

CHAPTER 5

MOVING TOWARD ZERO AND ARMAGEDDON?*

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Assuming current nuclear trends continue, the next 2 decades will test America's security and that of its closest allies as they never have been tested before. Before 2020, the United Kingdom will find its nuclear forces eclipsed not only by those of Pakistan, but of Israel and of India. Soon thereafter, France will share the same fate. China, which has already enough separated plutonium and highly enriched uranium to triple its current stockpile of roughly 300 nuclear warheads, could expand its nuclear arsenal too. Meanwhile, Japan will have ready access to thousands of bombs worth of separated plutonium. U.S. and Russian nuclear weapons-usable material stocks—still large enough to be converted back to many tens of thousands of weapons—will decline only marginally while similar nuclear weapons-usable stores in Japan and other nuclear weapons states could easily double.¹

Compounding these developments, even more nuclear weapons-ready states are likely: As of 2009, at least 25 states have announced their desire to build large reactors—historically, bomb starter kits—before 2030. None of this will foster the abolition of nuclear weapons. Certainly, the current battery of U.S.-backed arms control measures, including the ratification of

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major arms reductions treaties with Russia, a Comprehensive Test Ban, a cut-off treaty banning further military nuclear fissile production, and enhanced inspections of civilian nuclear programs—are unlikely to be enough to head off the troubling trends described. What is worse, the expected arms control measures, if executed too hastily, could easily make matters worse.

Thus, congressional critics of strategic arms reductions with Moscow argue that if the United States and Russia cut their strategic nuclear deployments too deeply and too quickly, it might undermine the credibility of our nuclear security alliances with states like Japan and Turkey who, in turn, might be tempted to go nuclear themselves. As for pushing ratification of a Comprehensive Test Ban Treaty, this too could backfire: India, whose last nuclear test series was followed by a Pakistani nuclear test, recently debated whether to resume nuclear testing to beat what some in India fear is an approaching nuclear test ban deadline. Meanwhile, American test ban treaty opponents have urged the U.S. Senate to tie the treaty's test limits to what other states, like Russia, say the treaty might allow. Pegging the treaty to this limit, however, could conceivably actually encourage some forms of low-yield nuclear testing.

As for securing a nondiscriminatory, global ban against the "military" production of separated plutonium and enriched uranium for nuclear weapons, this also could inflict unintended harm. Here, the danger is that the treaty bans the production only of fissile material for military purposes and, as such, could encourage increased production for civilian purposes. The odds of inspectors catching military diversions from such "peaceful" plants are quite low. Finally, with the

growing popularity of “peaceful” nuclear energy, nuclear supplier states are claiming that exporting new power reactors will strengthen nonproliferation since it will come with the application of enhanced nuclear inspections. Unfortunately, in most of the truly worrisome cases, even enhanced inspections may not be reliable enough to safeguard against significant military diversions. As it is, international nuclear inspections are failing to maintain continuity of inspections over most of the world’s spent or fresh fuel that can be enriched and reprocessed to make weapons-usable fuels. These nuclear fuel-making plants, moreover, can be hidden from inspectors and, even when declared, be used to make weapons-usable materials without necessarily being detected in a timely fashion.²

Several of these points are beginning to receive attention in the United States. The debate over these matters, however, needs to be broadened. Why? Because even if Washington’s favorite nuclear control initiatives are well-executed and avoid running the risks noted above, the United States and its allies will still face a series of additional nuclear proliferation dangers of major proportions.

A PACKED NUCLEAR ARMED CROWD?

The first of these is that as the United States and Russia reduce their nuclear weapons deployments, China, India, Pakistan, and Israel are likely to increase theirs. Currently, the United States is proposing to reduce U.S. and Russian strategic weapons deployments to as low as 1,000 warheads each. As a result, it is conceivable that in 10 years’ time the nuclear numbers separating the United States and Russia from the other nuclear weapons states might be measured in the

hundreds rather than the thousands of weapons (see Figure 1). In such a world, relatively small changes in any state's nuclear weapons capabilities will have a much larger impact than it might on the world's international security today.

