8.

Market-Fortified Nonproliferation

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A Peculiar Consensus

One of the oddities of the current nuclear crisis posed by North Korea and Iran's civilian nuclear energy programs is how little these countries' diplomats disagree with ours about their right to almost any nuclear activity, even if it brings them to the very brink of acquiring nuclear weapons. The depth of this agreement might be surprising, given that it is widely understood that there is no way to detect military diversions from key nuclear activities (such as making nuclear fuel) early enough to prevent a state from breaking out and building a bomb. Nor does it seem to matter that developing nuclear power programs makes little or no economic sense for many countries seeking to do so.

According to the prevailing view in Washington, Pyongyang, Tehran, and beyond, all states have a per se right to any and all nuclear activities and materials, no matter how unnecessary or dangerous—so long as they are declared to and occasionally visited by international inspectors. This principle is enshrined, these diplomats insist, in Article IV of the Nuclear Non-Proliferation Treaty (NPT), which recognizes that all non-nuclear weapons states have an "inalienable right" to develop, produce, and research the "peaceful applications of nuclear energy."

As such, North Korea's sin was not that it built a plant that could process many bombs' worth of nuclear fuel, or that it operated a reactor disconnected from its electrical grid and optimized it to produce weapons-usable plutonium. All of this was permissible.

What was impermissible was North Korea's decision to block inspectors from having full access to these facilities. Similarly, Iran's crime was not that it began enriching uranium (a process that can be used to make either reactor fuel or bombs) even before it had a single large reactor on line, or that it imported nuclear weapons design information. Instead, it was Iran's failure to declare all its nuclear activities in a timely manner to the International Atomic Energy Agency (IAEA).

The inanity of this rather affected view of the nuclear rules was on display in a statement by President Bush's national security adviser, who explained that "although Iran had a right to enrich uranium," the United States was hoping that Iran would see that it was in its own best interest to exercise that right outside of its borders, in Russia. Not surprisingly, the Iranians, who want to develop a nuclear weapons option, simply disagreed.

The Unsustainable Status Quo

The consequences of continuing to interpret NPT rights and obligations in such a lenient fashion are clear. As UN secretary-general Kofi Annan noted at the 2005 NPT Review Conference:

> The regime will not be sustainable if scores more States develop the most sensitive phases of the fuel cycle and are equipped with the technology to produce nuclear weapons on short notice—and, of course, each individual State which does this only will leave others to feel that they must do the same. This would increase all of the risks—of nuclear accident, of trafficking, of terrorist use, and of use by states themselves.[1]

It is for this reason that experts have tried to offer new ideas that might allow nuclear power to spread without increasing the prospect of further nuclear proliferation. The most fashionable of these proposals, pushed by the IAEA and the United States under its Global Nuclear Energy Partnership (GNEP), focus on assuring nations a steady supply of nuclear fuel. These assured supply proposals are touted as a way to keep nations from acquiring nuclear

fuel–making plants of their own.[2] The question is how this is to be accomplished.

In the past decade, access to foreign nuclear fuel has been denied to many countries, including India, Iraq, North Korea, and now, Iran. These states were denied access, though, because of their nonproliferation misbehavior. As for assuring against economic disruptions by guaranteeing access to "affordable" nuclear fuel, the problem of subsidies arises; while societies may view arts or dairy cows or rail service as so socially valuable as to warrant public subsidy, the international community has a strong interest in drawing the line against subsidies in the risky energy sector. Why should any nation enjoy guaranteed access to nuclear fuel at anything but "competitive market prices"? After all, the cost of nuclear fuel is among the very least of the life cycle costs associated with the production of nuclear electricity.

