

Potential Impact of Foreign Testing: U.S. Security Interests and Concerns

This chapter addresses the potential impact on U.S. national-security interests and concerns of the degree of foreign nuclear testing that could plausibly occur without detection under a CTBT regime, or, alternatively, through overt testing. Our principal focus here is on the technical question of what additions to their nuclear-weapon capabilities other countries could achieve through nuclear testing at yields that might escape detection, but we give some attention as well to the related military and political question of the impact of such additions on the security interests and freedom of action of the United States. These questions are embedded in a wider set of political, military, and diplomatic circumstances which, although not in our charge to analyze here, must be mentioned by way of context for the narrower questions we address.

Currently the United States is the preeminent nation in the world, measured in political, economic, and military terms. In the military dimension, the United States possesses dominant conventional forces as well as deployed and reserve nuclear weapons of mature and amply tested design. Should nuclear weapons proliferate widely across the globe, U.S. military pre-eminence will be diminished. Nuclear weapons are the “great equalizer” among the world’s strong and weak military powers. The freedom of action of the United States in exploiting its conventional military superiority will be limited if nations not now possessing nuclear weapons acquire them.

The primary diplomatic tool for restraining the proliferation of nuclear weapons has been the Nuclear Non-Proliferation Treaty (NPT), which entered into force in 1970. That treaty divided its signatories into Nuclear-Weapon States (NWS) and Non-Nuclear-Weapon States (NNWS), where the Nuclear-Weapon States are those nations that had manufactured and exploded a nuclear weapon prior to January 1, 1967. Ever since the enactment of the NPT, achievement of a CTBT has been a litmus test of the willingness of the Nuclear-Weapon States to meet their obligations under Article 6 of the NPT. Nonetheless, most states would probably continue to adhere to the NPT without a CTBT, and therefore could neither acquire nuclear weapons nor test them. But the absence of a CTBT limiting the five Nuclear-Weapon States increases the possibility that some might leave the NPT in order to test—thereby creating a dynamic of proliferation and competition.

By giving up their highly visible right to testing, the Nuclear-Weapon States were seen to be consenting to a halt to the modernization and diversification of their nuclear arsenals, thus at least plausibly beginning a process of de-emphasizing the role of nuclear weapons in international relations. The linkage of enactment of a CTBT to the future viability of a non-proliferation regime was explicitly recognized both in the preamble to the NPT and in the 1995

Review and Extension Conference, which converted the NPT into a treaty of indefinite duration.

The potential impact on U.S. security interests and concerns of the foreign nuclear tests that could plausibly occur without detection in a CTBT regime can only be meaningfully assessed by comparison with two alternative situations—the situation in the absence of a CTBT, and the situation in which a CTBT is being strictly observed by all parties. The key questions are: How much of the benefit of a strictly observed CTBT is lost if some countries test clandestinely within the limits imposed by the capabilities of the monitoring system? In what respects is the case of limited clandestine testing under a CTBT better for U.S. security interests—and in what respects worse—than the case of having no CTBT at all? If some nations do not adhere to a CTBT and test openly, how do the technical and political impacts differ from a no-CTBT era?

In these comparisons, two kinds of effects of nuclear testing by others on U.S. security interests and concerns need to be recognized: the *direct* effects on the actual nuclear-weapon capabilities and deployments of the nations that test, with implications for military balances, U.S. freedom of action, and the possibilities of nuclear-weapon use; and the *indirect* effects of nuclear testing by some states on the aspirations and decisions of other states about acquiring and deploying nuclear weapons, or about acquiring and deploying non-nuclear forces intended to offset the nuclear weapons of others. A CTBT, to the extent it is observed, brings security benefits to the United States in both categories—limitations on the nuclear-weapon capabilities that others can achieve, and elimination of the inducement of states to react to the testing of others with testing and/or deployments of their own.

A nuclear test or series of tests affects the nuclear-weapon-related capabilities of the state that tests—and, if detected by other countries, may affect their aspirations and decisions relating to nuclear weapons—but whether nuclear testing actually leads to weaponization and, beyond that, to deployment, depends on additional factors. These may include a country's motivation to acquire nuclear weapons, as well as its production of or access to plutonium or enriched uranium for fission weapons, the necessary tritium for boosted fission weapons and boosted primaries for thermonuclear weapons, and the lithium-deuteride “salt” that is used in thermonuclear weapons.

Another important factor is the means of delivery, some of which impose greater demands on the nuclear-weapon payload. Although many people appear to believe that the threat from newly nuclear countries is dependent on their possession of an intercontinental ballistic missile (ICBM), even the 1998 Rumsfeld Commission charged with evaluating such ICBM threats called attention very emphatically to the availability of other means of delivery that would accommodate larger, heavier warheads.¹ The possibilities include delivery by military and civilian aircraft, by short-range ballistic missiles and cruise missiles that could be launched from ships near U.S. shores, by truck or car after a weapon has been smuggled across U.S. borders, or by a ship entering a U.S. port with a nuclear weapon on board.

The factors beyond nuclear testing that affect weaponization and deployment—and thus affect the actual military threats that new nuclear-weapon capabilities can pose to the United States—are far beyond the mandate and capacity of this committee to address. Analysis of these factors is the daily meat of intelligence assessment and, while a necessary part of a “net assessment” of threats to U.S. security interests, cannot practically be incorporated into our treatment of the implications of potential clandestine nuclear testing under a CTBT. We confine ourselves here to the nuclear-weapon potentials likely to be achievable with nuclear testing in various yield ranges (as well as without testing at all), referring to such factors as delivery systems only in the

¹ D.H. Rumsfeld, et al., *Executive Summary of the Report of the Commission to Assess the Ballistic Missile Threat to the United States* (July 15, 1998).

context of their interaction with the question of what kinds of nuclear weapons can be developed.

In the remainder of this chapter, we first consider the characteristics of the two reference cases—no CTBT and a CTBT scrupulously observed—in relation to the kinds of advances in the nuclear-weapon capabilities of other countries that could be expected and how these two situations would affect U.S. security interests and concerns. We then discuss the advances that could plausibly be made by clandestine testing in various yield ranges, under a CTBT, by countries with greater prior nuclear test experience and/or design sophistication and those with lesser experience and/or sophistication.

