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Health of the Non-Proliferation Regime  
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After the use of the first two nuclear weapons against Japan in August 1945-- just 60 years ago-- farsighted scientists and statesmen understood that a major question was the control of the nuclear weapon. Were we headed for a world in which every country had its own stock of nuclear weapons, to carry out, in some cases, feuds and quarrels of centuries standing? Or could we arrange to bring the nuclear weapon, with all its destructive power, under international control or perhaps eliminate it entirely?

Thus was the origin of the Acheson-Lilienthal report, to which Robert Oppenheimer, the inspired choice as Director of the Los Alamos Scientific Laboratory and a key leader of the Manhattan Project, contributed.

More conventional preferences prevailed in the United States, with President Truman designating Bernard Baruch to present the plan to the United Nations, but Baruch's heart was not in it, and the Soviet Union judged that it would be the subject of a nuclear weapon monopoly if it did not develop its own nuclear weapons. Britain followed, having worked closely with the United States from the beginning of the weapon project and having been shut out of access to nuclear weapon secrets after the war. Despite the formation of NATO in 1949, France (probably for reasons of prestige rather than security) followed with its own nuclear program, and the Chinese then made enormous sacrifices to build their own weapon, first with the support of the Soviet Union, and then going it alone with their hydrogen bomb.

With the passage of time and the advance of general industrial technology, many of the enormous problems that faced the first builders of nuclear weaponry simply vanished. And it proved to be impossible to restrict the spread of specific knowledge about the early atomic bombs, in part because of a misguided judgment that it was more important to stay ahead of the Soviet Union than to prevent the diffusion of information about bombs that were much inferior to what the Soviets already had.

For years national leaders were well aware of the hundreds of thousands of people killed in the detonation of the two small (13 kilotons and 20 kilotons) bombs over Hiroshima and Nagasaki, and not long after (November 1, 1952) the test explosion of the MIKE thermonuclear explosive with a yield of 11 megatons showed that it was possible to have and deliver a weapon one thousand or more times the yield of the Hiroshima bomb.

The late Hans Bethe noted in 1995 that the tens of thousands of bombs that had been built were "one hundred times more than any of us at Los Alamos could ever have imagined." Many of these built by the United States and the Soviet Union were strategic nuclear weapons (on the order of 12,000 on each side) of yield comparable with a megaton. In contrast, already in his public speeches in 1945, Oppenheimer had anguished that unless the bomb could be controlled, a future war between nuclear-armed opponents would see nuclear weapons *used* by the thousands or the tens of thousands.

Many of us have carried on the tradition and spent much of our lives trying to reduce the number of nuclear weapons from the 20,000 or so still in the world today to on the order of a few hundred, which would not eliminate the danger to humanity but would reduce the risk of total destruction of civilization. In parallel, there has been the struggle to enhance the control of nuclear weapons so as to prevent their accidental or unauthorized use.

Key to these efforts has been the approach to non-proliferation that attempted to reduce the incentive to acquire nuclear weaponry and erected barriers to the transfer or the acquisition of technology by those states that did not have nuclear weapons.

One set of the incentives was a provision in the Non-Proliferation Treaty of 1970--the NPT-- by which states joining as non-nuclear weapon states would be entitled to the sharing of peaceful uses of nuclear energy such as medical, industrial, and scientific applications. In the days in which peaceful uses of nuclear explosives were envisioned, the non-nuclear weapon states were to have access on a nondiscriminatory basis to such tools for massive geo-engineering.

Another incentive addressed the national security motivation for obtaining nuclear weapons for protection, and that was the encouragement of negative security guarantees from the nuclear weapons states--NWS--according to which non-nuclear states--NNWS--would not be subject to attack with nuclear weapons.

There were also, under some circumstances, positive security guarantees, by which some of the nuclear weapon states in separate agreements committed themselves to use their weapons in support of their allies or members of regional security groups such as NATO or, presumably, the later Warsaw Pact. This was an attempt at *extended* deterrence--extended to deter attacks against allies as well as against itself.

Additional commitments made by the nuclear weapon states in the NPT itself addressed the discrimination inherent in that treaty, by which nuclear weapon states were permitted to retain their nuclear weapons and even to build as many more as they liked, and (by 1970) to test them without inhibition except for those three nuclear weapon states that have signed the Limited Test Ban Treaty of 1963 that banned all but underground tests. However, the nuclear weapons states were committed to work toward nuclear (and general and complete) disarmament, but with no timescale.