If one makes nuclear fuel available at "affordable" (that is, subsidized) prices, what exactly is being secured from the fuel customer in exchange? At a minimum, there is a problem in harping on the need to guarantee fuel access as part of an effort to dissuade nations from acquiring the means to make their own fuel: it puts undue emphasis on the need for fuel, as if it was difficult to get or to stockpile in advance. In fact, nuclear fuel is easy to acquire, and suggesting otherwise unintentionally helps nations justify spending to assure their own supply even when it makes little or no economic sense to do so.[3] Again, once you concede states have a per se right to make nuclear fuel, and get to the very brink of making bombs, they are unlikely to give up that right for *any* promised guarantee or subsidy.

What else, then, can be done to reverse the trend toward "peaceful" nuclear weapons proliferation? I would like to suggest two things that have not yet been tried.

A More Sensible Reading

The first step we could make to turn things around is to get members of the NPT to read its rights and restrictions in a more sensible and stringent fashion. The NPT actually makes no mention of nuclear fuel-making, reprocessing, or enrichment. In fact, when Spain, Romania, Brazil, and Mexico all tried in the late 1960s

to get NPT negotiators to include an explicit reference to "the entire fuel cycle," including fuel-making, as a per se right, each of their proposals was turned down.[4] At the time, the Swedish representative even suggested that rules needed to be established to *prevent* nations from getting into such dangerous activities since there seemed no clear way to prevent nations from either diverting the fuel or converting their fuel-making plants very quickly to make bombs.[5] The NPT was designed to share the "benefits of the application of peaceful nuclear energy" and it made no sense to have the NPT protect uneconomical propositions that were unnecessary and that could bring states to the brink of having bombs.[6]

Delegates at the time also understood that when a nuclear energy application did not offer clear economic benefits, there was no clear right to demand it under the NPT. A clear case in point was the NPT's handling of peaceful nuclear explosives, which turned out to be so dangerous and impossible to safeguard that the treaty spoke only about sharing the "potential benefits" of peaceful nuclear explosives. No effort, however, was ever made to request or to offer such nuclear explosives because they were so costly to use that no clear economic benefit could be found.[7]

Finally, in no case did the framers of the NPT believe that the inalienable right to develop, research, or produce peaceful nuclear energy should allow states to contravene the NPT restrictions designed to prevent the proliferation of nuclear weapons. These restrictions are contained in Articles I, II, and III of the treaty. Article I prohibits nuclear weapons states "assist[ing], encourag[ing], or induc[ing] any non-weapons state to manufacture or otherwise acquire" nuclear weapons. Article II prohibits non-weapons states from acquiring in any way nuclear explosives or seeking "any assistance" in their manufacture. Together, these two prohibitions suggest that the NPT bans the transfer not only of actual nuclear explosives, but also of any nuclear technology or materials that could "assist, encourage or induce" non-weapons states to "manufacture or otherwise acquire" them.[8]

If there was any doubt on this point, the NPT also requires all non-weapons states to apply safeguards against all of their nuclear facilities and holdings of special nuclear materials. The purpose of these nuclear inspections, according to the treaty, is "verification

of the fulfillment of [a state's] obligations assumed under this Treaty with a view to preventing diversion of nuclear energy from peaceful uses to nuclear weapons."[9] At the time of the treaty's drafting it was hoped a way could be found to assure such safeguards. However, it was not assumed that such techniques already existed or that they would inevitably emerge.[10]

We now know that this hope was misplaced. Japan's experience with recycling plutonium from spent reactor fuel highlights the problem. On January 27, 2003, Japanese nuclear officials admitted that they had "lost" 206 kilograms of nuclear weapons usable plutonium at their Tokai-mura pilot reprocessing plant, which is under IAEA inspections. This is enough material to make over forty crude nuclear bombs. Where this plutonium went is still unknown. The plant's operators claimed that 90 kilograms "probably" was diluted into the aqueous reprocessing waste, and another 30 kilograms may have been dissolved into other waste elements during reprocessing. They offered no explanation as to where the remaining 86 kilograms of plutonium might have gone. Perhaps, they suggested, it was never even produced.

