CHAPTER 15

A HARDHEADED GUIDE TO NUCLEAR CONTROLS

Henry D. Sokolski

With truly nettlesome problems, like preventing the spread of nuclear weapons, it is tempting to celebrate any current success as a turning point for entirely vanquishing the problem. With the fall of the Berlin Wall, the end of history was foretold. With Saddam Hussein's toppling and Maummar Kaddafi's termination of Libya's strategic weapons programs, Washington pundits portrayed the remaining "Evil Axis" holdouts—Iran and North Korea—as the next dominoes to fall. Now, with the ratification of a follow-on New Strategic Arms Reductions Treaty (New START)—the first legally binding arms control agreement to be reached in nearly 20 years—the elimination of nuclear weapons is being portrayed as a practical possibility.

It is easy to dismiss such optimism. What is more challenging is harnessing such enthusiasm to make things better or, at least, to not make them worse. This requires sound insight into what is and is not possible, and, in Washington, sensitivity to an increasing number of contentious political views regarding nuclear controls.

Here, a significant stumbling block is how heavily the Barack Obama administration's nuclear agenda depends on the successful negotiation and ratification of legally binding bilateral and international control agreements. These formal agreements include arms reduction treaties to follow New START, the Com-

prehensive Test Ban Treaty (CTBT), a Fissile Material Cutoff Treaty (FMCT) banning further military nuclear production, and a variety of multilateral and international nonproliferation and nuclear fuel-supply arrangements. These formal devices are, at best, an awkward way to secure the support of administration critics in Congress who are skeptical of traditional nuclear controls. Nor are any of these treaty-based agreements—some of which require ratification by North Korea, Iran, Pakistan, India, Egypt, and China—likely to come into force any time soon, if at all.

This suggests developing a more practical additional set of control measures that are not at odds with the current agenda, but are more likely to secure bipartisan support and can be implemented without necessarily securing the legal consent of so many other states. Before fleshing out this agenda, it is critical to first clarify the character of the long-term nuclear threats the United States and its friends face, and to identify which ones are most tractable.

WASHINGTON'S CURRENT AGENDA

With the ratification of the New START follow-on agreement late in 2010, the Obama administration has argued that additional nuclear weapons-reductions agreements can occur not only between the United States and Russia, but the world's other nuclear weapons states. Beyond this, the administration and its supporters hope that such agreements will help persuade the world's non-nuclear weapons states to do more to steer clear of dangerous civilian nuclear fuel-making activities and to open their civilian nuclear facilities to more intrusive international inspections.

It is improbable, however, that all states will fall into line. Certainly, barring regime change in either

North Korea or Iran, neither Pyongyang's renunciation of its nuclear arsenal nor Iran's cessation of nuclear weapons-related activities seems all that likely. Also, whichever reductions are achieved quickly or easily among existing nuclear weapons states are unlikely to capture Russia's large number of tactical nuclear weapons. The near-term odds, moreover, of China, India, Pakistan, or Israel reducing their nuclear weapons-related holdings seem slim.

Some nuclear trends, moreover, could easily make further reductions less likely. Before 2020, the United Kingdom (UK) is expected to find its nuclear forces eclipsed by those of Pakistan, Israel, and India. Soon thereafter, France could share the same fate.[1] China has enough separated plutonium and highly enriched uranium to increase its current presumed stockpile of roughly 200 nuclear warheads by a factor of 5 to 10.[2] Meanwhile, Japan, which already has over 2,000 bombs' worth[3] of weapons-usable plutonium on its soil, could soon begin operation of a reprocessing plant capable of separating out an additional 1,000 bombs' worth of weapons-usable plutonium annually.[4] U.S. and Russian reserves of 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 stores in Japan and other nuclear weapons states could easily double.[5] Compounding these developments, even more nuclear weapons-ready states are likely to emerge: As of early 2011, at least 35 states had announced their desire to build large reactors—all potential bomb-starter kits—before 2030.[6]

None of this is likely to bolster the cause of nuclear weapons abolition or nonproliferation. Certainly, ratification of major arms reductions treaties with Russia

(New START and its follow-ons), CTBT, FMCT, international civilian nuclear fuel banks, and enhanced inspections of civilian nuclear programs are unlikely to be enough to head off the troubling trends described. What is worse, these arms control measures, if executed improperly, could actually make matters worse.

Thus, critics of strategic arms reductions with Moscow warn that if the current New START follow-on agreement is superseded with reductions down to 1,000 or fewer strategic nuclear warheads, it might undermine the credibility of U.S. nuclear security alliances. In this case, these critics argue, states like Japan, Saudi Arabia, and Turkey might be tempted themselves to go nuclear.[7]

As for pushing ratification of a CTBT, this too might backfire: India, whose last nuclear test series was followed by Pakistani nuclear tests, conducted a loud, public debate in 2009 over whether or not to resume nuclear testing. One of the key Indian arguments made for resuming testing was to beat what many Indians feared was an approaching nuclear test ban deadline. Meanwhile, American test ban treaty opponents have recommended that the U.S. Senate tie the treaty's test limits to which nuclear weapons activities other states, like Russia, will agree are permissible under a CTBT. In this regard, some Russians have voiced that very low-yield nuclear tests that release a lower nuclear yield than the explosive energy of the non-nuclear triggering mechanisms in a nuclear explosive are permissible. Yet, pegging the treaty to such clarifications would encourage low-level nuclear testing.[8]

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, a worry is that the FMCT only bans the production of fissile material for military purposes. Could its finalization encourage increased civilian production of fissile material that might be used to make weapons? The short answer is yes. Furthermore, there is little to fend off such an ostensibly "peaceful" activity. The odds of inspectors catching military diversions from civilian nuclear plants, in fact, can be quite low.[9]

Then there is the potential problem of setting a double inspections standard. While most nuclear weapons states might lack the incentives to cheat (since the fissile material cutoff would still allow them to keep their nuclear weapons holdings), non-nuclear weapons states would likely insist that their civilian nuclear fuel-making activities be inspected no more carefully than those of weapons states under a cutoff. It would be difficult to persuade states that do not have nuclear weapons not to make nuclear fuel or to do so under stricter conditions than those of nuclear weapons states, which are free to do so under relatively loose nuclear "safeguards." Affording non-nuclear states access to international civilian nuclear fuel services is also unlikely to deter them, since, unless they are breaking the nuclear rules, they already have access to such services from a variety of providers, and major nuclear supplier states have argued that they have a legal right to make their own fuel.