Following this general comparison of the clandestine-testing case with the two reference cases, we offer some additional observations, on a country-by-country basis, for particular states: Russia, China, Pakistan, Iraq, Iran, and North Korea. The first two in this group are Nuclear-Weapon States that have possessed nuclear weapons for 50+ and 35+ years, respectively, and that have long been able to deliver these weapons against the United States with ICBMs as well as by other means. Given the capabilities they have long possessed, further improvements in their nuclear weapons would be of limited security impact on this country. India and Pakistan have carried out limited nuclear testing, and weaponization and deployment plans appear to be hanging in the balance. Iraq, Iran, and North Korea have manifested nuclear ambitions in recent years, but have conducted no tests.

Two Reference Cases: No CTBT and the CTBT Strictly Observed

No CTBT

In the reference case of no CTBT at all, the Nuclear-Weapon States Party to the NPT would be able to test without legal constraint in the underground environment (except for the 150-kiloton limit agreed to by the United States and Russia under the bilateral Threshold Test Ban Treaty), and non-parties to the NPT would similarly be able to test without legal constraint. Non-Nuclear-Weapon States Party to the NPT would be legally constrained from testing.

As discussed further in the country-specific treatments in this chapter, all of the countries that would be free to test in the absence of a CTBT have some motivation to do so. (This includes the United States, which if unconstrained might test to explore further improvements in the safety of its nuclear weapons, to test nuclear weapons effects, to explore new nuclear-weapon concepts, and, occasionally, to add to confidence in solutions devised in the Stockpile Stewardship Program for age-related defects in stockpiled weapons.) Given that the United States has already conducted more than 1,000 nuclear tests, however, compared with 715 of the Soviet Union, 215 of France, 45 of Britain, and 45 of China, and given the relative maturity of U.S. designs, it is likely that the other countries that would be unconstrained in the absence of a CTBT could make more relative progress with additional tests than could the United States. India and Pakistan claim six nuclear tests each.

China and Russia might use the option of testing to make certain refinements in their nuclear arsenals, which are discussed further in the country-by-country treatment. In the case of Russia, it is difficult to envision how such refinements could significantly increase the threats to U.S. security interests that Russia can pose with the previously tested nuclear-weapon types it

already possesses. In the case of China, further nuclear testing might enable reductions in the size and weight of its nuclear warheads, as well as improved yield-to-weight ratios. Such improvements would make it easier for China to expand and add multiple independently targetable re-entry vehicles (MIRVs) to its strategic nuclear arsenal if it wanted to do so, and changes in these directions would affect U.S. security interests. But China could also achieve some kinds of improvements in its nuclear weapons without nuclear testing, and if it wanted to do so it could achieve considerable expansion and MIRVing of its arsenal using nuclear-weapon types it has already tested.²

More importantly for U.S. security interests and concerns, India and Pakistan could use their option of testing, as non-parties to the NPT, to perfect boosted fission weapons and thermonuclear weapons. This would greatly amplify the destructive power available from a given quantity of fissile material and the destructive power deliverable by a given force of aircraft or missiles. (Of course they might also do this under a CTBT that they had not signed, but the absence of a CTBT and the resumption of testing by others would make it politically much easier for them to do so.) The likelihood that either of these countries would use nuclear weapons against the United States seems very low, but the United States and its allies would nonetheless have serious concerns about the increase in nuclear-weapon dangers and arms-race potential in and around South Asia that such developments would portend.

Plausibly larger than the direct effects of testing by Nuclear-Weapon States and non-parties to the NPT in the absence of a CTBT is the potential indirect effect of a resumption of such testing in the form of a breakdown of the NPT regime, manifested in more widespread testing (by such countries as North Korea, Iraq, and Iran, for example), which could lead in turn to nuclear weapons acquisition by Japan, South Korea, and many others. With sufficient testing, many countries would be able to master boosted fission weapons and thermonuclear weapons. Some might do this, in a world of more and more nuclear-armed states, not to solve real security problems but simply for reasons of prestige or "equity."

A future no-CTBT world, then, could be a more dangerous world than today's, for the United States and for others. In particular, the directions from which nuclear attack on the United States and its allies would have become conceivable—and the means by which such attack might be carried out (meaning not only ICBMs but also, among others, ship-based cruise missiles, civilian as well as military aircraft, and truck bombs following smuggling of the weapons across U.S. borders)—would have multiplied alarmingly.

We note, finally, that while a CTBT does not add to the obligations of Non-Nuclear-Weapon State NPT parties not to conduct nuclear tests or to acquire nuclear weapons, it does greatly strengthen the capacity of the international community to monitor nuclear testing (both by internationally agreed remote detection of nuclear tests in any country and, in the case of parties to the CTBT, by the rights to on-site inspections). These contributions of a CTBT to international monitoring capabilities would be absent in the no-CTBT scenario.

² "China has had the technical capability to develop multiple RV payloads for 20 years. If China needed a multiple-RV (MRV) capability in the near term, Beijing could use a DF-31-type RV to develop and deploy a simple MRV or multiple independently targetable reentry vehicle (MIRV) for the CSS-4 in a few years. MIRVing a future mobile missile would be many years off." National Intelligence Council, *Foreign Missile Developments and the Ballistic Missile Threat to the United States Through 2015* (September 1999, unclassified).

CTBT Strictly Observed

Even scrupulous observance of a CTBT would not preclude the emergence of additional nuclear-armed states. Most of the activities involved in the development of nuclear weapons do not involve nuclear testing. The mature nuclear-weapon states are widely credited with sophisticated computational techniques, advanced hydrodiagnostic methods, and extensive knowledge of relevant materials properties. Similar, even if less-advanced capabilities available to would-be nuclear states would allow constructing some relatively simple types of nuclear weapons that could be expected to work (albeit with far less efficient use of nuclear material and much lower yield-to-weight ratios than in designs attainable with the help of nuclear testing).

Computational capabilities have evolved from the three multiplications per second of the 1944 card-punch calculator, to the ten million operations per second of the CDC 7600 mainframes of the 1970s and early 1980s, on which much of the U.S. enduring stockpile was designed, to the billion operations per second of the personal computer in the year 2000. Unclassified computer programs for one- and two-dimensional hydrodynamics and neutronics calculations are widely available. Neutron cross-section libraries and much relevant equation-of-state data are in the public domain. High-explosive and detonator technologies are widely dispersed. Optical techniques using high-speed framing and streak cameras are routine state of the art in industry.