In response to these revelations, the IAEA made no demand that the Japanese shut down Tokai-mura to track the missing material by cleaning it out. Instead, the IAEA's director-general merely noted that the IAEA had no information that would suggest that any nuclear material had been "diverted from the facility." It later was revealed that the IAEA first learned of accounting shortfalls at the plant five years earlier, but had chosen to take no action. Japanese officials, meanwhile, were reluctant to admit to the losses publicly. Since then, the Japanese opened a much larger reprocessing facility at another site, which experts estimate is likely to "lose" some 240 kilograms of plutonium *every year*.[11]

Nor is the problem of knowing precisely how much weapons usable material a nuclear facility has produced limited to plutonium reprocessing or plutonium fuel fabrication plants.[12] Centrifuge uranium enrichment plants present comparable problems. Like reprocessing and plutonium fuel fabrication plants, which constantly produce or handle weapons-usable plutonium, uranium enrichment facilities can be converted to produce a bomb's worth of weapons-grade uranium so quickly (a matter of a few days) that little can be done to intervene and prevent the uranium from being hijacked for

illicit use. Similarly, it is extremely difficult for inspectors to know precisely how much material a given plant might actually be able to produce, or to keep track of the many hundreds of tons of material it might make.[13] As a result, there are ways these plants can be operated to conceal illicit production of weapons-usable uranium from IAEA inspectors.[14]

Properly understood, then, it is not possible to safeguard these nuclear fuel-making activities. There is no question that IAEA inspectors can look at or monitor them. But they cannot detect the diversion of enough material to make a bomb early enough to prevent the diversion from being completed. Nor does it make sense to permit countries that might be hiding covert nuclear fuel-making plants to have large reactors. Most large reactors need lightly enriched fuel and all produce large amounts of spent fuel laden with nuclear weapons-usable plutonium. These fresh and spent fuels, in turn, can be seized and used to acquire nuclear weapons fuel with so little warning time as to defeat any effort to safeguard them.[15]

Turning the Ship Around

What, then, is the bottom line? Any sound reading of the NPT would argue *against* the current dominant view that all states have a per se right to any and all nuclear materials and activities so long as they declare them, claim they are for peaceful purposes, and allow IAEA inspectors occasionally to visit them.

To some extent, U.S. and allied officials recognize this. A senior U.S. State Department representative to the NPT Review Conference in 2005, for example, noted that the NPT does not obligate nuclear supplier states to transfer nuclear fuel-making technologies since such aid would possibly violate Article I.[16] Moreover, the French government has argued since 2004 that nuclear fuel-making technology should be transferred only to countries that have a clear "energy need," a "credible nuclear energy program," and "an economically rational plan for developing such projects."[17] It has been Iran's inability to meet any of these criteria that has caused the French to question the sincerity of Tehran's claim to have an inalienable right to make its own nuclear fuel. This same concern with the lack of

economic rationality also prompted a detailed critique from senior State Department officials.[18]

Yet, for all the support that a select number of officials in the U.S. and allied capitals now afford to a sounder reading of the NPT's "inalienable right," there are a far greater number who back the conventional view. Thus, President Bush and senior State Department officials have repeatedly contended that the NPT has a major "loophole" that supports a per se right for states to make nuclear fuel and thereby come within days of acquiring nuclear weapons.[19] The State Department's legal division, moreover, has been emphatic in supporting this view.[20]

Why, after the nuclear fuel-making activities of North Korea, Iraq, and Iran, is the current view so entrenched? The simple answer is history. The United States and its key allies have long condoned the nuclear fuel-making of so many of its key allies and friends who do not yet have nuclear weapons—countries such as Germany, the Netherlands, Japan, Brazil, Argentina, Australia, and Ukraine—that it is now very difficult to reverse course. In a very real sense, public officials have chosen to make their past mistakes hereditary.

This suggests it will take a good deal of time to convince NPT states to read the treaty's provisions in a much firmer fashion. This brings us to the second effort that should be taken in the interim in order to accelerate such a turnaround—forcing nuclear operators to own up to the full costs of nuclear power.