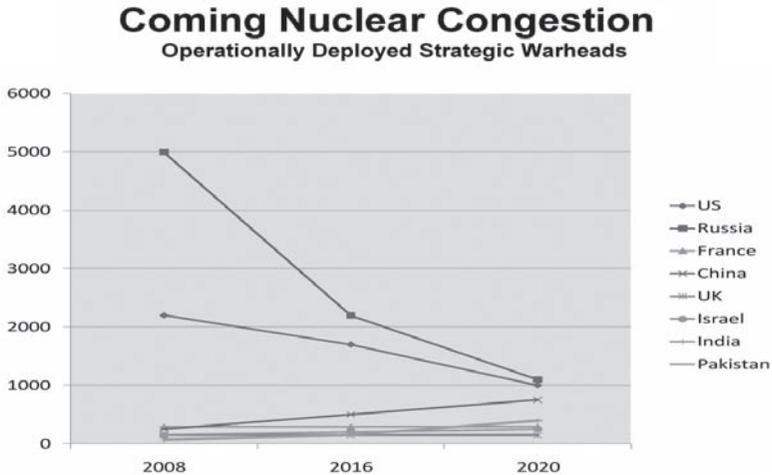
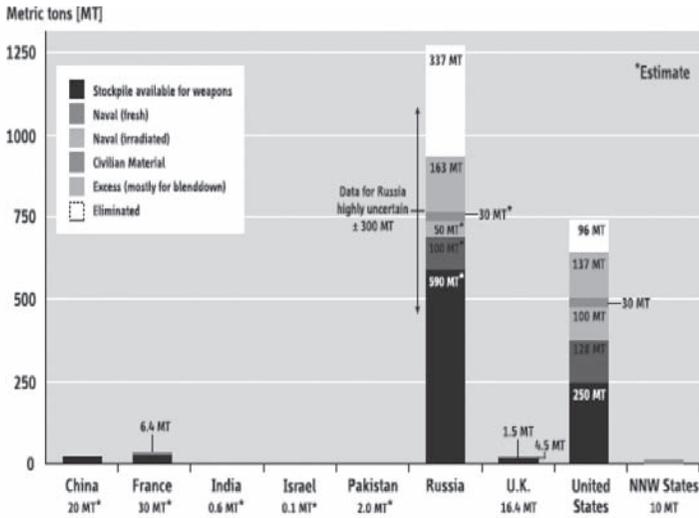


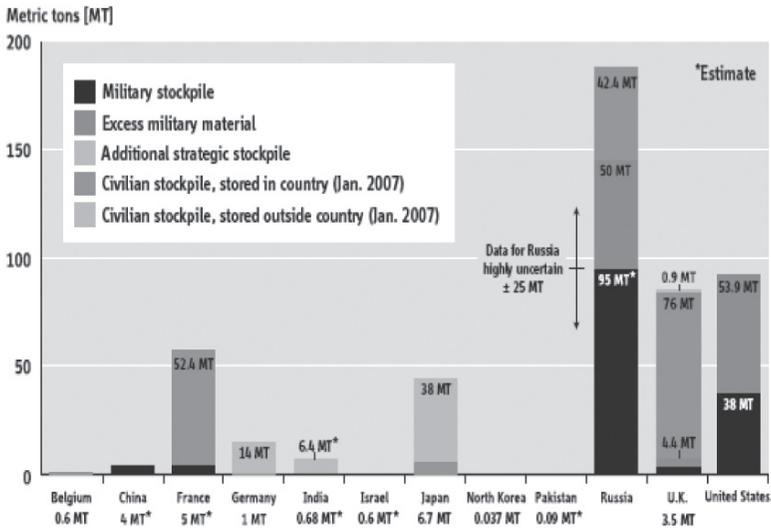
Figure 1. Coming Nuclear Congestion.³

Compounding the international volatility that this set of trends is likely to induce are the large and growing stockpiles of nuclear weapons-usable materials (i.e., of separated plutonium and highly enriched uranium) in several states. These already exceed tens of thousands crude bombs' worth of material in the United States and Russia and are projected to grow in Pakistan, India, China, and Israel (not to mention Japan, which currently has no nuclear weapons). This will enable these four states to increase their current nuclear deployments much more quickly and dramatically than ever was possible previously. (See Figures 2 and 3 for these states' current holdings of nuclear weapons fuel waiting in the wings).



Civilian stocks are for January 2007 and based on the latest national INFCIRC/549 declarations to the IAEA (with the exception of Germany). Civilian stocks are listed by ownership, not by current location. Weapon stocks are based on nongovernmental estimates except for the UK and the United States, whose governments have made declarations. India's plutonium separated from unsafeguarded spent PHWR fuel is categorized as an additional strategic stockpile.

Figure 2. National Stocks of Highly Enriched Uranium as of Mid-2008.⁴



The numbers for the UK and the United States are based on official information. Numbers with asterisk are nongovernmental-estimates, often with large uncertainties. Numbers for Russian and U.S. excess HEU are for June 2008. HEU in non-nuclear weapon (NNW) states is under IAEA safeguards.