So-called subcritical tests for the study of the properties of fissile materials subject to shock from high explosives avoid the initiation of a nuclear chain reaction and are not prohibited by the CTBT. They typically involve small plates or other shapes formed of plutonium or uranium. Hydrodynamic tests involve material in weapon configuration but are arranged to avoid criticality, either by means of reducing the scale below critical mass or by replacing the plutonium or U-235 with a simulant material. These, too, are not prohibited by the CTBT. The "pin" technique basic to the design of implosion systems is 55 years old, modified only by the use of modern fast-recording systems. (The "pins" are fine wires or optical fibers that report time of contact with an imploding metal shell.)

Relatively unobtrusively, these tools can be used to establish a nuclear-weapon design capability. Dynamic radiography capabilities, which were not available for the early 1960s U.S. stockpile designs, are somewhat more difficult to conceal. But all these development tools, short of an actual nuclear proof test, would be available under the CTBT. They can be used by experienced nuclear-weapon states to refine their understanding and by would-be proliferators to develop simple nuclear-weapon designs in which it would be possible to have some confidence without testing them (although such conduct by a Non-Nuclear-Weapon State Party to the NPT would violate that treaty).

In 1945, after all, Hiroshima was devastated by a nuclear weapon that had never been subject to a nuclear-explosion test. This weapon, containing weapon-grade uranium, weighed some 8,000 pounds and had a yield of about 13 kilotons. In such a weapon, a U-235 projectile is fired into a U-235 sleeve, to form a compact configuration that exceeds a critical mass. For any nation with a modest technical competence, laboratory measurements would suffice for such a uranium-235 gun design, together with firing the gun with a dummy projectile. Such developments could take place without violating the CTBT.

Without nuclear testing, South Africa produced six modernized, lighter U-235 gun-type weapons, which were dismantled when South Africa joined the Non-Proliferation Treaty as a Non-Nuclear-Weapon State. Knowledge of these and of the fact that the United States once pos

sessed large numbers of artillery-fired gun-type nuclear shells might lead a proliferant country to a system much lighter and smaller than the Hiroshima weapon.

Access to highly enriched uranium, either by indigenous production or by purchase or theft abroad, is key to the acquisition of gun-type weapons. Indigenous production is a substantial effort, subject to detection; acquisition abroad might also be discovered. Of course, acquisition of U-235 for weapons purposes by a Non-Nuclear-Weapon State belonging to the NPT would violate that treaty.

U-235 can also be used in implosion-type weapons, which require considerably less of this material than do gun-type devices. This approach, then, increases the number of weapons that can be made from a given stock of U-235. A country possessing U-235 might develop without testing an implosion weapon that, although large and heavy by virtue of the quantity of high explosive used, could readily be delivered by ship, commercial aircraft, truck, or train.

Nagasaki was destroyed by an implosion weapon containing about 6 kg of plutonium. It weighed 9,000 pounds and had an explosive yield of about 20 kilotons. Fifty-five years later, and with all the information that has since been declassified, a state with the requisite technical skills in explosives, electronics, and metallurgy could with some confidence reproduce the Nagasaki device without the full-scale test the United States conducted in New Mexico on July 16, 1945. Many non-nuclear tests would be needed to demonstrate the mastery of the technology, and there would be some uncertainty in yield. A weapon weighing 1,000-2,000 pounds might similarly be built, with somewhat less confidence; this might resemble the U.S. Mark-7 bomb of 1951 that weighed 1,800 pounds.

The task of perfecting an implosion weapon is more difficult than the path leading to a U-235 gun-type weapon, but is essential if plutonium is to be used and also provides, as noted above, a path to a weapon using less U-235 than a gun design requires. Technology transfer—authorized or unauthorized, and ranging from tips about dead-end or productive approaches, to transfer of computer codes, to precise working drawings and specifications, to actual transfer of nuclear explosive devices—could greatly ease a recipient state's path to relatively light and compact implosion weapons and could reduce the number of nuclear tests needed to master these. A single full-yield test would validate both the legitimacy of a blueprint and success in reproducing the object, but that test might be of yield too high to be concealed. Access to plutonium for an implosion weapon, moreover, would require either indigenous production in a nuclear reactor or acquisition from outside sources. Either acquisition or clandestine reprocessing of plutonium from nuclear reactors incurs risk of detection.

The size and weight of fission bombs that could be developed confidently without nuclear testing limit the available means of delivery. Transport aircraft, ships, trucks, and trains can carry any nuclear weapon. The most common missile of 300-kilometer range, the SCUD, has a payload capacity of 1,000 kg. The extended-range SCUD used by Iraq against Israel and Saudi Arabia in the Gulf War can carry 500 kg. The 3-stage Taepo Dong-2, under development but as yet untested by North Korea, could deliver a 700-kg payload anywhere in the United States.³

In summary, if a CTBT was scrupulously observed, nuclear threats to the United States could still evolve and grow, but the range of possibilities would be considerably constrained. Boosted fission weapons and thermonuclear weapons would be confined to the few countries that already possess them and to those to which such weapons might be transferred, or to which designs might be communicated with sufficient precision that a trusting and competent recipient

³Testimony by R.D. Walpole, U.S. Senate, 1999. Committee on Foreign Relations. *Ballistic Missiles: Threat and Response*. 106th Congress, 1st session. September 16.

might be able to reproduce them. Other countries might have less stringent confidence requirements than does the United States, but, in general, they also are much more limited in the technology available for pursuing an exact reproduction; substitution of materials or techniques might bring uncertainty or even failure. Perhaps most importantly, in a world in which nuclear testing had been renounced and the NPT remained intact, nuclear proliferation would be opposed by a powerful political norm in which Nuclear-Weapon States and other parties to the NPT and CTBT would find their interests aligned.

Evasive Testing Under a CTBT

In the case we now wish to compare to the no-CTBT and rigorously-observed-CTBT reference cases—that of clandestine testing under a CTBT within the limits imposed by the monitoring system—we distinguish between two classes of potential cheaters, those with greater prior nuclear test experience and/or design sophistication and those with lesser prior experience and/or sophistication. The purposes and plausible achievements for testing at various yields by countries with little versus extensive prior nuclear test experience are summarized in the following table. Table 3-1 (see next page) describes what could be done, not necessarily what will be done. The case of subcritical testing—legal under a CTBT—has been discussed above under the category of the scrupulously observed CTBT. In the following subsections, we elaborate on the other yield categories in this table.