A Proper Accounting

The most dangerous nuclear projects, it turns out, are also the most economically uncompetitive. These projects include nuclear power plants in oil and natural gas–rich nations (for example, Iran) or states that lack a large electrical grid (North Korea). They also include nuclear fuel-making plants in countries or regions lacking a large number of reactors (any state outside of China, Russia, Japan, the European Union, and the United States). Moreover, a nuclear facility that is built in the wrong way and in the wrong place runs much higher risks of nuclear accidents and vulnerabilities to nuclear theft and terrorist attacks.

As it is, most of the key issues related to nuclear facilities—financial, insurance, proliferation, safety, and physical security—are heavily influenced (or entirely decided) by governmental policies, regulation, and subsidies. The weight of government intervention in these issues is overwhelmingly favorable to supporting nuclear activities. Governments, by underwriting risks and providing a safety net against externalities, are, in effect, subsidizing nuclear programs. If, on the other hand, a much more accurate counting of all of nuclear power's hidden costs relating to these issues were required, it would be possible to question the purpose and value of dangerous, uneconomical nuclear undertakings much earlier, and to discourage governments from supporting them.

Fortunately, there is an attractive political vehicle for demanding such an accounting. The international movement to reduce greenhouse gas emissions continues to gain momentum, and there is broad-based agreement that these cuts should be conducted in the most cost effective manner.

In order to achieve such reductions, the European Union (EU) has already created an emissions cap and trading scheme, and discourages member governments from subsidizing their energy sector. The EU is discovering that its own emissions cap and trading scheme can be effective only if there is true transparency concerning the full costs of different energy options (that is, that the cost of any given energy option reflect the full environmental and security costs as well as the direct and indirect government subsidies). The United States and other countries are sure to back into this insight as they consider how to control their emissions.[21]

Toward this end and to assure more restrained promotion of nuclear power, four steps should be taken right away.

- *First, the world's major nations (including both signatories and observers) should live up to the open market and full costing principles they have already endorsed in the Energy Charter Treaty and the Global Energy Charter for Sustainable Development, and apply these principles to international commerce in electrical power plants.* Here, winning bids in any national competition for an electrical power system should go not to the most costly or the most subsidized project, but rather to

the option that provides the best value once the full costs for producing a desired amount of clean electricity are determined. This practice should be used as a springboard to encourage nations to open up their electrical generation markets, account for all the costs (internal and external) of any given bid, and accept the lowest bidder—which more often than not will be a nonnuclear electrical generation option.[22]

- *Second, to meet tough greenhouse gas emission goals, large power-producing states must recognize that a consumption tax of some sort on greenhouse gas-generating fuels will be necessary.* Proposed legislation to impose a cost for emitting greenhouse gases is already before Congress. In several years, some form of tax is likely to be imposed in the United States and other economically advanced states.

  The specific attributes of any such tax matter. It ought to be made progressive, with rebates for citizens who are poor. It also should be kept simple by taxing the carbon content in fuels rather than trying to monitor and tax the emissions of companies and consumers who might burn the fuel. In addition, tax neutrality is desirable to keep governments from using whatever money is raised to again subsidize specific fuel types. Finally, the tax should be accompanied by legal requirements that all subsidies now in place for nuclear power, natural gas, oil, clean coal, and renewables be identified, and that all fuel-specific subsidies be eliminated as soon as possible. It seems clear that anything less would only stack the deck higher in favor of nuclear energy against safer alternatives such as natural gas, increased efficiency programs, coal with carbon sequestration, hydropower, and renewable resources that may well turn out to be much cheaper. As the British government noted in its most recent energy review, published July 11, 2006, it would be appropriate and practical for firms building and operating nuclear electricity-generating plants to assume the full costs of financing, insuring, and decommissioning these plants if a proper tax or price was placed on carbon emissions.[23]
- *Third, trade zones that have enforcement powers should penalize any large electrical power production program that is enjoying national government subsidies.* In the case of the EU, this means taking far more seriously the formal complaints that

have been raised about the French government's construction of a nuclear power plant in Finland, to which the Finnish and French governments have lent financial support.[24] Thought also should be given now, before the current Kyoto regime is to be updated in 2012, to how penalizing governments for subsidizing electrical generation projects might be made a priority not only for the EU, but also for other trading zones and the World Trade Organization.