Finally, with the growing popularity of "peaceful" nuclear energy, nuclear supplier states are claiming that exporting new power reactors will not increase proliferation, since their export will come with the application of "enhanced" nuclear inspections. Yet, in many of the most worrisome cases—e.g., Syria, Iran, India, Pakistan, Saudi Arabia, and North Korea—even

enhanced inspections may be too unreliable to deter or prevent significant military diversions effectively. As it is, most remote nuclear inspection monitoring systems are unable to guarantee the continuity of inspections over a majority of the world's spent or fresh fuel—materials that can be used as feed for nuclear enrichment and reprocessing plants to accelerate the production of weapons-usable materials. These nuclear fuel-making plants, moreover, can be hidden from nuclear inspectors and, even when declared, used to make weapons-usable fuel without those inspectors necessarily detecting such activity in a timely fashion. For all these reasons, then, one needs somehow to be sure that any recipient of a large reactor (even of a reputed "proliferation resistant" light-water reactor) is entirely out of the nuclear bomb-making business and will stay away from such activities in the future.[10]

Several of these points are beginning to receive attention in the United States. The debate over these issues, though, needs to be broadened. Even if Washington and the European Union's (EU) favorite nuclear control initiatives—START follow-ons, CTBT, FMCT, civilian nuclear fuel banks, and intrusive nuclear inspections—are all adopted and implemented in ways that avoid the risks already discussed, the United States and its allies would still face a series of additional, major nuclear weapons proliferation threats.

NUCLEAR REDUCTIONS AND ARMS COMPETITIONS

The first of these is that as the United States and Russia incrementally reduce their nuclear weapons deployments, China, India, Pakistan, and Israel may increase theirs. Currently, the United States is plan-

ning to reduce U.S. and Russian strategic weapons deployments to as low as 1,000 warheads each.[11] 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 hundreds rather than thousands of weapons. In such a world, relatively small changes in any state's nuclear weapons capabilities could have a disproportionate impact on the perceived balance of power.

Compounding the increased volatility that these trends could produce are the large and growing stockpiles of nuclear weapons-usable materials (i.e., of separated plutonium and highly enriched uranium) that are being held in several states. These stockpiles already exceed tens of thousands of crude bombs' worth of material in the United States and Russia and are projected to grow in Pakistan, India, China, Israel, and Japan. This growth will enable these states to increase their current nuclear deployments much more quickly and dramatically than any of the superpowers could during the worrying early years of the Cold War.

Finally, 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 35 states have announced their desire to launch large civilian nuclear programs. If they all realize their dreams of bringing their first power reactors online by 2030, it would constitute more than a doubling of the 31 states that currently have such programs (most of which are now operating in the United States, Europe, Japan, and South Korea).

If this civilian nuclear expansion and the large reactors it promises to bring online are realized, it could

have major military implications. Every current weapons state first brought a large reactor online prior to acquiring its first bomb. The UK, France, Russia, India, and the United States all made many of their initial bombs from reactors that also provided power to their electrical grids. The United States still uses a "proliferation resistant" light-water power reactor operated by the Tennessee Valley Authority to make all of its weapons-grade tritium for its nuclear arsenal.[12]

Other plants besides large power reactors, of course, would be needed to chemically separate out weapons-usable plutonium from the spent power reactor fuel or to enrich the uranium used to power such machines. Yet, as the recent cases of Iran and North Korea demonstrate, such fuel-making plants can be built in ways that can be difficult to detect and operated to make timely detection of illicit production improbable.[13] Certainly, if all of the announced civilian nuclear power 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 (i.e., able to acquire weapons in 12 to 24 months), to contend with.[14]

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

Finally, these nuclear trends would surely aggravate the prospects for nuclear-charged terrorism and irredentism. Not only would there be more opportunities to seize nuclear weapons and nuclear weapons materials, there would be more military and civilian nuclear facilities to sabotage. In addition, the potential for miscalculation and nuclear war could rise to a point that even non-nuclear acts of terror could ignite larger conflicts that could turn nuclear.

This sort of international volatility could easily mimic that which preceded World Wars I and II—periods in which overly ambitious arms control agreements were sought while states raced to complete significant covert and overt military programs. Ultimately, the latter only helped heighten tensions and subsequently were employed in unrestricted warfare. If such wars should break out in the future, though, the key difference would be that the ammunition in such conflicts, increasingly, might not just be highly explosive, but nuclear.

WHAT IS TO BE DONE?

Can the United States and like-minded nations avoid or mitigate these trends? The short answer is yes, but only if they attend more closely to several basic principles.

First, as nuclear weapons deployments decline, greater care must be taken to ensure military reductions or additions actually decrease the chances for war. If American nuclear security guarantees are to continue to neutralize the nuclear weapons yearnings of key U.S. allies, it is critical that Washington avoid doing anything to undermine the correlation of forces it currently enjoys against America's key nuclear competitors. In addi-

tion to enhancing its conventional military capabilities and making roughly equal nuclear reductions with Russia, then, the United States and the North Atlantic Treaty Organization (NATO) in the near- to mid-term will have to keep other nuclear-armed states, such as China, either from trying to catch up with either the United States or Russia, or—as in the case of India and China, Pakistan and India, and Japan and China—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 fuels, will need to be reached not only with Russia, but with China, India, and Pakistan. As a practical matter, this also means that other nuclear weapons-ready or virtual weapons states (e.g., Israel and Japan) will have to be asked to curtail or end their production of nuclear weapons-usable materials or to dispose of some portion of what they currently have.

Conventional Force Enhancements and the Demand for Nuclear Weapons.

In any effort to maintain the relative parity of competing nuclear-armed states forces through non-nuclear military assistance or buildups, it may be necessary to enhance conventional forces in a manner that avoids increasing one or both sides' interest in acquiring more nuclear weapons. Unfortunately, this is not a simple matter.

