process of converting, their fuel from HEU to LEU may reverse course and demand U.S. HEU exports. If the United States refuses, these operators could seek HEU from Russia, and Washington would have little ground to object, given the precedent of the Burr amendment.

All told, annual worldwide HEU commerce could increase by several hundred kilograms—sufficient for multiple nuclear weapons each year—and continue indefinitely instead of being phased out as envisioned previously.<sup>34</sup> In light of the relatively lax security at civilian nuclear facilities, the technological ease of making a nuclear weapon with HEU, and the expressed will of groups like

exports. The Burr amendment might be viewed as an acceptable but singular exception to long-standing U.S. policy, derailing the phaseout of such exports but only modestly increasing HEU commerce for isotope production and associated risks of nuclear terrorism and proliferation. More likely, however, if the Burr amendment is permitted to stand, other current and potential HEU users—including isotope producers outside of Canada and Europe, and operators of high-power reactors worldwide—will seek and win similar exemptions on the grounds that their operations are neither less important nor more risky than those covered by the Burr amendment. This outcome would erase much of the progress in reducing global HEU commerce, magnifying the risks of nuclear terrorism.

To avoid this nightmare scenario, Congress should pursue two remedies in its next session. The first is to repeal the Burr amendment's waiver of HEU export restrictions, so that isotope producers are forced to resume work on conversion to LEU targets as a condition of receiving HEU exports in the interim. Otherwise, as a senior Energy Department official warned last summer, the Burr amendment may “undermine support of the U.S. HEU minimization policy and nuclear export control system.”<sup>35</sup>

The second remedy is to create a

labs, though it would be necessary to construct a processing plant and deal with resulting radioactive waste.

Alternately, the United States could embrace an innovative technology being pursued by at least two U.S. companies, New Mexico-based TCI Medical and Virginia-based BWXT, in which isotopes are produced in the liquid core of a small reactor.<sup>36</sup> Russia originally developed the technology with HEU but has explored conversion to LEU, which would be used in any prospective U.S. facility. Several of the small reactors would need to be built, but the new technology is more efficient and significantly reduces nuclear waste. Either or both of these options could be facilitated by a few million dollars of congressional seed money—a tiny price to block one of the most vulnerable paths to nuclear terrorism.

If the United States met its isotope needs with domestic LEU-based production, current law would block HEU exports to foreign isotope producers that refused to convert. Indeed, if Congress pursued this path, foreign producers would race to convert to LEU targets as soon as possible, to ensure their own operations and to avert the creation of a U.S. competitor. Either way, the United States could halt HEU exports for isotope production, a major step toward its long-standing goal of ending global commerce in bomb-grade uranium.<sup>37</sup> ✪

1. U.S. Energy Department, "Remarks Prepared for Energy Secretary Spencer Abraham," May 26, 2004.

2. See, for instance: "Statement from Sam Nunn, Co-Chairman of the Nuclear Threat Initiative, Regarding the Global Threat Reduction Initiative," Nuclear Threat Initiative, May 26, 2004.

3. On the creation of GTRI: Energy Department, "Department of Energy Launches New Global Threat Reduction Initiative," May 26, 2004.

4. Alan J. Kuperman, "Civilian Highly Enriched Uranium and the Fissile Material Convention," in Paul L. Leventhal, ed., *Nuclear Power & the Spread of Nuclear Weapons* (Dulles: Brassey's Inc., 2002), pp. 249–260.

5. Andrew Bieniawski, U.S. Energy Department, "Overview of GTRI," presented to the Twenty-Seventh Annual International Meeting on Reduced Enrichment for Research and Test Reactors (RERTR), November 7, 2005; Kasia Mendelsohn and John Pantaleo, Energy Department, "Molybdenum-99 Production with LEU Targets," presented to the Nuclear and Radiation Studies Board, the National Academies, December 6, 2005.

6. Mendelsohn and Pantaleo, "Molybdenum-99 Production with LEU Targets."

7. Ian MacLeod, "Area Firm 'A Terrorist Target'; MDS Nordion Has Enough Enriched Uranium for a Bomb," *Ottawa Citizen*, June 9, 2002, p. A1. Also see Carey Sublette, "Nuclear Weapons Frequently Asked Questions," February 20, 1999 ([nuclearweaponarchive.org/Nwfaq/Nfaq4.html](http://nuclearweaponarchive.org/Nwfaq/Nfaq4.html)).