Under such a market regime, nations that choose to subsidize any particular form of energy production would be called to account for undermining international trade and economic fairness. If they subsidized nuclear activities, they also could also be collared for threatening international security. Certainly, subsidizing nuclear fuel-making makes no economic sense. Countries might claim that they need to make fuel for energy independence, but this is nonsense: the reactors and the fuel-making plants that such an effort requires would have to be imported, in most cases along with raw uranium to fuel them.

- *Fourth, states keen on promoting nonproliferation should make a sounder reading of the NPT's "inalienable right" to "peaceful" nuclear energy a priority going into the current round of 2010 NPT Review Conference preparatory meetings.* Here, in addition to the safeguards qualifications inherent to the NPT's discussion of this "right," it would make sense to emphasize the NPT's discussion of sharing the "benefits" of the application of peaceful nuclear energy and of peaceful nuclear explosives. The latter were never thought to be significant. As such, no sharing of peaceful nuclear explosive benefits ever took place. We need to consider what the benefits of the applications of peaceful nuclear energy clearly are.[25] There is no question that isotopes for agriculture and medicine have been a major economic boon. As for nuclear power, the net benefits remain disputed. For nuclear fuel-making, it is even more questionable.

We should be willing to get the answers even if it means having less international promotion of nuclear power. At a minimum, the NPT should no longer be used as a legal justification for nations to subsidize dangerous, uneconomical nuclear projects that bring them to the brink of acquiring bombs. Instead, a proper reading of the

treaty and its various qualifications to exercising the right to "peaceful nuclear energy" should make any state's subsidization of large nuclear projects cause for suspicion and, if such subsidization is persistent, for alarm.

Conclusion

Would a market-fortified NPT regime of this sort end the use or expansion of nuclear power? No. As noted, a carbon tax would actually favor nuclear power if it is clearly cheaper than clean coal, natural gas, hydropower, and renewable alternatives.

Would it eliminate the problems posed by a nuclear-ready Iran or North Korea? Unfortunately, again, the answer is no. Those problems can now be dealt with only by military, economic, and diplomatic efforts to squeeze Iran and North Korea—such as those used on the Soviet Union during the Cold War.

But the market fortified system suggested would help prevent Iran and North Korea's patently uneconomic ploys from becoming an international nuclear model for countries now professing an earnest desire to back peaceful nuclear power development. These countries include Indonesia, Libya, Saudi Arabia, South Korea, Nigeria, Egypt, Turkey, Morocco, Jordan, and Yemen (each of which are bizarrely receiving active U.S. or IAEA cooperative technical assistance to complete their first large power stations[26]).

Also, unlike the situation under today's interpretation of the NPT, which ignores suspicious "civilian" nuclear undertakings even when they obviously lack any economic rationale, the market fortified system described would help flag worrisome nuclear activities far sooner—well before a nation came anywhere near making bombs. Such an approach, in short, would encourage an NPT-centered world worthy of the name, a world in which the NPT would restrain the further spread of nuclear weapons-related technology rather than foster it.

10. "EU Aide Worried by Calls to Drop India WMD Clause," Reuters, March 2, 2007, available online at http://www.bilaterals.org/aricle.php3?id_article=7311.

11. See "EU OKs India Joining ITER Nuclear Reactor Project," Reuters, December 2, 2005.

12. Norway and Sweden are conflicted on the issue but appear unwilling to block consensus.

13. Recently, several other NAM members, including Egypt, have expressed frustration that the U.S.-India nuclear deal has complicated efforts to mount pressure against Israeli nuclear activities.

Chapter 7

1. George P. Shultz, William J. Perry, Henry A. Kissinger and Sam Nunn, "A World Free of Nuclear Weapons," *Wall Street Journal,* January 4, 2007, p. A15.