Figure 3. National Stocks of Separated Plutonium.⁵

Moreover, 20 years out, there could be more nuclear weapons-ready states—countries that could acquire nuclear weapons in a matter of months, like Japan and Iran. As already noted, more than 25 states have announced plans to launch large civilian nuclear programs. If they all realize their dreams of bringing their first power reactors on line by 2030, it would constitute a near doubling of the 31 states that currently have such programs, most of which are in Europe (see Figures 4 and 5).



Figure 4. Today Number of States or Regions with Power Reactors Is Limited.⁶

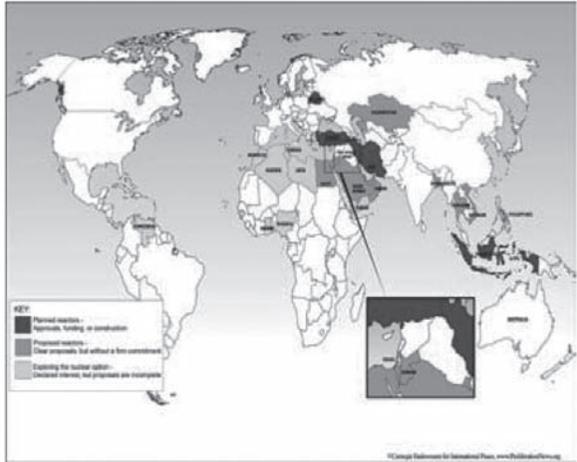


Figure 5. Planned for 2030.⁷

Such a nuclear expansion could have major military implications. Every current weapons state first brought a large reactor on line prior to acquiring its first bomb. The United Kingdom (UK), France, Russia, India, Pakistan, and the United States all made many of their initial bombs from reactors that also provided power to their electrical grids. The United States, in fact, still uses a power reactor, a “proliferation resistant” light water reactor operated by the Tennessee Valley Authority, to make all of its weapons grade tritium for its nuclear arsenal.

Other plants, of course, are needed to chemically separate out weapons-usable plutonium from the spent reactor fuel or to enrich the uranium used to power such machines. Yet, as the recent cases of Iran and North Korea demonstrate, such plants can be built and operated in ways that make it difficult to detect diversions in a timely fashion. Certainly, if all of the announced civilian nuclear programs are completed as planned, the world in 2030 would be far less stable. Instead of there being several confirmed nuclear weapons states—most of which the United States can claim are either allies or strategic partners—there could be an unmanageable number of additional nuclear weapons capable-states—armed or weapons-ready—to contend with, as Figures 6 and 7 depict.

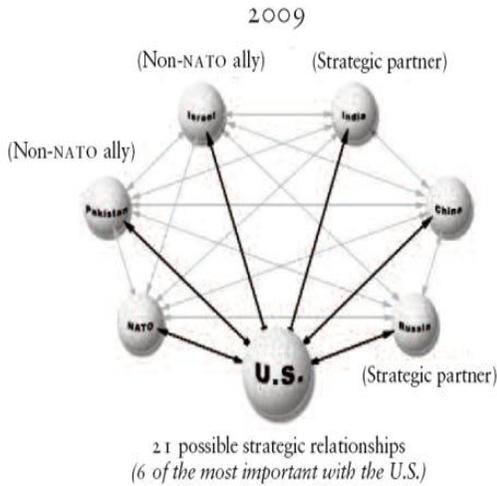


Figure 6. Current proliferation seems manageable, but DPRK and Iran are problematic.

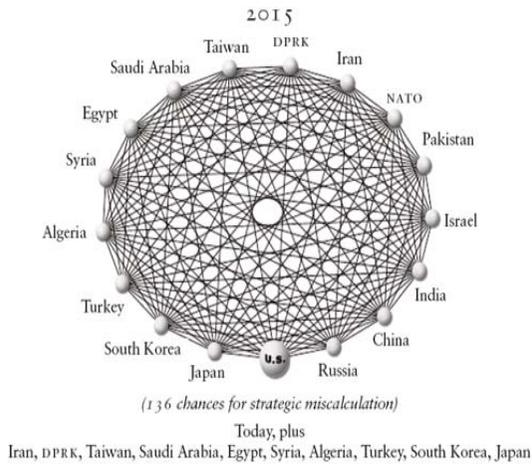


Figure 7. With more nuclear-ready states will we ramp up to a nuclear World War I?