Consider long-range precision strikes 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 to ensure that their nuclear forces could not be knocked out by precise Indian conventional strikes. Exporting the wrong kinds of advanced non-nuclear weapons systems in India or helping it to build them in disproportionate numbers could adversely influence Pakistan's nuclear weapons plans.[15]

Ballistic missile defenses (BMD) could also be tricky. Under the right circumstances, having such defenses could afford a non-nuclear 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 defenses might be used to counter them after launch. Such defenses also could be useful as a form of insurance against cheating on any future nuclear-capable ballistic missile reduction agreements. As already noted, though, to secure these benefits, more than just their deployment may be necessary.

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 get Islamabad to sue for peace quickly. India has also begun to develop missile defense systems of its own to counter both Pakistani and Chinese offensive missile threats.

Under these circumstances, sharing equal amounts of missile defenses with India and Pakistan would only give India yet another non-nuclear 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 and help secure the benefits of missile defense for both countries would be to address the underlying conventional asymmetry between them.

Missile Limits.

One idea regional security experts have long favored is creating low-, medium-, and high-density 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. A key element of these proposals is that both sides eliminate their existing short-range ballistic missiles (SRBM), since their use could mistakenly prompt nuclear reactions. If such military confidence-building measures were implemented, they might be effective enough to attenuate the perceived stability risks of deploying more advanced, discriminate, non-nuclear military systems.[16]

Elsewhere other measures might be desirable. As China increases its medium- and long-range nuclear-capable missile superiority over Taiwan and its capability to target U.S. carrier battle groups with advanced, long-range, conventional missiles, the United States and its Pacific allies must worry that Beijing may be able to overwhelm the missile defenses they are now deploying.[17] China, meanwhile, is developing missile defenses of its own to counter possible U.S. nuclear and precise conventional intercontinental missile attacks. Countering offensive Russian long-range missiles may also be a Chinese objective. All of these missile threats and defensive efforts suggest that

diplomatic efforts might be focused usefully on reaching offensive, long-range missile limits to ensure that whatever missile defenses are deployed there will not immediately be overwhelmed.

In this regard, several precedents exist. The Strategic Arms Reduction Treaty (START), which limits U.S. and Russian strategic missile delivery systems, is one. The Intermediate Range Nuclear Forces (INF) Treaty, which covers Russian and NATO missiles with ranges between 500 and 5,500 km, is another. The Missile Technology Control Regime (MTCR), which limits commerce in large missiles capable of lifting at least 500-kilogram (kg) payloads 300 kilometers (km) or farther in range, as well as goods and technology that might contribute to such systems, is another still.

The trick in reaching new, additional missile limits is to make sure they are aggressive enough to capture the missiles that matter most—those optimized for use in massive, coordinated first strikes[18]—so as to reduce the need or desire for nations to deploy more nuclear warheads without creating new categories of permissible missiles. It certainly would make little sense to eliminate ballistic missiles above the 500-km range, only to end up legitimizing slightly lower-range missile systems that are above the limits restricted by the MTCR.

Yet another related concern in limiting offensive, long-range missiles, while making room for the deployment of missile defense systems that employ large ballistic missile interceptors themselves, is to make sure the proliferation of missile defenses does not itself result in the further spread of large ballistic missiles or related technologies. Here, one might start by prohibiting the export of ballistic missile-based defensive systems that employ rockets in ex-

cess of the MTCR's category one missile limits (i.e., missiles capable of lifting 500 kg more than 300 km). Alternatively, agreements might be reached to encourage states to move away from the employment of missile defense systems that rely on large ballistic missile systems toward alternatives (e.g., small boost-phase missile interceptors borne on drones, directed energy systems, etc.). In either case, the aim would be the same—to ensure efforts to reduce the spread of offensive, nuclear-capable missiles that do not end up increasing such proliferation. This brings us to the second general principle.

Reducing existing nuclear weapons and nuclear-capable delivery systems should be related more closely to 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, ought to follow; this, in turn, should persuade non-nuclear weapons states to submit to much-more-intrusive inspections of their civilian nuclear activities.[19] 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.

First, after the International Atomic Energy Agency (IAEA) failed to detect the covert nuclear programs in Iraq, Iran, Syria, and North Korea, it is an open question if even "enhanced" international nuclear inspections will be able to detect illicit nuclear activities reliably. This is especially so if, as some believe, large civilian nuclear programs do spread to regions like the Middle East.

Second, not only the United States but Israel, Japan, NATO, India, Russia, and China are planning

to deploy BMD systems—each for very different reasons. Yet, the United States and the allied approach to controlling nuclear strategic threats is practically silent as to whether these defense programs should be promoted or restricted and, if so, how. Nor, outside of strategic reduction talks with Russia, is there much discussion as to whether or how other states' development of large, long-range missiles (both nuclear and non-nuclear) should be approached.

Then, there are 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 reduce strategic nuclear weapons deployments to 1,000 warheads on each side? Will Russia agree to limit its nonstrategic nuclear weapons? Which demands will Moscow make for such reductions? Will Russia demand the United States and NATO cripple their conventional and missile defense plans? Finally, when, if ever, might such agreements be reached? The success of America and the EU's arms control and nonproliferation policies depend on the answers to these questions being favorable to the United States.

Finally, and related to the political issues noted above, are the questions related to enforcement. 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 keep clear of trying to acquire them? Certainly, the Greater Middle East is watching 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 at 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 limits lacks any teeth. What, if anything, will be done to prevent further nonproliferation violations?

These questions all suggest the need for promoting an additional set of more immediate incremental arms control and nonproliferation measures to complement the set of arms control treaties and understandings (which may or may not succeed) that the United States and the EU are currently pushing. In this regard, there are a number of possibilities.

Fissile Material Controls.

To date, the United States has given only very basic guidance on how it intends to reduce the production of nuclear weapons-usable materials—i.e., highly enriched uranium and separated plutonium. President Obama has called for the negotiation of a FMCT. But most versions of this agreement explicitly allow "civilian" nuclear fuel production, which is virtually identical to military production. Also, after decades of fruitless talks in Geneva, it is unclear if any such agreement could ever be negotiated, much less brought into force.