8. Personal communication with Frank von Hippel, professor of public and international affairs, Princeton University. On Canada's waste from processed targets, see: Donald Hart, Paul McKee, and Chris Wren, *Ecological Effects Review of Chalk River Laboratories* (Brampton: EcoMetrix Inc., January 2005). The amount of spent HEU from targets in Canada's radioactive waste is estimated from the fact that it has been using 10 to 20 kilograms per year of HEU in targets for many years.

9. Mendelsohn and Pantaleo, "Molybdenum-99 Production with LEU Targets."

10. *Ibid.*

11. *Ibid.*

12. On Nordion's pledge: J. B. Slater, general manager, Major Facilities Business Centre Operations, Atomic Energy of Canada Limited (AECL) Research, "The Program on Future HEU Supply for AECL's Radioisotope Production Operation," submitted in support of XSNM-02667, December 4, 1990 ([nci.org/05nci/11/Full%20page%20fax%20print.pdf](http://nci.org/05nci/11/Full%20page%20fax%20print.pdf)). On the facility design: Daniel Horner, "Nordion Headed for 'Showdown' with U.S.?" *Nuclear Fuel*, March 15, 2004, p. 1. See also, U.S. Nuclear Regulatory Commission, public meeting, transcript, "Briefing on Proposed Export of High Enriched Uranium to Canada," July 10, 2000 ([www.nrc.gov/reading-rm/doc-collections/commission/tr/2000/20000710b.html](http://www.nrc.gov/reading-rm/doc-collections/commission/tr/2000/20000710b.html)).

13. On Canada's pledge: The diplomatic

notes were exchanged between the Canadian Ministry of Foreign Affairs and the U.S. Embassy in Canada on September 4, 1997. See NRC, Memorandum and Order, CLI-99-20, June 29, 1999 ([nci.org/n/nrc62999.txt](http://nci.org/n/nrc62999.txt)). On Nordion's slowness: Horner, "Nordion Headed for 'Showdown' with U.S.?"

14. Horner, "Nordion Headed for 'Showdown' with U.S.?"

15. Daniel Horner and Rennie MacKenzie, "Nordion Still Facing Technical, Commercial Hurdles on Isotope Work," *Nuclear Fuel*, August 29, 2005, p. 3.

16. Jennifer Strom, "The Companies He Keeps," *Independent Weekly*, July 7, 2004.

17. R. Jeffrey Smith, "Measure Would Alter Nuclear Nonproliferation Policy," *Washington Post*, October 4, 2003, p. A2.

18. Public Citizen's Critical Mass Energy and Environment Program, "Hot Waste, Cold Cash: Nuclear Industry PAC Contributions to the Members of the 108th Congress," May 20, 2003.

19. Committee on Isotope Supply Member List ([nci.org/05nci/08/IndustryDocuments/LobbyingCoalitionforBurrAmendment.pdf](http://nci.org/05nci/08/IndustryDocuments/LobbyingCoalitionforBurrAmendment.pdf)).

20. "Addition of a New Section 4030 to Subtitle B of Title IV," March 12, 2003 ([nci.org/05nci/08/IndustryDocuments/2003BurrAmendmentdraftedbyGlasgow.htm](http://nci.org/05nci/08/IndustryDocuments/2003BurrAmendmentdraftedbyGlasgow.htm)). Microsoft Word document with James Glasgow's name in properties section in author's possession.

21. On the committee's payment: The Center for Public Integrity ([publicintegrity.org/lobby/profile.aspx?act=firms&year=2003&lo=L002898](http://publicintegrity.org/lobby/profile.aspx?act=firms&year=2003&lo=L002898)). On Alpine's donations: Information tabulated by Union of Concerned Scientists based on data from the Center for Responsive Politics ([nci.org/05nci/08/IndustryDocuments/UCS-LobbyistContributionsToKeyLegislators.pdf](http://nci.org/05nci/08/IndustryDocuments/UCS-LobbyistContributionsToKeyLegislators.pdf)).

22. Committee on Isotope Supply Member List.

23. See letter from Carol S. Marcus, president of the California chapter of the ACNP, to Sen. Barbara Boxer, March 25, 2003 ([nci.org/05nci/08/IndustryDocuments/LobbyletterdraftedbyAlpine-March2003.htm](http://nci.org/05nci/08/IndustryDocuments/LobbyletterdraftedbyAlpine-March2003.htm)). Microsoft Word document with Richard White's name in properties section in author's possession.