In such a world, the United States might know who its friends and potential adversaries might be, but Washington would have difficulty knowing what such states might do in a crisis—close ranks with the United States, go their own way developing weapons options, or follow the lead of some other nuclear-capable nation. As for America's possible adversaries, Washington would have difficulty determining just how lethal these adversaries' military forces might be.

All of this would only heighten the prospects for nuclear terrorism. Not only would there be more opportunities to seize nuclear weapons or nuclear weapons materials, there would be more military and civilian nuclear facilities to sabotage. Finally, the potential for miscalculation and nuclear war could rise to a point where even non-nuclear acts of terror could ignite larger conflicts that could turn nuclear.

Taken together, then, these trends could easily duplicate or exceed the kind of volatility that preceded World Wars I and II—periods in which overly ambitious arms control objectives were pursued while states completed major covert and overt military preparations that heightened tensions and subsequently were employed in total wars.

MAKING THE MOST OF ZERO

All of this raises the question of whether we can avoid such a future. The short answer is yes, but only if we attend more closely to four basic principles. Let us discuss them in turn. First, as nuclear weapons deployments decline, more care must be taken to ensure that military reductions or additions actually work to decrease the chances for war. If our security guarantees are to continue to neutralize the nuclear weapons

yearnings of our allies, it is critical that we avoid doing anything to undermine the favorable correlation of forces the United States enjoys against its key nuclear competitors. In addition to making roughly equal nuclear reductions with Russia, then, the United States will have to keep other nuclear-armed states, such as China and India, from trying to catch up with U.S. nuclear weapons deployment levels and—as in the case of India and China, Pakistan and India, and Japan and China—from trying to catch up with each other. This means that additional nuclear restraints, either in the form of nuclear weapons reductions or further limits on the production or stockpiling of weapons-usable fuel, will need to be reached with Russia, of course, but also with China, India, and Pakistan. As a practical matter, this also means that other nuclear weapons-ready or virtual weapons states (e.g., Japan) will have to be persuaded to curtail or end their production of nuclear weapons-usable materials or to dispose of some portion of what they currently have.

To date, the United States has not publicly grappled with how best to do this. President Barack Obama has called for the negotiation of a fissile material cut-off treaty. But this agreement allows civilian nuclear fuel production, which is virtually identical to military fuel production. Also, after decades of fruitless negotiations in Geneva, it is unclear whether any such agreement could ever be brought into force. Some officials, including those advising Secretary of State Hillary Clinton, have suggested a complementary approach to these negotiations known as the Fissile Material Control Initiative. Instead of a binding treaty, both NPT weapons states *and* nonweapons states would simply identify what portion of their separated plutonium and highly enriched uranium stocks was in

excess of either their military *or* civilian requirements and secure or dispose of them.⁸

Yet another practical idea, which would have direct bearing on India's nuclear weapons activities, would be to ensure that implementation of the U.S. civilian nuclear cooperative agreement with New Delhi does nothing to help India make more nuclear weapons-usable fuels than it was producing when the deal was finalized late in 2008. Under the NPT, the states that had nuclear weapons in 1967—the United States, Russia, France, the UK, and China—swore not to help any other state outside of these five ever to acquire them directly or indirectly. Meanwhile, under the Hyde Act, which authorized the civilian U.S.-Indian nuclear deal, the White House is routinely required to report to Congress on just how much uranium fuel India is importing, how much it is using to run its civilian reactors, how much uranium it is producing domestically, and the extent to which the operation of its unsafeguarded reactors is expanding its stockpiles of unsafeguarded plutonium with either the direct or indirect help of NPT weapons states.⁹

India's unsafeguarded plutonium stockpiles might grow faster per year than was the case prior to the nuclear cooperative agreement's finalization in 2008 because Indian uranium imports from one or more of the NPT weapons states could allow India to use more of its domestically produced uranium in its unsafeguarded reactors to make bomb usable plutonium. If this ever happened, the exporting nuclear weapons states would be implicated in violating the NPT. To prevent such a violation or, at least, limit the harm it might do, the United States should urge all other nuclear-supplying states to suspend civilian nuclear assistance until India's unsafeguarded nuclear weap-

ons-usable material production declines. The logical venue at which to make this request would be the Nuclear Suppliers Group. Such vigilance should also be matched with efforts to keep Pakistan from expanding its nuclear weapons capabilities as well.