There were to be NPT review conferences every five years, and after 25 years a decision by the member states as to whether the NPT would be made permanent or should be renewed for periods of five years or some other term. At that conference the members voted to keep the NPT in force permanently. In conjunction with the 1995 review conference and the 2000 review conference, the U.S. Administration made certain commitments, with the other nuclear weapon states, as recorded in the Consensus Document issued by the year-2000 NPT Review:

"An unequivocal undertaking by the nuclear-weapon States to accomplish the total elimination of their nuclear arsenals leading to nuclear disarmament to which all States parties are committed under Article VI."<sup>1</sup>

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<sup>1</sup> [http://www.armscontrol.org/act/2000\\_06/docjun.asp](http://www.armscontrol.org/act/2000_06/docjun.asp)

In the NPT Conference held in New York May 2005, the United States government largely ignored these commitments of the Clinton Administration, thus calling into question any non-treaty commitment of that country. Unfortunately, this same administration has shown substantial disregard for its obligations under international treaties and has been very forthright in its judgment that such treaties are worse than useless: countries that would have done without a treaty what they are committed to do (or not to do) by the terms of the treaty will abide by the treaty, and other countries will cheat or abandon the treaty.

There is something in this view, as exhibited by the behavior of the Bush Administration itself, which in the year 2001 abandoned the U.S.-Russian ABM Treaty of 1972 without revealing what "supreme national interests" of the United States were imperiled by continued adherence to the treaty. Nor did the Bush Administration seem to have attempted to obtain the approval of Russia for the supposedly very limited missile defense system that the administration promised to erect against future ICBMs that might be acquired by North Korea and launched against U.S. territory.

But the NPT has not been in good health. In the 1990s North Korea refused mandatory inspections by the IAEA and reprocessed plutonium from its five megawatt (electric) reactor at Yongbyon-- enough to make two plutonium weapons. More recently North Korea claims to have reprocessed 6000 additional fuel elements removed from that reactor, enough to make another four or so nuclear weapons.

Much of this work was done while North Korea was a member of the NPT and forbidden to do so. More recently North Korea has resigned from the NPT, exposing an obvious defect in the treaty. Non-nuclear weapon states are guaranteed support and technology for peaceful uses, and this includes the acquisition of nuclear reactors and even of enrichment plants, in some cases, which the NNWS is then free to use without hindrance simply by resigning from the NPT.

The story is playing out more publicly in the case of Iran, which for at least 18 years concealed nuclear-related activities it was committed as a member as the NPT to declare to the International Atomic Energy Authority-- IAEA. Iran argues that the nuclear weapon states violated their own obligations to NNWS by imposing restrictions on Iran's acquisition of peaceful nuclear technology for causes unrelated to its nuclear activities. So Iran says it had no choice but to acquire these capabilities by stealth rather than declaring them as was required under the NPT.

Iran now has a nuclear reactor at Bushehr-- a full-scale producer of nuclear power for which it has negotiated contracts with Russia to provide the fuel elements (low-enriched uranium of about 4.4% U-235) and for Russia to retrieve the spent fuel after the four years of exposure in the reactor, for disposal in Russia.

At the same time, Iran has invested in the infrastructure to produce LEU itself in a vast hall for centrifuges at the city of Natanz, which would house about 50,000 centrifuges. Those at Urenco or in Pakistan if replicated 50,000 times would be just about enough to keep up with the annual need for the Bushehr reactor for about 1000 kg of U-235 in the form of 4.4% LEU. Britain, France, and Germany, negotiating (as the "E3") on behalf of the European Union, together with the IAEA have argued that Iran has no need for

such a vast enrichment plant, and that even a much smaller one has the potential of producing HEU for nuclear weapons.

In fact, a plant that can produce 1000 kg per year of U-235 as LEU can produce about 670 kg/yr of U-235 as HEU-- ideal material for nuclear weapons. It might take about 20 kg of this HEU to make a nuclear explosive such as that first built by the Chinese and then by Pakistan, so the Natanz plant could be the source of some 30 bombs per year.

If, instead, Natanz produced LEU, this could essentially without loss be converted into HEU at a rate of about 2000 kg per year, and this is the reason for the E3's reluctance (and that of the United States) to allow Iran to have such a big enrichment facility.

If North Korea expands its nuclear armory, or tests nuclear weapons, it may be impossible for Japan to avoid becoming a nuclear weapon state, and Japan has vast stocks of plutonium from its civil fuel cycle that could be used to make thousands of plutonium implosion weapons comparable with the one that destroyed Nagasaki in 1945.

In addition, nascent, small nuclear arsenals are unlikely to have the use-control mechanisms that it took the United States until 1962 to incorporate into its nuclear weapons. At that time, we had some 7000 nuclear weapons deployed in Europe, nominally under the control of the United States, but that U.S. control consisted in many cases of a few soldiers armed with rifles standing on a European airfield. If the bombs on the aircraft had been carried to their targets by killing or immobilizing the guard, they would have been dropped with full effect. It was at that time that, largely at the initiative of Harold M. Agnew, later to be Director of the Los Alamos National Laboratory for ten years, that the Congress and the administration was motivated to introduce the PAL-- "Permissive Action Link"-- that required not just administrative approval but also a specific number to be inserted into the electromechanical lock that would otherwise prevent the weapon from detonating.