Tests Conducted Underground Without Fear of Detection By Seismic Signals

For purposes of our discussion, “hydronuclear tests” refer to those with a nuclear yield below 0.1 ton of high-explosive equivalent (0.0001 kt). Their primary utility is to conduct so called one-point safety tests.⁴ A series of such tests—which are difficult to design and implement for an experienced Nuclear-Weapon State and even more so for states with little or no testing experience—can determine whether a full-scale weapon would provide a tolerably low yield if the high explosive were accidentally detonated at the single most hazardous point. In this yield range, the decompression and disassembly of the plutonium is little affected by the nuclear reaction, and the yield is so low that it gives little information of value for designing full-scale weapons. The U.S. definition of tolerable yield for a one-point detonation is 2 kg of high explosive (HE) equivalent. If there were containment provided up to, say, 10 tons, a clandestine test below that limit would stand little chance of discovery by seismic, infrasound, hydroacoustic, or radionuclide detection schemes; in this situation, an experienced state would need fewer tests to demonstrate one-point safety than if each test were strictly limited to 2 kg. Of course,

⁴For the one-point safety tests authorized by President Eisenhower to be conducted in secrecy during the moratorium he initiated in 1958, a yield limit was set of four pounds (2 kg) of high explosive equivalent. In its historical record (see V. Mikhailov, ed., *Nuclear Testing in the USSR*, vol. 1, VNIIEF: Sarov, 1997, p. 95.), Minatom defines a hydronuclear test as one with a yield less than 100 kg of high explosive equivalent. As for “nuclear test,” Minatom adopted the definition developed in the 1990 Protocol to the Threshold Test Ban Treaty—the same one used by the U.S. Department of Energy—in preparing its comprehensive list. A test is defined as either a single explosion, or two or more explosions fired within 0.1 second of one another within a circular area with a diameter of two kilometers. The yield is the aggregate of all of the explosions. The 715 Soviet nuclear tests thus involved 969 explosions; in addition, Russia reports about 90 hydronuclear tests. (See, e.g., the data in Natural Resources Defense Council, “Table of Known Nuclear Tests Worldwide: 1945-69 and 1970-96,” at <http://www.nrdc.org/nuclear/nudb/datab15.asp>.)

states newly acquiring nuclear weapons might not be concerned initially about one-point safety at all.

Table 3-1 Purposes and Plausible Achievements for Testing at Various Yields

| Yield | Countries of lesser prior nuclear test experience and/or design sophistication ⁵ | Countries of greater prior nuclear test experience and/or design sophistication |
|--|--|---|
| Subcritical testing only (permissible under a CTBT) | <ul style="list-style-type: none"> Equation-of-state studies High-explosive lens tests for implosion weapons Development & certification of simple, bulky, relatively inefficient unboosted fission weapons | same as column to left, plus <ul style="list-style-type: none"> limited insights relevant to designs for boosted fission weapons |
| Hydronuclear testing (yield < 0.1 t TNT, likely to remain undetected under a CTBT) | <ul style="list-style-type: none"> one-point safety tests (with difficulty) | <ul style="list-style-type: none"> one-point safety tests validation of design for unboosted fission weapon with yield in 10-ton range |
| Extremely-low-yield testing (0.1 t < yield < 10 t, likely to remain undetected under a CTBT) | <ul style="list-style-type: none"> one-point safety tests | <ul style="list-style-type: none"> validation of design for unboosted fission weapon with yield in 100-ton range possible overrun range for one-point safety tests |
| Very-low-yield testing (10 t < yield < 1-2 kt, concealable in some circumstances under a CTBT) | <ul style="list-style-type: none"> limited improvement of efficiency & weight of unboosted fission weapons compared to 1st-generation weapons not needing testing proof tests of compact weapons with yield up to 1-2 kt (with difficulty) | <ul style="list-style-type: none"> proof tests of compact weapons with yield up to 1-2 kt partial development of primaries for thermonuclear weapons |
| Low-yield testing (1-2 kt < yield < 20 kt, unlikely to be concealable under a CTBT) | <ul style="list-style-type: none"> development of low-yield boosted fission weapons eventual development & full testing of some primaries & low-yield thermonuclear weapons proof tests of fission weapons with yield up to 20 kt | <ul style="list-style-type: none"> development of low-yield boosted fission weapons development & full testing of some primaries & low-yield thermonuclear weapons proof tests of fission weapons with yield up to 20 kt |
| High-yield testing (yield > 20 kt, not concealable under a CTBT) | <ul style="list-style-type: none"> eventual development & full testing of boosted fission weapons & thermonuclear weapons | <ul style="list-style-type: none"> development & full testing of new configurations of boosted fission weapons & thermonuclear weapons |

A Nuclear-Weapon State could in principle use a series of hydronuclear tests to validate new designs for unboosted nuclear weapons in the yield range of 10 tons but probably not to 1 kiloton. This is difficult, but could be done with appropriate instrumentation. It would require a large quantity of plutonium or enriched uranium, because multiple experiments would need to be done, each with almost the full amount of fissionable material needed for a complete weapon. Advice from an experienced tester could reduce the number of tests required.

Successful Evasion Possible But By No Means Assured

The range from 0.1 ton to 1 kiloton is categorized by the Russian nuclear establishment as that of “very-low-yield tests.” For purpose of analysis we break this range into two parts—extremely low yield” from 0.1 to 10 tons, and “very-low-yield” from 10 tons to 1-2 kt. Tests toward the lower end of the extremely-low-yield category would be easy to conceal from seismic monitoring under a CTBT. In the higher part of this category, such tests could serve a country

⁵That is, lacking an adequate combination of nuclear-test data, advanced instrumentation, and sophisticated analytical techniques, and without having received assistance in the form of transfer of the relevant insights.

with little prior test experience for the demonstration of one-point safety somewhat more readily than would be the case if there were a firm restraint to avoid exceeding 0.1 tons. A state with experience in testing and design might use tests in this range to develop, with some confidence, weapons with yields up to about 100 tons.

The “very-low-yield” range from 10 tons to 1-2 kt could serve either category of country to develop and validate a deployable weapon of 10-ton to 1 or 2-kt yield. With a series of tests in the 1 to 2-kt range, an inexperienced state might be able to improve the efficiency and yield-to-weight of unboosted fission weapons compared to the performance of the first-generation weapons that could be developed and deployed with some confidence without any testing at all. Concealment of tests in this yield range is plausible under some circumstances, but increasingly difficult as the 1-kiloton level is approached, and much more difficult for inexperienced testers than for experienced ones. Working closely with experienced personnel might permit an inexperienced state to manage with fewer tests. Under some circumstances, such technology transfer could also increase the probability of successful concealment. In the case of experienced Nuclear-Weapon States, tests in this range might serve to help partially develop primaries for thermonuclear weapons.