As for trying to maintain the relative parity of competing nuclear-armed state forces through non-nuclear military assistance or buildups, the trick will be to substitute conventional arms for nuclear ones in a manner that avoids increasing one or both side's interest in acquiring more nuclear weapons. Unfortunately, deploying more advanced non-nuclear systems to compensate for forgone nuclear systems will not necessarily assure this. Consider long-range precision strike and advanced command control and intelligence systems in the case of India and Pakistan. Pakistan believes it must threaten to use its nuclear weapons first to deter India's superior conventional forces. Precision strike systems, however, could conceivably target Pakistan's nuclear weapons. As a result, one could imagine that arming India with such weapons would only put Pakistan even more on nuclear alert and encourage Islamabad to acquire even more nuclear weapons. Building up the wrong kinds of advanced nonnuclear weapons systems in India or helping it to build them in disproportionate numbers could adversely affect any restraint Pakistan might be inclined to show in its nuclear weapons plans.

Ballistic missile defenses could also be tricky. Under the right circumstances, having such defenses could provide a nonnuclear form of deterrence that might facilitate reducing the numbers of deployed nuclear weapons. Instead of neutralizing a possible opponent's missiles by targeting them with nuclear or non-nuclear offensive weapons, active missile defens-

es might be used to counter them after launch. They also could be useful as a form of insurance against cheating on any future nuclear-capable ballistic missile reduction agreements. To secure these benefits, though, it is important to deploy missile defenses correctly.

Again, consider the Indian and Pakistani case. While Pakistan insists it must use its nuclear weapons first in any major war against India, New Delhi is hoping to use its conventional forces to capture enough of Pakistan from a cold start to induce Islamabad to quickly sue for peace. Under these circumstances, sharing equal amounts of missile defenses with India and Pakistan would only give India yet another nonnuclear military edge against Islamabad. This, in turn, risks encouraging Pakistan to beef up its offensive nuclear missile forces even more. The only way to counter this eventuality and help secure the benefits of missile defense for both countries would be to address the underlying conventional asymmetry between them. One idea regional security experts have long favored is creating, low, medium, and high conventional deployment zones on both sides of the Indo-Pakistani border to equalize each side's ability to launch quick conventional attacks against one another. Such schemes might also attenuate the perceived stability risks of deploying more advanced, discriminate nonnuclear military systems.¹⁰

Elsewhere other measures might be required. As China increases its nuclear and nonnuclear missile superiority over Taiwan and its capability to target U.S. carrier battle groups with conventional ballistic missiles, the United States and its Pacific allies must worry that Beijing may be able to overwhelm the missile defenses the United States is now working on. China, meanwhile, is considering developing ballistic missile

defenses of its own to counter possible missile attacks. Thus, reaching an agreement limiting ballistic missile might make sense for both sides.

Several precedents exist. START, which limits U.S. and Russian strategic ballistic missile delivery systems, is one. The Intermediate Nuclear Forces (INF) Treaty, which covers Russian and NATO missiles with ranges between 500 and 5,500 kilometers, is another. The Missile Technology Control Regime (MTCR), which limits commerce in missiles with 300 kilometer range and 500 kilogram payload capabilities, is another still. The trick in reaching additional ballistic missile limits is to make sure they are robust enough to address the ballistic missiles that matter without creating new categories of permissible missiles. It certainly would make little sense to eliminate ballistic missiles above 500 kilometers range only to end up legitimizing slightly lower range missile systems that are above the limits restricted by the MTCR.

The second basic principle is that, in reducing existing nuclear weapons and nuclear-capable delivery systems, we include steps for preventing their further spread. Currently, the connection between reducing nuclear arms and preventing their spread is mostly symbolic. As the United States and Russia reduce their nuclear deployments, other nuclear-armed states, it is argued, should follow the U.S-Russian example so as to persuade nonweapons states to submit to much more intrusive inspections of their civilian nuclear activities. Putting aside the hard cases of Iran and North Korea, this line of reasoning ignores several key technical developments and turns on several questionable political assumptions.

Certainly, after failing to detect the covert nuclear programs in Iraq, Iran, Syria, and North Korea, it is an

open question whether even enhanced international nuclear inspections will be able to reliably detect future illicit nuclear activities. This is especially so if, as some believe, large civilian nuclear programs spread in regions like the Middle East.

Not only the United States but Israel, Japan, NATO, Russia, and China are planning to deploy ballistic missile defense systems. Yet, the approach of the United States and its allies to controlling nuclear strategic threats is practically silent as to whether these defense programs should be promoted or restricted, and how. Nor, outside of strategic reduction talks with Russia, is there much discussion as to whether or how other states' development of ballistic missiles (both nuclear and nonnuclear) should be approached.