Some officials, including those currently advising Secretary Hilary Clinton, have suggested a complementary approach to negotiating a FMCT, known as the Fissile Material Control Initiative (FMCI). Instead of a binding treaty, both Nonproliferation Treaty (NPT) weapons states *and* nonweapons states would simply identify which portion of their separated plutonium and highly enriched uranium stocks were in excess of either their military *or* civilian requirements and secure or dispose of them.[20] One could also make

it more difficult for states to access whatever surpluses they declare by requiring the prior consent of all parties participating in the initiative for any state to regain access to these materials.[21]

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 India 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 nuclear weapons directly or indirectly. That would include India, which tested its first nuclear explosive in 1974. Meanwhile, under the Hyde Act, which authorized the civilian U.S.-India nuclear deal, the White House is 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 India's stockpiles of unsafeguarded plutonium with either the direct or indirect help of NPT weapons states.[22]

If India's unsafeguarded plutonium stockpiles grow faster per year than was the case prior to the nuclear cooperative agreement's finalization in 2008 and this growth could be shown to be related to Indian uranium imports from one or more of the NPT weapons states, the latter would be implicated in violating Article I of the NPT. To prevent such a violation or, at least, limit the harm it might do, the United States should be prepared to alert all other nuclear-supplying states and ask that they suspend civilian nuclear

assistance until India's unsafeguarded nuclear weapons-usable material production declines. The logical place to make this request would be the Nuclear Suppliers Group (NSG). Such vigilance could also be matched with efforts to keep Pakistan from expanding its nuclear weapons capabilities as well.

Finally, the United States, China, Japan, and South Korea could reconsider the merits of expanding civilian recycling of plutonium-based fuels. As has already been noted, prior to the nuclear accidents at Fukushima, Japan was planning to open a commercial plutonium-reprocessing plant in Rokkasho. Projected to cost over $100 billion over its lifetime, the plant is designed to produce roughly 1,000 Nagasaki-sized bombs' worth of weapons-usable plutonium annually. Although it originally was supposed to produce plutonium-based fuels for a large-breeder reactor program, the Japanese breeder effort has fallen many years behind schedule. Japan has also decided not to expand its current fleet of light-water reactors, which might burn mixed oxide fuels containing recycled plutonium. As a result, the many tons of plutonium that will be produced at Rokkasho are only likely to add to the 2,000 bombs' worth Japan already has stored on the site. Technical difficulties have already delayed the plant's opening several times. The Japanese government is currently reviewing if it should proceed with its fast reactor and plutonium-recycling program as a part of its post-Fukushima energy review.

South Korea, meanwhile, sees Japan's plutonium-recycling effort as something of a model. Seoul, which the United States had previously caught trying to use its civilian nuclear program to make plutonium weapons, now wants to revise the civilian nuclear cooperative agreement it has with the United States to allow

it to recycle plutonium. Where is China on all of this? Not far behind. In 2009, Beijing announced that it had contracted with the French firm, AREVA, to build a plutonium-reprocessing plant nearly identical to the one the French built for Japan at Rokkasho. Whether China will keep this program on schedule after its own post-Fukushima nuclear pause is unclear. Finally, despite congressional interest in domestic commercial reprocessing, the U.S. Department of Energy's own blue ribbon panel on the future of nuclear power has decided that such a program is not needed at this time.[23]

Nuclear experts have repeatedly determined that none of these plutonium-recycling programs are as economical as simply burning fresh uranium fuel and storing the waste above ground. All of the programs run proliferation and physical security risks. That is why the bipartisan, congressionally mandated Commission on the Prevention of Weapons of Mass Destruction, Proliferation, and Terrorism called on Congress and the Executive Branch to maintain the moratorium Presidents Gerald Ford and Jimmy Carter imposed on U.S. commercial reprocessing in 1976.[24] Discussing the merits of expanding such a moratorium with China, Japan, and South Korea might make sense. In exchange for Japan, the United States, and South Korea holding off, it might be possible to persuade China to do so as well. It may even be possible to get Chinese officials to announce publicly what they have intimated to U.S. experts privately—that China has not made highly enriched uranium or plutonium for weapons for many years. If China were to agree to hold off, it would be helpful in continuing efforts to get India and Pakistan also to agree to halt their own nuclear weapons fissile material production efforts.

Repressing Nuclear Testing and NPT Violations.

As already noted, getting the U.S. Senate to ratify the CTBT will not be easy. More important, it may be many years at best before this agreement is ever brought into force. Certainly, focusing solely on finalizing this treaty is likely to come at a cost. North Korea might test a third nuclear weapon. In 2009, India's nuclear scientists seriously debated whether and when India might have to resume nuclear testing to perfect a thermonuclear device. Yet, if India tests, Pakistan would almost certainly follow suit.[25] It may not be possible to hem Pyongyang in, but India, Pakistan, China, France, the UK, and the United States have all gone on record previously announcing their policy not to test. Rather than wait for yet another nuclear explosion, it would be useful to get all of these states to recommit themselves now to the moratorium they previously said they supported. Certainly, if the United States cannot get these states to recommit, the prospects for ever bringing the CTBT into force would seem even more remote.

Enforcing the moratorium, of course, is a separate matter. Here, it would make sense to exploit the implicit legal ban against non-nuclear weapons states testing that is contained in the NPT. For nearly as many years as the NPT has been in force, civilian nuclear supplier states have tried through the NSG to bolster the NPT by imposing commonsense restrictions on civilian nuclear exports. Why not secure agreement there to block further civilian nuclear trade with any NPT nonweapons state that tests? Given Tehran's dependence on Russian civilian nuclear assistance, this would be immediately relevant in Iran's case.[26]

One could build on this by also seeking agreement to cut off supplies of nuclear-capable missile technology under the MTCR as well. Currently, violators of the NPT and IAEA safeguards and states that withdraw from the NPT while still in violation are not prohibited from receiving nuclear-capable missile technology and assistance from missile technology supplying states. Why not eliminate this loophole with the adoption of an automatic cutoff to goods controlled by the MTCR to these nuclear violators?