In our treatment of nuclear-test monitoring above, we conclude that 1 to 2 kt is the practical upper limit of effective decoupling. A test of this yield would provide data helpful for the partial development of a primary for a thermonuclear weapon. But deployment of such an untested component by one of the five Nuclear-Weapon States, which have available fully tested primaries of adequate yield, would not increase the state's capability and would reduce its confidence in its stockpile. A state that has not yet fully tested primaries could not rely on a primary test of less than full yield.

Unlikely to be Concealable

In the “low-yield” range of 1 kt to 20 kt, states with extensive nuclear test experience could develop and fully test primary nuclear explosives and low-yield thermonuclear weapons. Proliferants could do the same. Either could proof test a fission weapon with a yield up to 20 kt, but concealment is highly unlikely. If done openly, such nuclear explosions might have political as well as technical goals. But the political goals would not be achieved by clandestine tests, and clandestine achievement of technical goals would be precluded since tests above 1 to 2 kilotons could not be concealed with confidence.

Impossible to Conceal

The “high-yield” range in excess of 20 kt would normally be used in the absence of a CTBT to test new configurations of boosted fission weapons or thermonuclear weapons. As discussed above in our treatment of nuclear-test monitoring, any nation with a nuclear explosive could detonate it on a barge or small boat on the open ocean. Such a test would likely be detected, identified, and located, but might be attributed only with some difficulty to the nation responsible. A single such test might be attempted by a proliferator—checking the performance of an implosion weapon or even a boosted implosion weapon—as a proof test, before undertaking deployment.

Assessment of the Impact on U.S. Security Interests of Nuclear Weapons Tests of Selected Countries

We first discuss Russia and China, both Nuclear-Weapon States under the NPT, possessing long-standing nuclear-weapon-development programs and previously tested nuclear weapons of a variety of types. We then take up Pakistan and India—non-participants in the NPT with early-stage nuclear weapon programs and very limited test experience. Finally, we discuss North Korea, Iran, and Iraq, all three of which are NPT members but have been involved in nuclear-weapons activities to a varying extent.

Russia and China—States with Mature Nuclear Weapons Programs and Test Experience

Some motivations for evasive testing by Russia and China relating to their existing stockpiles—life-extension programs, safety, and confidence in remanufactured primaries, for example—are no more threatening to U.S. security interests than is an assumed ability of these nations to maintain their stockpiles without testing. For instance, if (as has been suggested) Russia were to employ clandestine nuclear-explosion testing to help maintain the safety and reliability of its stockpile, that would directly impact U.S. security interests only if the United States were unable to maintain its weapons safe and reliable without nuclear testing and thus suffered a comparative disadvantage.

This is not to condone clandestine nuclear testing by anyone; such testing always carries a risk of detection and is therefore dangerous to the non-proliferation regime. And in that way, it is harmful to the security interests of the United States. But potential undetected Russian and Chinese evasive testing is not relevant to the maintenance of U.S. nuclear weaponry. As noted in Chapter 1, we judge that the United States has the technical capabilities to maintain the reliability of its existing stockpile without testing, irrespective of whether Russia or China decides they need to test in order to maintain the reliability of theirs.

Russia

- Without CTBT

Without a CTBT, Russia could have an incentive to test, given the large changes in its military situation compared to that of the Soviet Union. Russia has renounced the Soviet nuclear doctrine of "no first use" of nuclear weaponry, and some members of the Russian nuclear weapons establishment have publicly advocated bolstering the new first-use doctrine by building thousands of new-design tactical nuclear weapons of very low yield—perhaps 10 to 100 tons. In addition, Russian weapon designers have had a long-standing interest in special effects, such as enhanced-radiation weapons, and these might be developed because of their inherent challenge and interest, as seen by the weapon designers, and for battlefield or sub-strategic use, as viewed by some military writers.

Russia might also want to test to reduce the cost of maintaining its nuclear forces. Russian nuclear weapons are remanufactured on a 10-year cycle, a substantial maintenance burden. Probably the nuclear organization would prefer weapons with longer life, with testing to permit some redesign of such weapons and to demonstrate performance. This would likely require

yields in excess of 10 kt—such tests are permissible underground in the absence of a CTBT, but not plausibly concealable with a CTBT in force.⁶

Because of the mature state of Russian nuclear weapons technology, unrestrained Russian nuclear testing would not directly impair U.S. security interests; but the indirect effects could be substantial—especially in eroding the non-proliferation regime and legitimizing the acquisition and test of nuclear weapons by other states, in particular those neighboring Russia.

- Russian advances strictly respecting a CTBT

Despite its vast experience in nuclear-weapon design and test, Russia could not confidently develop new nuclear weaponry without violating the zero-yield CTBT. Although it might seem a simple matter to design a weapon of 10 to 100 tons yield, with normal design approaches it would be difficult to have confidence in the yield.

- Evasive testing within the CTBT

As explained in detail in Chapter 2, in no case could a country in Eurasia, including Russia, have high confidence of concealing a test over 1-2 kilotons from seismic detection. Without constructing a large decoupling cavity, the limit to concealed testing is much lower.

With a 1-kt test not concealable at its operating test site, though marginally possible in areas particularly suited for cavity decoupling (e.g., salt domes), Russia could potentially do some development of a new primary. But to test, even in principle, an existing secondary with a new primary for a new nuclear weapon Russia would have to conduct further tests well above any practical evasion threshold. Even then, however, since its performance would be similar to weapons already available, and Russia already has plenty of heavy-lift capability, the direct impact on U.S. security interests would be minimal.

If Russia does not have them available already, it could fully develop (if evasion were successful) light tactical weapons of yield of 1 to 2 kt or less. At the lower end of the very-low-yield category, Russia could develop and test new very-low-yield tactical weapons in the range of 10 to 100 tons. With respect to seismic detection, the 10-ton weapon could confidently be adequately tested under decoupling conditions even at Novaya Zemlya, and might even be tested in a steel or composite containment so that it would give no ground-shock at all. Indeed, with its experience in testing and weapon design, Russia could develop a 10-ton nuclear weapon using only hydronuclear tests in the kilogram-yield range, and be reasonably confident of its performance. Russia might even aim for a 10-ton weapon as a modification of an existing weapon of higher yield, of which it has a surplus. The United States would not be affected by Russia's conversion of, say, a 300-ton weapon of a type that it has tested a number of times, to a 10-ton weapon.