Chapter 8

1. Statement by UN secretary-general Kofi Annan, 2005 NPT Review Conference, New York, May 2, 2005, available online at http://www.un.org/apps/sg/sgstats.asp?nid=1427.

2. The United States and IAEA are pushing such a scheme under two separate initiatives. See "Nuclear Threat Initiative Commits $50 Million to Create IAEA Nuclear Fuel Bank," Joint NTI/IAEA Press Release 2006/16, September 19, 2006, available online at http://www.iaea.org/NewsCenter/PressReleases/2006/prn200616.html, and "The Global Nuclear Energy Partnership: Greater Energy Security in a Cleaner, Safer World," U.S. Department of Energy, March 2007, available online at http://www.gnep.energy.gov/gnepProgram.html.

3. See e.g., Debra K. Decker and Erwann O. Michel-Kerjan, "A New Energy Paradigm: Ensuring Nuclear Fuel Supply and Nonproliferation through International Collaboration with Insurance and Financial Markets," Belfer Center for Science and International Security, March 2007, pp. 21–22. On the self-defeating character of the U.S. GNEP program's plea to divide the world into fuel supplying nations and fuel recipients, see Edwin Lyman, "The Global Nuclear Energy Partnership: Will It Advance Nonpro-

liferation or Undermine It?" presented at the annual meeting of the Institute of Nuclear Materials Management, July 19, 2006, available at http://www.npec-web.org/Essays/20060700-Lyman-GNEP.pdf and Steve Fetter and Frank N. von Hippel, "Is U.S. Reprocessing Worth the Risk?" *Arms Control Today*, September 2005, available online at http://www.armscontrol.org/act/2005_09/Fetter-VonHippel.asp.

4. "Mexican Working Paper Submitted to the Eighteen Nation Disarmament Committee: Suggested Additions to Draft Nonproliferation Treaty," ENDC/196, September 19, 1967, in U.S. Arms Control and Disarmament Agency, *Documents on Disarmament, 1967*, Publication No. 46 (Washington, D.C.: U.S. Government Printing Office, July 1968), pp. 394–95; "Romanian Working Paper Submitted to the Eighteen Nation Disarmament Committee: Amendments and Additions to the Draft Nonproliferation Treaty," ENDC/199, October 19, 1967, in *ibid.*, pp. 525–526; "Brazilian Amendments to the Draft Nonproliferation Treaty," ENDC/201, October 31, 1967, in U.S. Arms Control and Disarmament Agency, *Documents on Disarmament, 1967*, p. 546; and "Spanish Memorandum to the Co-Chairman of the ENDC," ENDC/210, February 8, 1968, in U.S. Arms Control and Disarmament Agency, *Documents on Disarmament, 1968*, Publication No. 52 (Washington, D.C.: U.S. Government Printing Office, September 1969), pp. 39–40.

5. "Statement by the Swedish Representative [Alva Myrdal] to the Eighteen Nation Disarmament Committee: Nonproliferation of Nuclear Weapons," ENDC/PV. 243, February 24, 1966, in U.S. Arms Control and Disarmament Agency, *Documents on Disarmament, 1966*, Publication No. 43 (Washington, D.C.: U.S. Government Printing Office, September 1967), p. 56.

6. Eldon V. C. Greenberg, "NPT and Plutonium: Application of NPT Prohibitions to 'Civilian' Nuclear Equipment, Technology and Materials Associated with Reprocessing and Plutonium Use," Nuclear Control Institute, 1984 (Revised May 1993).