Finally, as missile defense capabilities grow and spread internationally, one could consider linking the treatment of serious NPT control violations not just with access to NSG and MTCR goods but with the freedom of states to test nuclear-capable missiles with flight paths that go outside their borders. Currently, countries that flaunt the nuclear rules, such as North Korea, are free to fire nuclear-capable missiles over Japan toward the United States. Under current international law, this is legal. Yet, such missiles are indistinguishable from those designed to carry nuclear warheads, and their development and testing are inherently destabilizing. If a finding is made at the IAEA or the United Nations Security Council (UNSC) that a state is in violation of its NPT obligations, one might ask if there should be an international norm against such flights, just as there is with other illicit outlaw activities, such as piracy, drug running, and slave trading. If so, one could give states with the technical power authority 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. Similarly, if progress is made on creating additional limits on missile deployments (e.g., global INF, etc.), violators of these understandings could also be

banned from receiving controlled missile and nuclear goods and be subject to similar missile testing restrictions until they were determined by the appropriate authorities to have come back into full compliance.

The presumption here, of course, is that organizations such as the IAEA are fully able to make such determinations. In fact, they are not, which brings us to the third principle that the United States and other states need to focus on.

International nuclear inspectors should be encouraged to distinguish between nuclear activities and materials that they can reliably safeguard against being diverted to make bombs and those that they cannot. 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 is dangerously mistaken. After the nuclear inspections gaffes in Iraq, Iran, Syria, and North Korea, we now know that the IAEA cannot necessarily 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 ensure continuity of inspections for spent and fresh fuel rods at more than half of the sites that the agency inspects. Finally, we know that declared plutonium and enriched uranium can be diverted from their related production plants and made into bombs so quickly (in some cases, within hours or days) that no inspec-

tion system can offer timely warning of a country's bomb-making efforts. 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 against possible military diversions. This would finally raise first-order questions about the advisability of producing or stockpiling plutonium, highly enriched uranium, and plutonium-based reactor fuels, and believing that these materials and activities can be safeguarded. At the very least, this concession would suggest that nonweapons states ought not to acquire these materials or facilities beyond what they already have.

In this regard, the United States and other like-minded nations might independently assess whether or not the IAEA can meet its own inspection goals; under what circumstances (if any) these goals can be met; and, finally, whether these goals are set high enough. The U.S. House of Representatives approved legislation in 2009 to require the IAEA to make such assessments routinely and to report its findings. Similar legislation has been proposed in the Senate.[27]

Compare Costs.

Finally, to ensure safe, economically competitive forms of clean energy, greater attention should be paid to comparing costs and discouraging the use of government financial incentives for energy commercialization projects, especially nuclear power. Supporters of nuclear power insist that its expansion is critical to prevent global warming. Yet, they generally downplay or ignore the nuclear weapons-proliferation risks associated with the further spread of this technology. That said, 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. Given the security premium associated with the further spread of nuclear power technologies, though, no government should pay extra to promote it.

Certainly, creating new, additional government financial incentives specifically geared to build more commercial nuclear plants and their associated fuel-making facilities will only increase the difficulty of comparing these nuclear alternatives accurately with non-nuclear alternatives. Not only do such subsidies mask nuclear power's true costs; they tilt the market against less subsidized, potentially sounder alternatives.[28] This is troubling, since nuclear power continues to enjoy massive government support, and the most dangerous forms of civilian nuclear energy—nuclear fuel-making in most nonweapons states and large-power reactor projects in war-torn regions like the Middle East—are poor investments as compared with much safer alternatives.[29]

There are several ways to avoid this trend. The first would be to get as many governments as possible to open all large civilian energy projects in their coun-

tries up to international competitive bidding. This is already done in a number of countries. The problem is that when states want to build large civilian nuclear reactors, they limit the competition to nuclear bids only, rather than open the competition up to any energy option that can meet a given set of environmental and economic criteria.

This practice flies in the face of the Energy Charter Treaty, which has been ratified by the EU and is supported by Washington. This agreement calls on states to encourage open international bidding on any large energy project or transaction. Meanwhile, the Global Energy Charter for Sustainable Development, which the United States and many other states also support, calls on states to internalize many of the external costs (e.g., those associated with government subsidies and quantifiable environmental costs, such as the probable prices of carbon) in determining the costs of large energy projects.

Although these agreements have not yet played a significant role in reducing carbon emissions, they could. Certainly, the surest way to ensure that carbon reductions are accomplished in the quickest, cheapest fashion is to: a) include all the relevant government subsidies in the price of competing energy options; b) assign a range of probable prices to carbon for each option; c) use these figures to determine what the lowest cost energy source or technology might be in relation to a specific timeline; and, d) compete each option on the basis of both price and time.

Enforcing total adherence to these principles will be challenging. One can, however, do better or worse, and the downsides of not trying far exceed the risks of even partial failure. A good place to improve on a largely blank slate would be for Washington to suggest a modest carbon-abatement data-collection action

plan for the Group of Twenty Finance Ministers and Central Bank Governors (G-20) that would include establishing common energy project cost accounting and international bidding rules. Beyond this, it would be useful to call on the G-20 to give the IAEA notice of any state decisions they believe might violate these principles by favoring nuclear power over cheaper alternatives. The aim here would be to encourage the IAEA to ascertain the true purpose of such nuclear projects.[30]

As a complementary effort, the world's advanced states could also work with developing countries to create non-nuclear alternatives to address their energy and environmental needs. In the case of the United States, this would 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 non-fossil, 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 U.S. President has chosen to implement this law. The U.S. Congress has indicated that it would like to change this by requiring Title V country energy analyses (and outside, nongovernmental assessments of these analyses) to be done as a precondition for the U.S. initialing of any new, additional U.S. nuclear cooperative agreements.[31] The United Nations (UN), meanwhile, has an alternative, renewable (non-nuclear) energy initiative of its own—the International Renewable Energy Agency (IRENA) aimed at assisting developing states. As with most of the other suggestions already made, the United States and other states can emphasize these initiatives without waiting for any international treaty agreement.

What Is Possible.