In summary, Russia's nuclear threat to the United States would not be significantly changed by successful evasive testing, but widespread speculation that evasive testing is possible might have a marginal effect on the nuclear-weapon incentives for neighboring states.

⁶ JASON Report JSR-95-320, *Nuclear Testing - Summary and Conclusions* (McLean, VA: Mitre Corporation, August 3, 1995).

China

Given the modest current size and capabilities of China's nuclear forces overall—including the small number of strategic nuclear delivery vehicles (reported to be about 20 ICBMs at fixed sites)—it is not difficult to imagine changes in the numbers or character of these forces that would arouse U.S. security concerns. Such changes might include transformation of the strategic force to one based on mobile ICBMs, which might or might not be MIRVed, and the deployment of additional nuclear weapons for nominally non-strategic roles—such as short-range ship-based ballistic missiles or cruise missiles—that would have significant strategic as well as regional potential.

The basis of China's strategic nuclear posture with respect to the United States appears to be to hold a small fraction of the U.S. population at risk of nuclear attack. Given this approach, China has little incentive under present circumstances to use its missile payload capacity for multiple re-entry vehicles or multiple independently targetable re-entry vehicles—an approach that would lower the total deliverable yield. A U.S. national missile defense (NMD), on the other hand, could provide an incentive for China to MIRV as one means of improving penetration or of overwhelming a small NMD. Under those circumstances, China would have an incentive to increase substantially the number of delivered warheads. In that case, China might want to reduce the amount of plutonium or U-235 needed in a typical weapon and thereby allow a larger number of nuclear weapons to be built from a given amount of material. If China is limited instead by missile capacity rather than by its stock of fissionable material, weapons of smaller size and weight might be the goal, even if each used more nuclear material. The extent to which such developments might depend on further nuclear testing by China is not entirely clear. For example, in view of China's signing of the CTBT in 1996, it is likely that it had by then tested a strategic nuclear warhead suitable for its mobile intermediate-range ballistic missile now in flight test, or for an ICBM variant of it.⁷ Further testing might bring additional improvements in yield-to-weight ratio and/or efficiency of utilization of nuclear material that China would find useful in the context of an effort to modernize and/or greatly expand its nuclear forces, if a decision were taken to do that. The indirect impact of China's testing could be substantial, in view of its influence on nuclear developments in India, Pakistan, and perhaps Japan. But it is quite clear that China could also achieve substantial increases in the capabilities of its deployed nuclear forces, if it wants to do so, without developing nuclear-weapon types beyond those it has already tested.

- Without a CTBT

In the absence of a CTBT, China would be able to conduct nuclear tests in the yield range needed to develop a more nearly optimum (lighter weight and perhaps more efficient use of fissile material) warhead for its mobile ICBM. But reduced size and weight depend as much or more on advances in non-nuclear aspects of the warhead (such as power supplies, and arming, fuzing, and firing systems) as they do on the nuclear package, so some improvements in this direction could presumably be achieved by China even in the absence of further nuclear testing.

China has far too few strategic weapons to attack a significant fraction of U.S. ICBM silos, and the United States has other more survivable strategic systems. With no option of a counterforce strategy against the United States within reach, China has little incentive to under

⁷ NIC, September 1999, *op. cit.*

take the difficult task of developing a nuclear warhead resembling the U.S. W88, the special feature of which is its adaptability to a slim re-entry vehicle that can be effective against hardened point targets. In any case, a small force of warheads of this type would pose no greater threat to U.S. security interests than would a similar number of warheads of types the Chinese have already tested.

- Chinese advances strictly respecting a CTBT

Within a CTBT, China might exploit the possibilities for further developing its design expertise without nuclear testing, with an eye to the possibility of eventual collapse of the CTBT regime. China can certainly be expected to continue its stockpile stewardship program—smaller than that of the United States—including hydrodynamic tests with flash radiography and sub-critical tests. These activities will not impair U.S. security interests except in the unlikely event that they excited such Chinese interest in modifying an existing nuclear-weapon design or developing a new one that China elected to break out of the CTBT.

- Evasive tests within the CTBT

Overall, the direct impact of clandestine Chinese nuclear testing on U.S. security interests would be minimal. With the yields of concealable tests limited to 1-2 kilotons, China could not develop a new warhead. (Even if a test in excess of 10 kt could be fully decoupled by a factor 70, the decoupled signal would far exceed the seismic detection threshold at Lop Nor, and indeed at most other sites in China. At the few locations where this might not be the case, China would still need to worry about venting of radioactivity—which is very likely with decoupled nuclear explosions in hard rock—and about detection by U.S. and Russian National Technical Means.) As noted earlier, testing by China at lower yields for purposes of stockpile stewardship, if China decided that this was necessary, would not directly impact U.S. security interests. Of course, attempted clandestine tests that led to detection would indirectly impact U.S. security interests through the threat that this posed to the CTBT and non-proliferation regime.

India and Pakistan—States with Very Limited Test Experience

Neither India nor Pakistan is currently considered a strategic adversary of the United States, but the addition to the region of the kinds of nuclear-weapon capabilities these two countries have already demonstrated affects U.S. security interests at least indirectly, and further nuclear-weapon developments and deployments by these two countries would likewise be of concern to the United States.

- Without a CTBT (or without joining one)

Without a CTBT, India and Pakistan might undertake to perfect and modify their fission bombs and to develop thermonuclear weapons. This could result in a great increase in the destructive power of each weapon and at the same time provide an opportunity for increasing substantially the number of weapons that could be produced from a given amount of nuclear material. Ultimately, these countries could achieve strategic nuclear weapons that could be carried on considerably smaller ICBMs than would be needed for first-generation fission weapons.

More specifically, with a resumption of testing, India could refine its plutonium fission weapon. It could also master a thermonuclear weapon design with a size and mass compatible

with delivery by its missiles. Such tests would with high probability impel Pakistan to resume its nuclear tests and might well provoke a return to testing by China.

With resumption of testing, Pakistan could further refine its enriched uranium implosion weapon and could develop boosted fission weapons. With plutonium available in the future from its new 50-70 megawatt reactor (producing some 15 kg of plutonium per year), Pakistan could also explore the plutonium implosion route, almost certainly with boosting. Following India, it could also attempt to design and test thermonuclear weapons. In this activity, and in obtaining maximum information from a test program, Pakistan would have much to gain from technology transfer from a Nuclear-Weapon State, if that were forthcoming.