24. Society of Nuclear Medicine, "Action Alert: Support HEU Export for the Purpose of Medical Isotope Production," June 11, 2003 ([interactive.snm.org/index.cfm?PageID=538&RPID=971](http://interactive.snm.org/index.cfm?PageID=538&RPID=971)). As of January 2006, the three letters still could be downloaded, with the properties sections revealing the Alpine Group's authorship.

25. A. A. Sameh, Radiochemical Centre Mallinckrodt Medical, "Production of Fission Mo-99 from LEU Uranium Silicide Target Materials," invited paper for 2000 Symposium on Isotope and Radiation Applications, Institute of Nuclear Energy Research, Taiwan, May 18–20, 2000. See also, Smith, "Measure Would Alter Nuclear Nonproliferation Policy," and Daniel Horner, "Main Barriers to LEU Conversion for Isotopes Not Technical, U.S. Says," *Nuclear Fuel*, January 2, 2006, p. 3.

26. Smith, "Measure Would Alter Nuclear Nonproliferation Policy."

27. *Congressional Record*, June 23, 2005, pp. S7237–S7248. See also, letter from Cong. Edward J. Markey to Energy Secretary Samuel W. Bodman, June 14, 2005, citing a briefing by NRC Commissioner Edward McGaffigan ([nci.org/05nci/08/OtherDocuments/Markey'sunansweredlettertoDOE-June2005](http://nci.org/05nci/08/OtherDocuments/Markey'sunansweredlettertoDOE-June2005)).

28. On peak capacity: "Production of Fission Radioisotopes in the World," chart excerpted from Henri Bonet and Bernard David, Institut National des Radioéléments (IRE), Belgium, "Production of Mo-99 in Europe: Status and Perspectives," presented at Ninth International Topical Meeting on Research Reactor Fuel Management, April 2005 ([nci.org/05nci/08/OtherDocuments/Noshortageofisotopeproductioncapacity.pdf](http://nci.org/05nci/08/OtherDocuments/Noshortageofisotopeproductioncapacity.pdf)).

29. On Nordion's stockpile: MacLeod, "Area Firm 'A Terrorist Target.'"

30. See Section 630 of the Energy Policy Act of 2005, as passed by Congress ([www.ne.doe.gov/EPAct2005/hr6\\_textconfrep.pdf](http://www.ne.doe.gov/EPAct2005/hr6_textconfrep.pdf)), pp. 588–96.

31. U.S. Energy Department, "Highly Enriched Uranium Recovered from Czech Technical University," September 27, 2005.

32. Personal communication with congressional staff, July 24, 2005.

33. Calculation based on the fact that two European isotope producers (Mallinckrodt and IRE) together produce more molybdenum 99 than Nordion and so may seek more HEU from the United States than Nordion receives. In addition, worldwide isotope production and associated HEU consumption are growing. Bonet and David, "Production of Fission Radioisotopes in the World."

34. For example, the United States might resume and perpetuate HEU exports to European reactors that had been planning to convert to LEU. According to the International Atomic Energy Agency, "Management of High Enriched Uranium for Peaceful Purposes: Status and Trends" IAEA-TECDOC-1452, June 2005: "For the seven research reactors in the EU, the annual [fuel] consumption is in the range of 170 kilograms HEU." If converted reactors reverted to HEU as well, the annual consumption for fuel would climb even higher. These amounts are in addition to Europe's use of HEU for targets in isotope production, estimated to be at least 20 kilograms per year and growing.

35. Letter from Paul M. Longworth, deputy administrator for defense nuclear nonproliferation, Energy Department, to Kurt Gottfried, Union of Concerned Scientists, July 15, 2005 ([nci.org/05nci/08/domenic04/DOEletter-July2005.gif](http://nci.org/05nci/08/domenic04/DOEletter-July2005.gif)).

36. R. W. Brown, "The Radiopharmaceutical Industry's Effort to Migrate Towards Mo-99 Production Utilizing LEU," presented to the Twenty-Seventh Annual International Meeting on RERTR, November 8, 2005.

37. For further background documents, see [nci.org/news.htm#CHill](http://nci.org/news.htm#CHill). The author wishes to thank the *Bulletin* editors and Paul Leventhal for their helpful comments on earlier drafts.

Copyright of Bulletin of the Atomic Scientists is the property of Educational Foundation for Nuclear Science and its content may not be copied or emailed to multiple sites or posted to a listserv without the copyright holder's express written permission. However, users may print, download, or email articles for individual use.