For those who have already settled in with our government's current catalogue of treaty-based fixes, the list of incremental control recommendations in this chapter might seem too far off the beaten path to be viewed as anything but too ambitious. This, however, gets things backwards. Our government's current arms control and nonproliferation agenda is more than slightly ambitious itself: After the New START follow-on agreement that has just been reached, there is little chance any of the other treaties President Obama highlighted in his April 5, 2009, Prague, Czech Republic, speech—additional nuclear reduction treaties with Russia or other states, the CTBT or the FMCT—can be brought into force before the end of Obama's first term or even before the 2016 presidential elections.

In sharp contrast, several of this chapter's suggestions involve implementing nothing more than existing law (e.g., the Hyde Act on India, the Nuclear Nonproliferation Act of 1978 on alternative energy cooperation, conducting energy assessments, and making sure U.S. nuclear cooperation is safeguarded in a manner that affords timely warning of possible military diversions). Nor do any of these suggestions require negotiating or ratifying formal bilateral or international treaties. Most of the suggestions regarding sanctions involve modifying current NSG and MTCR guidelines, something that is done on a routine basis. The assessments of what the IAEA can and cannot safeguard, and how sound its own standards are to accomplish this, can be done with or without other states' cooperation.

Most of the other suggestions also can be implemented without waiting on international consensus or the consent of other countries. Yet, none of the ideas offered are at odds with our government's arms control objectives and ought, like the Fissile Material Control Initiative and recommittment to existing nuclear test moratoria, to make it easier to negotiate formal international treaties and bring them into force. Finally, more than a few of the suggestions—such as promoting a moratorium on the further expansion of commercial recycling of plutonium in the United States and Asia and encouraging the G-20 to compete large energy projects and adopt sound energy accounting rules—could save many billions in unnecessary spending.

Still, seasoned political experts in Washington would rightly be wary of either Democrats or Republicans seizing on these ideas. Certainly, until the presidential elections in November 2012, few, if any, in the majority party would have the time or the inclination to suggest that the head of their party do something different than what is already on the foreign affairs agenda. Meanwhile, Republicans running for office are unlikely to be drawn to anything other than criticizing the Obama administration. This hardly leaves much room even for incremental innovation.

November 2012, however, is not that far off. Certainly, by then, the glory of negotiating the START follow-on agreement will largely have worn off, and the prospect of not bringing any new treaty agreements into force for many years will begin to set in. In this environment, Democratic supporters of the President may actually look for new, additional ways to demonstrate their support of the President's nuclear control goals of reducing the amount of nuclear weapons and

nuclear weapons-usable materials, ending nuclear weapons testing, preventing the spread of nuclear weapons-related capabilities, and lowering the risks of nuclear use and theft.

Republicans, on the other hand, are likely to be focused like a laser beam on the prospects of defeating President Obama in 2012. Assuming that President Obama does not defeat himself, though, this will place a premium on the Republican Party to explain not just what it is against, but what it is for. In the case of nuclear controls, Republicans may find fault with the formal treaties President Obama is trying to negotiate and bring into force. Yet, they will be hard pressed to take major exception to President Obama's general goals of reducing the chances of nuclear use or theft, blocking the further spread of nuclear weapons-related capabilities, keeping other states from testing nuclear weapons, reducing the production and amounts of weapons-usable materials, and securing verifiable nuclear weapons reductions—not just with Russia but with the world's other weapons states. The question will be not whether Republicans support these goals, but rather in what different ways they might try to achieve them. For very different reasons, then, Democrats and Republicans will both have an interest in developing an additional list of nuclear control measures to those currently in play. One could do much worse than starting to consider those listed here.

ENDNOTES - CHAPTER 15

1. See "Pakistani Nuke Arsenal on Track to be World's Fifth Largest," *Global Security Newswire*, February 2, 2011, available from *gsn.nti.org/gsn/nw_20110201_5282.php*; Anthony H. Cordesman, "Study on a Possible Israeli Strike on Iran's Nuclear Development Facilities," Washington, DC: Center for Strategic and Internation-

al Studies, March 14, 2009, available from *csis.org/files/media/csis/pubs/090316_israelistrikeiran.pdf*; "Key Facts: Israel, Nuclear," *Jane's CBRN Assessments,* December 1, 2009; and Thomas Graham, "Nuclear Weapons Stability or Anarchy in the 21st Century: China, India, and Pakistan," Arlington, VA: The Nonproliferation Policy Education Center, Unpublished Analysis, June 9, 2011, available from, *www.npolicy.org/article.php?aid=621&rt=&key=thomas%20graham&sec=article*.

2. See International Panel on Fissile Materials, *Global Fissile Materials Report 2010*, available from *www.fissilematerials.org/ipfm/site_down/gfmr10.pdf*; 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*; and "长 城 工 程 (Great Works)," Baidu (China), January 13, 2011, available from *baike.baidu.com/view/981670.htm*, Google Chrome, trans.

3. A crude bomb's worth of plutonium (enough to make a bomb with a Hiroshima-sized yield) is conservatively defined by the Department of Energy as 4 kilograms (kg) of plutonium. Japan currently is storing 8.7 metric tons (i.e., 8,700 kg) of weapons-usable separated plutonium on its soil (see Endnote 2). For a more detailed analysis of how much material is required to produce Hiroshima-like yields, see Thomas B. Cochran, "The Amount of Plutonium and Highly Enriched Uranium Needed for Pure Fission Weapons," Washington, DC: The Natural Resource Defense Council, April 13, 1995, available from *www.nrdc.org/nuclear/fissionw/fissionweapons.pdf*.

4. See "Spent Fuel Causing Headaches for Nuclear Plants," June 29, 2011, available from *www.asahi.com/English/TKY201106280424.html*, and Chester Dawson, "In Japan, Provocative Case for Staying Nuclear," *The Wall Street Journal*, October 28, 2011, available from *online.wsj.com/article/SB10001424052970203658804576638392537430156.html?KEYWORDS=nuclear+reprocessing*.

5. See *Global Fissile Materials Report 2010*.

6. World Nuclear Association, "Emerging Nuclear Energy Countries," November 2011, available from *www.world-nuclear.org/info/inf102.html*.