A further security problem imposed by proliferation is the wider availability to terrorists of nuclear weapon materials. With the increasing popularity of suicide terrorism in the world, the acquisition of a nuclear weapon by terrorists eases very much the delivery problem if the people involved are not required to escape the detonation themselves. So it becomes all the more important to monitor, control, and soon to reduce the amount of nuclear weapon usable material and nuclear weapons in the world.

In general, state-owned nuclear weapons (in a stable government) are not a big problem, in that their use can be deterred. But the competitive arming on a rapid scale and the absence of adequate security in a universe full of surplus nuclear weapon material involves a great threat to civilization and the rule of law as well as of international agreements.

The near-term solution appears to lie in ensuring that nuclear weapons are greatly reduced in numbers and that the few remaining can be used only with the approval of regional security regimes-- eventually perhaps to involve the United Nations itself. A modern permissive action link could enforce a rather complex rule of authorization-- not necessarily requiring unanimity. This would involve giving up some of the trappings of sovereignty, as is done willingly every time a state signs a treaty.

At present, the attitude of the Bush Administration toward its treaty obligations is little different from that of Iran toward its obligations under the NPT-- each one obeying those elements it finds in its interest, and being perfectly willing, if necessary, to abandon the treaty if it limits its freedom of action.

This must change, and it would be better if it changed before several cities are lost to terrorist nuclear explosions than after.

A totally different dimension to the nuclear weapons dilemma is are the nuclear weapons possessed by the three states that never signed the NPT and thus had no legal inhibitions to acquisition of nuclear weapons, other than the bilateral restrictions imposed by suppliers of technology. Israel, India, and Pakistan apparently possess substantial stockpiles of nuclear weapons; India tested its weapons underground in 1974 and again in 1998. Pakistan tested immediately after the 1998 Indian tests. Since the NPT defines a Nuclear Weapons State as one that tested a nuclear explosive before 1 January 1967, these states can never join the NPT either as a NNWS or a NWS. Nevertheless, they could voluntarily assume the obligation of a NWS under the NPT not to transfer nuclear weapons or nuclear weapon technology to a NNWS. This is important, as Dr. A. Q. Khan, who was central in Pakistan's acquisition of nuclear weapons, played an important role in transferring weapon technology and even weapon designs to other countries. After confessing on national television, Dr. Khan was pardoned by Pakistan's president. Although Israel has signed the Comprehensive Test Ban Treaty of 1996, India and Pakistan have not.

It is not feasible to amend the NPT, but it can be strengthened and interpreted by additional "Protocols" and enhancement of the roles of the IAEA. These should be adopted in months and not years:

1. The United States and Russia, possessing more than 90% of the world's nuclear weapons, should immediately demilitarize all but 1000-2000 of their nuclear weapons and commit to a future level of a few hundred weapons and weapon-equivalents in support of international security-- e.g. under the control of regional security organizations or even of the United Nations.
2. An additional Protocol by which States commit themselves to return or destroy facilities and materials obtained as NNWS under the NPT if they abandon the NPT.
3. A protocol like the arrangement being offered by the E3 (Britain, France, Germany) to Iran, providing assured access to fuel for nuclear power plants, as well as a commitment to accept spent fuel for disposal at affordable cost.
4. In regard to disposal of spent fuel, whether directly disposed or reprocessed, the nations of the world should reverse the present requirement that each state dispose of spent fuel within its borders. Instead, there should be authorization and encouragement for commercial, competitive mined geologic repositories, licensed under the IAEA, which will accept IAEA-approved waste forms--encapsulated spent fuel elements or vitrified fission products for permanent disposal. This is an important step for opening the way to the expansion of nuclear power.

To impede terrorist acquisition of nuclear weapons:

5. The G7 must greatly accelerate the initiatives to consolidate and secure the approximately 1000 tons of highly enriched uranium and 100 tons of excess weapon plutonium in Russia and the other successor states to the Soviet Union.
6. The United States must take more seriously and the world should accelerate the transformation of research reactors worldwide from HEU to LEU fuel. In this regard the recent US Energy Bill that permits HEU-fuel export to Canada for the production of medical isotopes is a step in the wrong direction.
7. A modern and universal accounting system should be introduced for nuclear materials in general (e.g., intense radioactive sources used in industry and medicine) and nuclear weapons and weapon-usable material in particular.

The IAEA is doing much to advance this agenda. It needs increased financial support, and the nations of the world must give these measures the priority they deserve.

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