Then there are the political questions. How likely is it that Russia will agree to further nuclear cuts beyond the current START negotiations? Will there be yet another START agreement to lower numbers to 1,000 strategic deployed warheads? Will Russia agree to limit its nonstrategic nuclear weapons? What demands will Moscow make for such reductions? Will Russia demand that the United States and NATO cripple their conventional and missile defense plans? Finally, when, if ever, might such agreements be reached? The success of the White House's arms control and nonproliferation policies depends on favorable answers to these questions.

Also, if there are no new penalties or risks for developing nuclear weapons-related capabilities, how likely is it that states without nuclear-capable missiles or atomic weapons will refrain from trying to acquire them? Certainly, the Greater Middle East is watching to see what, if anything, the United States and its allies might do to penalize Iran's nuclear misbehavior. Most

states in the region are already hedging their nuclear bets by acquiring peaceful nuclear programs of their own. Similar dynamics are in play in the Far East in relation to North Korea's nuclear weapons program. Beyond these two cases, there is the general worry that the enforcement of nuclear nonproliferation lacks any teeth.

These questions suggest the need for an additional set of arms control and nonproliferation measures to complement the current set, an additional set that does not depend so much upon the legally binding agreement of any one state. Rather than expect international treaties on nuclear weapons material production and testing to come into force and merely *hope* that progress on this front will somehow persuade nonweapons states to keep clear of nuclear related activities, why not instead promote limits that would begin to constrain both nuclear weapons and non-nuclear weapons states at the same time? Rather than waiting for Iran, Pakistan, India, North Korea, and Egypt to ratify the Comprehensive Test Ban, why not use the implicit ban on nuclear testing contained in the Nuclear Nonproliferation Treaty to secure an immediate agreement among civilian nuclear supplier states to block nuclear trade with any NPT nonweapons state that tests? Once agreement on this has been reached, an additional agreement might be sought to expand such trade restrictions to *any* state that tests. Why not proceed with the Fissile Material Control Initiative, which would have an immediate (albeit initially modest) impact on both nuclear weapons states and nonweapons states, while simultaneously pushing the Fissile Material Cut-off Treaty, which would only affect nuclear weapons countries?

In addition, it would be useful to tie existing nu-

clear controls to controls over nuclear-capable missiles. Currently, violators of the NPT and states that withdraw from the treaty, while still in violation, are not prohibited from receiving nuclear-capable missile technology and assistance from missile technology supplying states. It would be useful to eliminate this loophole with the adoption of an automatic cutoff of access to goods controlled by the MTCR by these nuclear violators.

Such nuclear violators are also free to test nuclear-capable missiles, as North Korea recently did, launching them into airspace outside of their borders. Under current international law, all of this is legal. Yet, such missiles are ideal for carrying nuclear warheads, and their development is meant to intimidate. Should there be an international norm, as there is with piracy and slave trading, giving states with the technical power to shoot such objects out of international air space (e.g., the United States, Russia, Israel, and soon Japan, NATO, and China) as “outlaw” objects? Finally, if progress is made on creating additional limits on ballistic missile deployments (e.g., global INF, etc.), should violators of these understandings also be banned from receiving controlled missile and controlled nuclear goods?

The third basic principle is that international nuclear inspectors need to distinguish between nuclear activities and materials they can reliably safeguard against being diverted to make bombs, and those that they cannot. This distinction should be publicly announced. The NPT is clear that all peaceful nuclear activities and materials must be safeguarded – that is, inspected in a manner that can reliably prevent them from being diverted to make nuclear weapons. Most NPT states have fallen into the habit of thinking that if

they merely declare their nuclear holdings and allow international inspections, they have met this requirement.

This view is dangerously mistaken. After the nuclear inspection gaffes in Iraq, Iran, Syria, and North Korea, we now know that the IAEA cannot reliably detect covert nuclear activities early enough to allow others to intervene to prevent possible bomb making. We also now know that inspectors annually lose track of many bombs' worth of nuclear weapons-usable plutonium and uranium at declared nuclear fuel-making plants. Privately, IAEA officials admit that the agency cannot assure continuity of inspections for spent and fresh fuel rods at more than half of the sites that they inspect. Finally, we know that declared plutonium and enriched uranium can be made into bombs, and their related production plants converted so quickly (in some cases, within hours or days) that no inspection system can offer timely warning of a bomb-making effort. Yet, any true safeguard against military nuclear diversions must reliably detect them early enough to allow outside powers to intervene to block a bomb from being built. Anything less is only monitoring that might, at best, detect military diversions *after* they occur.