7. See Josh Rogin, "Exclusive: House Republicans Ding Obama on Nuke Treaty in Previously Unreported Letter," September 16, 2009, available from *thecable.foreignpolicy.com/posts/2009/09/16/exclusive_house_republicans_ding_obama_on_nuke_treaty_in_previously_unreported_lettter*.

8. On these points, see Jonathan Medalia, "Comprehensive Nuclear-test-ban Treaty: Issues and Arguments," *CRS Report for Congress,* RL 34494, Washington, DC: Congressional Research Service, March 12, 2008, pp. 20 ff., available from *www.fas.org/sgp/crs/nuke/RL34394.pdf*; and U.S. Congressional Commission on the Strategic Posture of the United States, *America's Strategic Posture,* Washington, DC: United States Institute of Peace Press, 2009, p. 83, available from *media.usip.org/reports/strat_posture_report.pdf*.

9. On the inherent difficulty of effectively safeguarding declared nuclear fuel plants against incremental or abrupt military diversions, see Marvin M. Miller, "Are IAEA Safeguards on Plutonium Bulk-Handling Facilities Effective?" *Nuclear Control Institute*, 1990, reprinted in Paul Leventhal, *et al*., eds., *Nuclear Power and the Spread of Nuclear Weapons,* Washington, DC: Brassey's, 2002; Brian G. Chow and Kenneth A. Solomon, *Limiting the Spread of Weapon-Usable Fissile Materials,* MR-346-USDP, Santa Monica, CA: The Rand Corporation, 1993, pp. 1-15; Andrew Leask, Russell Leslie, and John Carlson, "Safeguards as a Design Criteria: Guidance for Regulators," Canberra, Australia: Australian Safeguards and Non-proliferation Office, September 2004; and Edwin S. Lyman, "Can Nuclear Fuel Production in Iran and Elsewhere Be Safeguarded against Diversion?" in Henry Sokolski, ed., *Falling Behind: International Scrutiny of the Peaceful Atom,* Carlisle, PA: The Strategic Studies Institute, U.S. Army War College, 2008, pp. 101-20.

10. On these points, see Henry S. Rowen, "This 'Nuclear-Free' Plan Would Effect the Opposite," *The Wall Street Journal*, January 17, 2008, available from *www.npolicy.org/article.php?aid=165&rt=&key=This%20%E2%80%98Nuclear-Free%E2%80%99%20Plan%20Would%20Effect%20the%20Opposite&sec=article&author=*; David Kay, "Denial and Deception Practices of WMD Proliferators: Iraq and Beyond," in Brad Roberts, ed., *Weapons Proliferation in the 1990s*, Cambridge, MA: Harvard, MIT Press, 1995; Victor Gilinsky *et al*., "A Fresh

Examination of the Proliferation Dangers of Light Water Reactors," Washington, DC: Nonproliferation Policy Education Center (NPEC), 2004, available from *www.npolicy.org/article.php?aid=172&rt=&key=A%20Fresh%20Examination%20of%20the%20Proliferation%20Dangers%20of%20Light%20Water%20Reactors&sec=article&author=*; and Andrew Leask, Russell Leslie, and John Carlson, "Safeguards As a Design Criteria—Guidance for Regulators," Barton, Australia: Australian Safeguards and Non-proliferation Office, September 2004, available from *www.asno.dfat.gov.au/publications/safeguards_design_criteria.pdf*.

11. See Elaine M. Grossman, "U.S. Blueprint for New Nuclear Arms Cuts Expected by Year's End," *Global Security Newswire,* November 8, 2011, available from *www.nti.org/gsn/article/us-blueprint-for-new-nuclear-arms-cuts-expected-by-years-end/*.

12. Within the oldest and most significant nuclear states, government-run, dual-use reactors were long connected to electrical grids to produce nuclear weapons fuels and electricity. In the United States, these include the Hanford dual-purpose reactor in Washington State (which is no longer operating), and the Tennessee Valley Authority's tritium-producing light-water reactors (whose operations are about to be expanded). Also included are Russia's RBMK (Reaktor Bolshoy Moshchnosti Kanalniy) reactors, which made plutonium for Russia's arsenal until the l990s; France's gas-cooled natural uranium and breeder reactors, which did the same for France through the l980s; India's unsafeguarded heavy water reactors and planned breeder reactors, which currently provide tritium and plutonium for India's nuclear weapons program; and Britain's early Magnox power plants, which provided the bulk of the plutonium for the United Kingdom's nuclear arsenal. See *50 Years of Public Power,* Richland, WA: Energy Northwest, 2007, available from *www.energy-northwest.com/downloads/EN_Annual_Report_2007_small.pdf*; *Global Secuirty.org*, "RBMK Reactor," available from *www.globalsecurity.org/wmd/world/russia/rbmk.htm*; "The French Nuclear Reactor Fuel Reprocessing Program: An Intelligence Assessment," Washington, DC: U.S. Central Intelligence Agency, September 1984, approved for release July 1992, available from *www.gwu.edu/~nsarchiv/NSAEBB/NSAEBB184/FR30.pdf*; Paul Brown, "First Nuclear Power Plant to Close," *The Guardian*, March 21,

2010; "British Nuclear Facilities," The Nuclear Weapon Archive, available from *nuclearweaponarchive.org/Uk/UKFacility.html*; Zia Mian, A. H. Nayyar, R. Rajaraman, and M.V. Ramana, "Fissile Materials in South Asia and the Implications of the US-India Nuclear Deal," International Panel on Fissile Materials Research Report, September 2006, available from *www.fissilematerials.org/ipfm/site_down/ipfmresearchreport01.pdf*; Christine Kucia, "Tritium Production Licenses Granted to Civilian Power Plants," *Arms Control Today,* November 2002; and Daniel Horner, "Obama Budget Seeks Rise in Tritium Capacity," *Arms Control Today*, June 2009.

13. See Endnotes 9 and 10; and Henry Sokolski, "Assessing the IAEA's Ability to Verify the NPT," in Sokolski, ed., *Falling Behind*, pp. 3-62.

14. See Victor Gilinsky, "Nuclear Power and Weapons: A New Look at an Old Problem," presentation made at a Nonproliferation Policy Education Center Workshop, "Reassessing Nuclear Proliferation's Key Premises," London, UK, November 3-4, 2011, available from *npolicy.org/article.php?aid=1114&tid=30*.