7. See Report of Main Committee III, Treaty on the Nonproliferation of Nuclear Weapons Review and Extension Conference, May 5, 1995, NPT/CONF.1995/MC.III/1, Sec. I, para. 2 (emphases added) available online at http://www.un.org/Depts/ddar/nptconf/162.htm, which states: "wThe Conference records that the potential benefits of the peaceful applications of nuclear explosions envisaged in article V of the Treaty have not materialized. In this context, the Conference notes that the potential benefits of the peaceful applications of nuclear explosions have not been demonstrat-

ed and that serious concerns have been expressed as to the environmental consequences that could result from the release of radioactivity from such applications and on the risk of possible proliferation of nuclear weapons. Furthermore, no requests for services related to the peaceful applications of nuclear explosions have been received by IAEA since the Treaty entered into force. The Conference further notes that no State party has an active programme for the peaceful application of nuclear explosions."

8. Eldon V. C. Greenberg, "NPT and Plutonium"; Henry D. Sokolski and George Perkovich, "It's Called *Non*proliferation," *Wall Street Journal*, April 29, 2005, p. A16.

9. NPT, Art. III, para. 1.

10. For example, see "British Paper Submitted to the Eighteen Nation Disarmament Committee: Technical Possibility of International Control of Fissile Material Production," ENDC/60, August 31, 1962 (Corr. 1, November 27, 1962), in U.S. Arms Control and Disarmament Agency, *Documents on Disarmament, 1962*, Publication No. 19, Vol. 2 of 2 (Washington, D.C.: U.S. Government Printing Office, November 1963), pp. 834–52.

11. See Bayan Rahman, "Japan 'Loses' 206 kg of Plutonium," *Financial Times*, January 28, 2003, available online at http://news.ft.com;servlet/ContentServer?pagename=FT.com/StoryFT/FullStory&c=StoryFT&cid=1042491288304&p=10112571727095, and Nuclear Control Institute, "Enormous 'Plutonium Gap' at Japan's Tokai Plant Highlights Proliferation Risks of Reprocessing," January 28, 2003, available online at http://www.nci.org/03NCI/01/pr12803.htm.

12. In addition to the material unaccounted for at the Japanese plants noted above, the commercial British reprocessing plant at Sellafield reported as missing 19 and 27 kilograms of separated plutonium in 2004 and 2005. See Edwin S. Lyman, "Can Nuclear Fuel Production in Iran and Elsewhere Be Safeguarded Against Diversion?" an essay presented at "After Iran: Safeguarding Peaceful Nuclear Energy," NPEC/King's College-London Conference, London, U.K., October 2005, pp. 10–12, available online at http://www.npec-web.org/Frameset.asp?PageType=Single&PDFFile=Paper050928LymanFuelSafeguardDiv&PDFFolder=Essays.

13. In the case of at least one U.S. HEU fuel fabrication plant operating during the l960s in Apollo, Pennsylvania, the U.S. Atomic Energy Commission reported that the amount of material unaccounted for was approximately 100 kilograms. Several former senior U.S. officials suspect this material was diverted to Israel's nuclear weapons program. See Seymour M. Hersh, *The Samson Option* (New York: Vintage, 1993), pp. 241–57.

14. On these points, see John Carlson, "Addressing Proliferation Challenges from the Spread of Uranium Enrichment Capability," paper for the annual meeting of the Institute for Nuclear Materials Management, Tucson, July 8–12, 2007; Paul Leventhal, "Safeguards Shortcomings: A Critique," NCI, Washington, D.C., September 12, 1994; Marvin Miller, "Are IAEA Safeguards in Plutonium Bulk-Handling Facilities Effective?" NCI, Washington, D.C., August 1990; Brian G. Chow and Kenneth A. Solomon, *Limiting the Spread of Weapons-Usable Fissile Materials* (Santa Monica, Calif.: RAND, 1993), pp. 1–4; and Marvin Miller, "The Gas Centrifuge and Nuclear Proliferation," in Victor Gilinsky et al., *A Fresh Examination of the Proliferation Dangers of Light Water Reactors* (Washington, D.C.: The Nonproliferation Policy Education Center, October 22, 2004), p. 38, available online at http://www.npec-web.org/Frameset.asp?PageType=Single&PDFFile=20041022-GilinskyEtAl-LWR&PDFFolder=Essays.