In light of these points, it would be useful for the IAEA to concede that it cannot safeguard all that it inspects. This would finally raise first-order questions about the advisability of allowing the stockpiling of plutonium, highly enriched uranium, and plutonium-based reactor fuels in the belief that these materials and activities can be safeguarded. At the very least, it would suggest that nonweapons states ought not to acquire these materials or facilities beyond what they already have. These points are important enough to

raise before, during, and after the May 2010 NPT Review conference.

In this regard, the United States and other like-minded nations might independently assess whether the IAEA can meet its own inspection goals; under what circumstances (if any) these goals can be met; and, finally, whether these goals are technically sound. The U.S. House of Representatives last year approved legislation to require the executive to make such assessments routinely and to report their findings. Similar legislation has been proposed in the Senate.¹¹

The fourth basic principle is that greater attention must be paid to comparing costs and discouraging the use of government financial incentives for commercialization projects, especially nuclear power, in order to assure safe, economically competitive forms of clean energy. Supporters of nuclear power insist that its expansion is critical to prevent global warming. Yet, they almost always downplay or ignore the nuclear weapons proliferation risks associated with this technology's further spread. It may be impossible to prevent the spread of nuclear power if it turns out to be the cheapest, quickest way to provide low or no-carbon energy, but given the security risk associated with nuclear energy, no government should pay extra to promote it.

Moreover, offering additional government financial incentives specifically geared to building more commercial nuclear plants and their associated fuel-making facilities will only increase the difficulty of accurately comparing nuclear power with nonnuclear alternatives. Not only do such subsidies mask the true costs, they tilt the market against less subsidized alternatives. The most dangerous forms of civilian nuclear energy and nuclear fuel making in most nonweapons

states and large power reactor projects in war-torn regions like the Middle East – turn out to be poor investments as compared to much safer alternatives.¹²

There are several ways to mitigate such market distortions. The first would be to get as many governments as possible to open all large civilian energy projects in their countries to international competitive bidding. This procedure is already in place in a number of countries. The problem is that when states want to build large energy-producing facilities, they limit the competition to nuclear bids rather than open the competition to any energy option that could meet the applicable set of environmental and economic criteria. Limiting the competition in this way ought to be discouraged internationally.

Most advanced nations, including the United States, claim to back the principles of the Energy Charter Treaty and the Global Energy Charter for Sustainable Development. These international agreements are designed to encourage all states to open their energy sectors to international bidding to assure that all energy options are considered, and that the various subsidies and ancillary costs associated with each are identified and reflected in the price of what is being proposed. Promoting adherence to these rules is essential if the United States and other states are serious about reducing carbon emissions in the quickest, least costly manner.

Such states should thus reference and enforce the principles of the Energy Charter Treaty and the Global Energy Charter for Sustainable Development as part of the follow-on to the understandings reached at Copenhagen, Denmark. In addition, states that elect to build a nuclear plant, when less costly nonnuclear alternatives would clearly make more sense, ought to be

flagged by an economic competitiveness monitoring body qualified to oversee large international energy project transactions. Such uneconomic nuclear picks (e.g., several proposed Middle Eastern nuclear projects) might also be referred to the IAEA for further investigation.¹³

As a complementary effort, the world's advanced states could work with developing countries to create non-nuclear alternatives for addressing their energy and environmental needs. In the case of the United States, this would simply entail implementing existing law. Title V of the Nuclear Nonproliferation Act of 1978 requires the Executive Branch to do analyses of key countries' energy needs and identify how these needs might be addressed with nonfossil, non-nuclear energy sources. Title V also calls on the executive branch to create an alternative energy cadre to help developing nations explore these alternative options. To date, no president has chosen to implement this law. Some members of Congress have indicated that they would like to remedy this omission by requiring Title V country energy analyses (and independent assessments of these analyses) to be performed as a precondition for U.S. approval of any additional U.S. nuclear cooperative agreements.¹⁴ As with most of the other suggestions already made, the United States can act on this idea without waiting for the full development of any international consensus.

ENDNOTES - CHAPTER 5

1. International Panel on Fissile Materials, "Global Fissile Materials Report 2008," October 2008, available from www.ipfmlibrary.org/gfmr08.pdf; and Andrei Chang, "China's Nuclear Warhead Stockpile Rising," *UPIAsia.com*, April 5, 2008, available from www.upiasia.com/Security/2008/04/05/chinas_nuclear_warhead_stockpile_rising/7074.