- Achievements strictly respecting a CTBT

Without further testing, India could reproduce and stockpile the fission weapon it has already tested. It could also pursue a program of hydrodynamic and other subcritical testing to improve its understanding of plutonium properties and other aspects of weapon physics that are accessible short of criticality. Substantial doubt has been expressed about the validity of Indian claims to having tested a true thermonuclear weapon, and essentially no progress could be made toward stockpiling such weapons without violating a CTBT.

Pakistan similarly could manufacture and stockpile its enriched uranium fission weapons without further testing, and it could make progress toward a plutonium implosion weapon (perhaps even producing and stockpiling one of simple—and inefficient—design, in which it could have some confidence). Also like India, Pakistan could conduct hydrodynamic and other subcritical tests to improve its nuclear-weapon-related knowledge base.

- Evasive tests within the CTBT

As a large country with varied terrain, India might be able to avoid detection of a decoupled explosion up to perhaps 1 kiloton yield. It would have to guard against leakage of radioactive gas or particulates, however. The size of the country adds to the difficulty of detecting leaked radioactivity because of the delay before the released material is blown across a national boundary, but still India could not be certain of escaping discovery. As the table presented earlier indicates, clandestine testing in this size range would permit India to conduct one-point safety tests and, with difficulty, proof tests of weapons with yields up to 1-2 kilotons. But it would not suffice to develop boosted fission weapons or thermonuclear weapons. The conclusions about clandestine testing are the same for Pakistan as for India, but with less chance of successful decoupling even at yields below 1 kiloton, because the territory of Pakistan is much smaller. (Nuclear tests would perforce be closer to borders than need be the case for India, with greater likelihood of cross-border detection of seismic signals or test debris.) Testing by India or Pakistan could make a much greater relative improvement in its nuclear weapons than would a similar number of additional tests by China or Russia.

States of Concern Without Nuclear Test Experience

As noted earlier, with no nuclear testing at all it would be possible for would-be proliferant states to develop U-235 gun-type and simple plutonium or U-235 implosion weapons in which they could have reasonable confidence. But without nuclear testing, such states would not be able to improve upon the low material-utilization efficiency and poor yield-to-weight ratios of these first-generation weapons. Technology transfer from Nuclear-Weapon States could ease the

transition to lighter and more efficient weapons, but for the recipient to have confidence in the performance or even the workability of its weapons, tests would be required.

To get the large efficiency gains and weight reductions associated with boosting, we believe an inexperienced state would need to test repeatedly at yields well above a kiloton, which it would not be able to conceal reliably. Tests in the 1 to 2-kt range, on the other hand, which could conceivably be concealed, might enable development—with difficulty—of an unboosted fission weapon in the 10 to 20-kt range that would be somewhat lighter than a first-generation "solid pack" implosion weapon. (This would not be needed if clandestine delivery by ship, transport aircraft, or truck were contemplated, but it would expand options for delivery by missile or military aircraft. The resulting improvement in short-range delivery capability would have some direct impact on U.S. security interests, for example by complicating the planning of U.S. military operations in conflicts similar to the Gulf War.) Tests in this 1 to 2-kt range could also validate the performance of the tested item as a weapon designed for this low yield, but designing such weapons would be difficult for an inexperienced state.

Repeated tests even at the 1 to 2-kt level would carry considerable risk of detection—tantamount to certainty for certain states. If an inexperienced state wanted to reduce this risk to a significantly lower level, it would probably try to limit test yields to 100 tons or less.

North Korea

- Without a CTBT

As an NPT signatory, North Korea is prohibited from nuclear testing even in the absence of a CTBT. In addition, under the Agreed Framework of 1994, North Korea is to be supplied two large nuclear reactors for the generation of electrical energy, and a number of other inducements, in return for its giving up the production of plutonium for nuclear weapons. These benefits would be withdrawn if North Korea tested nuclear weapons.

If North Korea were willing to abrogate the NPT and to give up the benefits it is enjoying under the 1994 Agreed Framework, and if it could produce or otherwise acquire plutonium or U-235 in sufficient quantity, it could develop and test a first-generation implosion weapon of perhaps 20-30 kt. With substantially more plutonium than it is suspected to have diverted in the past from its reactors, North Korea could have a test program leading eventually to a thermonuclear weapon. The resulting reduction in plutonium or U-235 needed for a given yield would increase the number of weapons that could be made from a given stock of fissionable material, and the improved yield-to-weight ratio of thermonuclear weapons would allow a given amount of damage to be done by fewer or lighter long-range missiles. This would represent a significant direct threat to U.S. security interests, and the indirect effects through encouragement of acquisition of nuclear weapons by Japan and South Korea would also be large.

- Strictly respecting a CTBT

North Korea might carry on nuclear-weapon-related activities permitted by a CTBT, even if such did not respect its obligations as a Non-Nuclear-Weapon State under the NPT. Such activities might include sub-critical tests with plutonium and hydrodynamic tests with surrogate materials.

- Evasive tests within a CTBT

Since North Korea has no suitable salt deposits, it could seek to test evasively in an underground cavity in hard rock. Such a test is very likely to leak radioactive particulates and gases, posing the risk of detection by the IMS or by U.S. NTM. Even in the absence of such leakage, a fully decoupled underground test of a 1-kt weapon would still provide an approximately 15-ton-equivalent seismic signal, which could readily be detected and located in North Korea by seismic means by a reasonably augmented IMS.

At the considerably lower yield that would stand a reasonable chance of evading detection, North Korea might test an unboosted implosion weapon leading toward a design that would give a yield of a few kilotons. But at lower yields more tests are required in order to provide equivalent confidence in the results.

Iraq and Iran

The acquisition of stockpiles of nuclear weapons by either of these states would have major political impact in the Middle East. Israel would believe its security and indeed its survival threatened. The uneasy relationship between Iran and Iraq would be destabilized. Such an event would likely lead to the acquisition of nuclear weapons by the other state, with possible assistance from outside powers. It could also lead to preemptive moves by Israel.

- **Without a CTBT**

Prior to the 1991 Gulf War, Iraq (despite being a party to the NPT) had mounted a large and varied clandestine program to acquire highly enriched uranium and possessed crude designs for nuclear weapons. Little remains of that program; it was dismantled under UNSCOM and according to the International Atomic Energy Agency apparently has not been reconstituted. Although Iran is also a member of the NPT, the U.S. government has stated that Iran is pursuing a nuclear weapons program.