15. Victor Gilinsky et al., *A Fresh Examination of the Proliferation Dangers of Light Water Reactors*.

16. See Christopher Ford, "NPT Article IV: Peaceful Uses of Nuclear Energy," statement of the principal deputy assistant secretary of state for verification, compliance and implementation to the 2005 Review Conference of the Treaty on the Non-Proliferation of Nuclear Weapons, New York, May 18, 2005, available online at http://www.state.gov/t/vci/rls/rm/46604.htm.

17. French Republic, "Strengthening the Nuclear Non-Proliferation Regime," working paper submitted to the Preparatory Committee for the 2005 Review Conference of the Parties of the Treaty on the Non-Proliferation of Nuclear Weapons, May 4, 2004, available online at http://disarmament2.un.org/wmd/npt/2005/PC3-listofdocs.html.

18. See, e.g., Under Secretary of State for Arms Control and International Security John R. Bolton, "Iran's Continuing Pursuit of Weapons of Mass Destruction," testimony before the House International Relations Committee, Subcommittee on the Middle East and Central Asia, June 24, 2004.

19. See, e.g., George W. Bush, "President's Statement on Non-Proliferation of Nuclear Weapons Treaty," White House, Office of the Press Secretary, March 7, 2005, available online at http://www.whitehouse.gov/news/releases/2005/03/20050307-10.html.

20. See "Assessing 'Rights' Under the Nuclear Nonproliferation Treaty," U.S. Congress, House Subcommittee on Terrorism, Nonproliferation, and Human Rights, hearing transcript, March 2, 2006, p. 16 ff., available online at http://commdocs.house.gov/committees/intlrel/hfa26333.000/hfa26333_0f.htm.

21. Preliminary recognition of these points was most recently made in a Council on Foreign Relations special report on nuclear power. See Charles D. Ferguson, *Nuclear Energy: Balancing Benefits and Risks* (New York: Council on Foreign Relations, April 2007).

22. For more on the current membership and investment and trade principles of the Energy Charter Treaty go to http://www.encharter.org/. The second principle of the Global Energy Charter for Sustainable Development calls for "The establishment of guidelines and internationally standardized methods of evaluation for determining the external effects and total lifecycle costs and risks for all energy systems, taking into account the environmental, health and other damage caused by energy-related activities." See *The Global Energy Charter for Sustainable Development,* available online at http://www.cmdc.net/echarter.html.

23. See "The Energy Challenge: Energy Review Report 2006," British Department of Trade and Industry, July 11, 2006, available online at http://www.dti.gov.uk/energy/review/. The British estimate of the breakeven point for nuclear power's competitiveness with a CO_2 tax of roughly $46 a ton is consistent with earlier U.S. estimates of between $25 and $50 per ton of CO_2 made in a study by the Massachusetts Institute of Technology. See *The Future of Nuclear Power* (Cambridge, Mass.: Massachusetts Institute of Technology, 2003), pp. 41–43.

24. See "EC Will Investigate 'Green Power' Complaint of State Aid to TVO EPR," *Nucleonics Week,* January 13, 2005. According to the complaint, the project is enjoying subsidized loans and French export loan credits and the final decision to buy the plant was made on the basis of an unsound study rather than competitive bidding.

25. For an historical and legal analysis of the NPT, see Robert Zarate, "The NPT, IAEA Safeguards and Peaceful Nuclear Energy: An Inalienable Right But Precisely to What?" a draft paper presented at an NPEC/FRS Conference, "Assessing the Ability of the IAEA to Safeguard Peaceful Nuclear Energy," Paris, France, November 11–12, 2006, available online at http://www.npec-web.org/Essays/20070301-Zarate-NPT-IAEA-Peaceful-Nuclear.pdf.

26. See David Sanger and William Broad, "With Eye on Iran, Rivals Also Want Nuclear Power," *New York Times*, April 15, 2007, and Henry Sokolski, "Hair Raising New World," *Wall Street Journal,* December 15, 2006.