2. See, e.g., Henry S. Rowen, "This 'Nuclear-Free' Plan Would Effect the Opposite," *The Wall Street Journal*, January 17, 2008. For additional technical background, see David Kay, "Denial and Deception Practices of WMD Proliferators: Iraq and Beyond," Brad Roberts, ed., *Weapons Proliferation in the 1990s*, Cambridge, MA: MIT Press, 1995; Victor Gilinsky, et al., *A Fresh Examination of the Proliferation Dangers of Light Water Reactors*, Washington, DC: NPEC, 2004, available from www.npec-web.org/Essays/20041022-GilinskyEtAl-lwr.pdf; and Andrew Leask, Russell Leslie, and John Carlson, *Safeguards As Design Criteria – Guidance for Regulators*, Canberra: Australian Safeguards and Non-proliferation Office, September 2004, available from www.asno.dfat.gov.au/publications/safeguards_design_criteria.pdf.

3. Data for this chart was drawn from the Natural Resources Defense Council, "Russian Nuclear Forces 2007," *Bulletin of the Atomic Scientists*, March-April 2007, available from thebulletin.metapress.com/content/d41x498467712117/fulltext.pdf; and Robert S. Norris and Hans M. Kristensen, "U.S. Nuclear Forces, 2008," *Bulletin of the Atomic Scientists*, March-April 2008, available from thebulletin.metapress.com/content/pr53n270241156n6/fulltext.pdf.

4. Source: Frank Von Hippel et al., International Panel on Fissile Material, *Global Fissile Material Report, 2009*, pp. 11, 16, available from www.fissilematerials.org/ipfm/site_down/gfmr09.pdf.

5. *Ibid.*

6. Graphs developed for NPEC by Sharon Squassoni, available from www.npec-web.org/Frameset.asp?PageType=Projects.

7. *Ibid.*

8. See, e.g., Robert Einhorn, "Controlling Fissile Materials and Ending Nuclear Testing," Presentation before the International Conference on Nuclear Disarmament, Oslo, Norway, February 26-27, 2008, available from www.ctbto.org/fileadmin/user_upload/pdf/External_Reports/paper-einhorn.pdf.

9. See the Henry J. Hyde, United States-India Peaceful Atomic Energy Cooperation Act of 2006, "Implementation and Compliance Report," available from frwebgate.access.gpo.gov/cgi-bin/getdoc.cgi?dbname=109_cong_bills&docid=f:h5682enr.txt.pdf.

10. On these points, see Peter Lavoy, "Islamabad's Nuclear Posture: Its Premises and Implementation," Henry Sokolski, ed., *Pakistan's Nuclear Future: Worries beyond War*, Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2008, pp. 129-166; and General Feroz Khan, "Reducing the Risk of Nuclear War in South Asia," September 15, 2008, available from www.npec-web.org/Essays/20090813-khan%20final.pdf.

11. See Section 416 of the House State Authorization Act of 2010 and 2011, "Implementation of Recommendations of Commission on the Prevention of WMD Proliferation and Terrorism," available from www.govtrack.us/congress/billtext.xpd?bill=h111-2410.

12. See, e.g., Peter Tynan and John Stephenson, "Nuclear Power in Saudi Arabia, Egypt, and Turkey—How Cost Effective?" February 9, 2009, available from www.npec-web.org/Frameset.asp?PageType=Single&PDFFile=Dalberg-Middle%20East-carbon&PDFFolder=Essays; Frank von Hippel, "Why Reprocessing Persists in Some Countries and Not in Others: The Costs and Benefits of Reprocessing," April 9, 2009, available from www.npec-web.org/Frameset.asp?PageType=Single&PDFFile=vonhippel%20%20TheCostsandBenefits&PDFFolder=Essays; Doug Koplow, "Nuclear Power as Taxpayer Patronage: A Case Study of Subsidies to Calvert Cliffs Unit 3," available from www.npec-web.org/Frameset.asp?PageType=Single&PDFFile=Koplow%20-%20CalvertCliffs3&PDFFolder=Essays.

13. For more on these points, see Henry Sokolski, "Market Fortified Non-proliferation," *Breaking the Nuclear Impasse*, New York: The Century Foundation, 2007, pp. 81-143, available from

nationalsecurity.oversight.house.gov/documents/20070627150329.pdf. More on the current membership and investment and trade principles of the Energy Charter Treaty and the Global Energy Charter for Sustainable Development is available from www.encharter.org and www.cmdc.net/echarter.html.

14. See Letter from Congressmen Brad Sherman, Edward Markey, and Ileana Ros-Lehtinen to Secretary of State Hillary Clinton, April 6, 2009, available from bradsherman.house.gov/pdf/NuclearCooperationPresObama040609.pdf.