Iran and Iraq were engaged in open warfare just over a decade ago, and the existing short-range missiles that both possess would be far more threatening to each other and to nearby states if these missiles carried nuclear weapons. Without a CTBT, either state might make the strategic calculation that its interests would be served by the acquisition of nuclear weapons and the demonstration of a nuclear capability. An underground nuclear test program might result (or even tests within the atmosphere), with eventual progression to boosted fission weapons and thermonuclear designs—providing a potential nuclear threat to U.S. cities, whether by ICBM, or by missiles of shorter range launched from ships, or by aircraft, or by detonation in a U.S. harbor.

- **Strict Observance of a CTBT**

If they could acquire the necessary nuclear material, Iran and Iraq could develop and produce—without nuclear testing—heavy and inefficient first-generation fission weapons. (This of course would violate their obligations as parties to the NPT.) But they could not improve on the material-utilization efficiency or the weight of these weapons without testing.

- **Evasive testing under a CTBT**

The yield of coupled underground tests in Iran or Iraq that might evade detection by the IMS or by United States Atomic Energy Detection System is somewhat higher than in North Korea. This arises because Iran and even Iraq are larger than North Korea, and seismic detectors

are accordingly farther from potential test sites; seismic waves suffer more attenuation in this area because of the nature of the geology; and there are frequent earthquakes that raise the noise level and can be confused with underground explosions. For evasive testing, Iran and Iraq have salt deposits—unlike North Korea. As indicated in Chapter 2, the IMS primary network provides a detection capability at magnitude 3.25 in this part of the world, which would drop to 2.75 with the inclusion of the IMS secondary stations. The corresponding yields are some 0.060 and 0.020 kt, respectively, for a tamped explosion. As regards seismic detection, if Iran or Iraq could manage to construct a decoupling cavity in salt, it might attempt to test evasively at a yield up to 1 to 2 kt. The implications of this for nuclear-weapon development would be similar to the case of North Korea—namely, the possibility of progress toward moderate improvements in weight and materials-utilization efficiency compared to first-generation fission weapons, and the possibility of proof testing a low-yield fission weapon, but no possibility of achieving the much larger efficiency gains and weight reductions associated with boosting and thermonuclear weapons.

Summary of Potential Effects of Clandestine Foreign Testing

States with extensive prior test experience are the ones most likely to be able to get away with any substantial degree of clandestine testing, and they are also the ones most able to benefit technically from clandestine testing under the severe constraints that the monitoring system will impose. But the only states in this category that are of possible security concern to the United States are Russia and China. As already noted, the threats these countries can pose to U.S. interests with the types of nuclear weapons they already have tested are large. What they could achieve with the very limited nuclear testing they could plausibly conceal would not add significantly to this.

If Russia or China were to test clandestinely, within the limits imposed by the monitoring system, because they thought they needed to do so to maintain the safety or reliability of their enduring stockpiles, this would not add to the threat they would have posed to the United States in the circumstance that they were able to maintain the safety and reliability of their stockpiles without testing. Clandestine testing by Russia or China to maintain their confidence in their stockpile—although in violation of the CTBT, threatening to the non-proliferation regime, and not to be condoned—might actually be less threatening to the United States than either their losing confidence in the reliability of their weapons and building up the size of their arsenal to compensate, or their openly abrogating a CTBT in order to conduct the testing they thought necessary to maintain or modernize their stockpiles.

U.S. security could reasonably be judged to be directly threatened by clandestine Russian and Chinese testing for stockpile reliability only if the Russians and Chinese were able to maintain the reliability of their stockpiles by means of this cheating while the United States, scrupulously adhering to the CTBT, was unable to maintain the reliability of its own stockpile. This is precisely what has been hypothesized by some critics of the CTBT, but (as explained in Chapter 1) we judge that the United States has the technical capabilities to maintain the reliability of its existing stockpile without testing. If really serious reliability problems that only could be resolved through testing did materialize in the Russian or Chinese arsenal, moreover, it is unlikely that the degree of testing needed to resolve them could be successfully concealed.

In contrast to the cases of Russia or China, where their substantial prior experience with testing makes it at least plausible that they might be able to conceal some substantial degree of testing at yields below the threshold of detection, states with lesser prior test experience and/or

design sophistication are much less likely to succeed in concealing significant tests. This is in part because of the importance of test experience in constructing cavities that can achieve seismic decoupling without leaking radioactivity, and in part because considerable weapon-design experience is required to achieve low yields. Countries with lesser prior test experience and/or design sophistication would also lack the sophisticated test-related expertise to extract much value from such very-low-yield tests as they might be able to conceal. They could lay some useful groundwork for a subsequent open test program in the event that they left the CTBT regime or it collapsed, but they would not be able to cross any of the thresholds in nuclear-weapons development that would matter in terms of the threat they could pose to the United States.

Undetected evasive testing under a CTBT would be limited to a level of about 1 to 2 kilotons and probably would be much less due to difficulties involved in evasive testing, particularly for states without extensive nuclear testing experience and availability of the required geological formations. They should properly be concerned that the yield of the test device might exceed that planned. To avoid this, an evader might conduct a series of “creep up” tests—which would increase the probability of detection and would be costly in terms of nuclear materials. The inability to test at yields above 1 to 2 kt would preclude the demonstration of boosted fission weapons, of primary nuclear explosives for driving the thermonuclear secondaries of strategic weapons, and the demonstration of thermonuclear weaponry. Possible evasive hydronuclear tests, which might escape detection by seismic means, would serve primarily to determine whether nuclear weapons are safe against accidental detonation at a single point; such tests in violation of the CTBT would not impair U.S. security interests and they would be costly in terms of the expenditure of plutonium.

In relation to two of the key “comparison” questions posed at the beginning of this chapter about the implications of potential clandestine testing, then, we conclude as follows:

- Very little of the benefit of a scrupulously observed CTBT regime would be lost in the case of clandestine testing within the considerable constraints imposed by the available monitoring capabilities. Those countries that are best able to successfully conduct such clandestine testing already possess advanced nuclear weapons of a number of types and could add little, with additional testing, to the threats they already pose or can pose to the United States. Countries of lesser nuclear test experience and/or design sophistication would be unable to conceal tests in the numbers and yields required to master nuclear weapons more advanced than the ones they could develop and deploy without any testing at all.
- The worst-case scenario under a no-CTBT regime poses far bigger threats to U.S. security interests—sophisticated nuclear weapons in the hands of many more adversaries—than the worst-case scenario of clandestine testing in a CTBT regime, within the constraints posed by the monitoring system.