15. The threat of India implementing a Cold Start is mostly theory. For a practical critique of this strategy, see Muhammad Azam Khan, "Understanding India's 'Cold Start' Doctrine," *The Express Tribune*, October 19, 2011, available from *tribune.com.pk/story/276661/understanding-indias-cold-start-doctrine*.

16. On these points, see Peter Lavoy, "Islamabad's Nuclear Posture: Its Premises and Implementation," in 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 *npolicy.org/article.php?aid=112&rt=&key=Reducing%20the%20Risk%20of%20Nuclear%20War%20in%20South%20Asia&sec=article*.

17. See Mark Stokes, "China's Evolving Conventional Strategic Strike Capability: The Anti-ship Ballistic Missile Challenge to U.S. Maritime Operations in the Western Pacific and Beyond," Project 2049, September 14, 2009, available from *www.project2049.net/documents/chinese_anti_ship_ballistic_missile_asbm.pdf*.

18. First-strike missile systems that can be launched in large numbers with the greatest level of positive command and control, coordinated precision, and speed are generally viewed as being the most "destabilizing" by arms control experts and strategic planners. These systems, which Reagan loosely referred to as "nuclear missiles," most clearly include ground-launched ballistic missile systems with single or multiple warheads. Air- and sea-launched systems, in comparison, are lacking in each of these attributes.

19. See, e.g., Gareth Evans and Yoriko Kawaguchi, *Eliminating Nuclear Threats: A Practical Agenda for Global Policymakers*, Canberra, Australia: International Commission on Nuclear Non-proliferation and Disarmament, 2010, pp. 3-36.

20. 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*.

21. See Albert Wohlstetter, "Nuclear Triggers and Safety Catches," in Robert Zarate and Henry Sokolski, eds., *Nuclear Heuristics: Selected Writings of Albert and Roberta Wohlstetter,* Carlisle, PA: Strategic Studies Institute, U.S. Army War College, 2009, pp. 374-377.

22. See the Henry J. Hyde United States-India Peaceful Atomic Energy Cooperation Act of 2006, "Implementation and Compliance Report," available from *www.bis.doc.gov/ap/documents/report_109-721.pdf*.

23. On these points, see "Rokkasho Reprocessing Plant Delayed Again," *World Nuclear News*, September 8, 2009, available from *www.resourceinvestor.com/News/2009/9/Pages/Rokkasho-reprocessing-plant-delayed-again.aspx*; Massafumi Takuba, "Wake Up. Stop Dreaming: Reassessing Japan's Reprocessing Program," *The Nonproliferation Review*, March 2008; The World Nuclear Association, "Nuclear Power in China," October 2008, available from *www.world-nuclear.org/info/inf63.html*; Frank von Hippel, "South Korean Reprocessing: An Unnecessary Threat to the Nonproliferation

Regime," *Arms Control Today*, March 2010, available from *www.armscontrol.org/act/2010_03/VonHippel*; and Rebecca Smith, "Panel to Weigh Nuclear Waste Options," *The Wall Street Journal*, March 26, 2010, available from *online.wsj.com/article/SB10001424052748703409804575144033667206698.html*.

24. See the Commission on the Prevention of Weapons of Mass Destruction Proliferation and Terrorism, *The World at Risk*, New York: Vintage Books, Random House, 2008, p. 51.

25. On these points, see Heejin Koo, "North Korea May Test Third Nuclear Bomb, Defector Agency Says," *Bloomberg News Service*, September 9, 2009, available from *www.bloomberg.com/apps/news?pid=newsarchive&sid=a.R3wxVSAX78;* and Daniel Horner, "Indian Scientist Triggers Debate on Testing," *Arms Control Today*, October 2009, available from *www.armscontrol.org/act/2009_10/India*.

26. Although the NPT does not legally prohibit nuclear weapons states from further testing, if there was sufficient support, an additional agreement might also be sought to expand such trade restrictions to nuclear weapons states as well.

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

28. On these points, see Doug Koplow, "Nuclear Power as Taxpayer Patronage: A Case Study of Subsidies to Calvert Cliffs Unit 3," available from *www.npolicy.org/article.php?aid=179&rt=&key=Nuclear%20Power%20as%20Taxpayer%20Patronage:%20A%20Case%20Study%20of%20Subsidies%20to%20Calvert%20Cliffs%20Unit%203&sec=article&author=*.

29. Some Middle Eastern states, such as Algeria, Libya, and states bordering the Persian Gulf, have significant proven reserves of relatively clean-burning natural gas, which can be used to produce power and industrial heat for a fraction of the costs of any nuclear system. New methods of drilling for gas are opening up new finds in the region (e.g., off Israel's coast). In addition, the few

states in the region that lack their own natural gas resources are themselves still major pipeline transit points, and so have ready access to this resource at very low prices. In fact, the key challenge to maintaining these cheaper energy supplies is ensuring that the natural gas is being given away through excessive state subsidies. Meanwhile, the growing availability of natural gas in the United States, Europe, and Asia has already reduced demand for liquefied natural gas and could conceivably reduce demand for this fuel from the Middle East. On these points, and on how uneconomical nuclear fuel-making can be for small numbers of nuclear power plants, see "An Unconventional Glut," *The Economist,* pp. 72-74, available from *www.economist.com/business-finance/displaystory.cfm?story_id=15661889*; Peter Tynan and John Stephenson, "Nuclear Power in Saudi Arabia, Egypt, and Turkey—How Cost Effective?" February 9, 2009, available from *www.npolicy.org/article.php?aid=352&rt=&key=Nuclear%20Power%20in%20Saudi%20Arabia,%20Egypt,%20and%20Turkey%20%E2%80%93%20how%20cost%20effective?&sec=article&author=;* and Frank von Hippel, "Why Reprocessing Persists in Some Countries and Not in Others: The Costs and Benefits of Reprocessing," April 9, 2009, available from *npolicy.org/article_file/Why_Reprocessing_Persists_in_Some_Countries_and_Not_in_Others-The_Costs_and_Benefits_of_Reprocessing.pdf.*

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

31. 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.*