

# Nuclear Weapons and Nuclear Power, Thoughts for the Next Four Years

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## **Nuclear weapons are more a threat to a modern, developed society than they are a useful tool.**

In the bipolar confrontation of the United States and the Soviet Union, nuclear weapons were regarded first as a guarantor of national survival by deterrence against nuclear and conventional attack and, with the enormous stocks of tens of thousands of nuclear weapons and their delivery systems, a tool for compellence. In the days of their rapid increase, nuclear weapons were prized and insufficient in numbers.

In the present fractured world, many of those nuclear weapons or their components still exist in Russia and in the United States, and hundreds of them in France, the UK, China, Israel, India, and Pakistan. There are even a few in North Korea, a country that survives in part by selling its technology and weapons to the rest of the world. In these days of nuclear weapon excess, those weapons and nuclear materials (plutonium especially) are a cost and a drag to the United States and Russia as indicated by the security lapses involved in the transfer of six nuclear-armed cruise missiles between two Air Force bases, with no one knowing for more than a day that six weapons were out of control of the required security. Secretary of Defense Robert Gates fired both the military and civilian heads of the U.S. Air Force, as a consequence, and security of U.S. nuclear weapons was then taken far more seriously.

A single nuclear explosion or even the threat of a nuclear detonation in a city would imperil as many as a million lives and disrupt society far beyond even that catastrophic loss. The threat comes not only from surplus U.S. and Russian nuclear weapons, but those in Pakistan and elsewhere, together with the hundreds of tons of nuclear materials that could be fashioned into tens of thousands of improvised nuclear explosives of yield comparable with that of the Hiroshima or Nagasaki bombs. One of these stolen or improvised nuclear explosives would be even more destructive because it would be detonated at ground level. As a result, the U.S., as a prime target for terrorism, has recognized that it must lead a concerted effort to secure and reduce availability and stocks of nuclear weapons and weapon-usable materials.

From the very beginning, nuclear weapons and nuclear power have been linked, technically, although there is no reason why a civil nuclear power program should lead to nuclear weaponry, as exemplified, for instance, by Germany, which has had an active program in nuclear power with no connection at all to nuclear weapons.

Similarly, a nuclear weapon program can be conducted without the delay, burden and cost of a civil nuclear power program.

To meet the current threat of nuclear weapons, several overarching topics must be addressed together:

1. The role of nuclear weaponry in United States military forces.
2. The feasibility of reducing the nuclear threat to the United States and to the world by diplomacy, arms control, and the possible elimination of nuclear weapons.
3. Responsible stewardship of whatever nuclear weapons exist, in order to prevent their unintended use or theft, while ensuring their performance in the deterrent role.
4. Safeguarding of nuclear-weapon-usable material the world over, to prevent the building of national nuclear forces or of improvised nuclear explosives.
5. The realization of the benefits of nuclear fission to the civil society—nuclear power, medical isotopes, industrial instruments, and the like—while avoiding such activities contributing to the acquisition of nuclear weapon capabilities.

In this brief presentation, I make specific recommendations for United States leadership in reducing the hazard of nuclear weapons and for advancing the safety and availability of civil nuclear power in the world, while maintaining and increasing its disconnect from possible nuclear weapon programs.

### **1. The role of nuclear weaponry in United States military forces.**

Nuclear weapons must be regarded as usable only to deter or to respond to a nuclear attack on the United States, its troops, and allies. This is not to say that nuclear weapons would have no effectiveness for other purposes, but their use would have such consequences, and the cities of the United States and its allies and other societies are so vulnerable that preserving the nuclear taboo is of the highest importance. Would that strict limitation on the purpose of nuclear weaponry open the United States to its destruction by cyber attack or biological warfare? No one should think so, because the U.S. Congress, if not the administration itself, would not allow the country to be destroyed by other means, and devastating response would surely follow, with nuclear weapons or otherwise, if the perpetrator could be identified.

This limitation on the purpose of nuclear weapons has profound implications on the number and nature of U.S. nuclear forces. It would reverse a major error made by Secretary of Defense Robert S. McNamara in assigning the role of “damage limitation” to nuclear weapons excess to the purpose of deterrence.

*Recommendations:*

*1.1 The U.S. should, with its NATO allies remove U.S. nuclear weapons (the B-61 bomb) from Europe.*

*1.2 The U.S. should seriously study the mechanisms, benefits, and costs of de-alerting the bulk of its nuclear forces, with appropriate transparency.*

**2. The feasibility of reducing the nuclear threat to the United States and to the world by diplomacy, arms control, and the possible elimination of nuclear weapons.**

There is no alternative to diplomacy and arms control in improving U.S. security against foreign or non-state nuclear weapons. Many nuclear weapons exist outside the United States, not only in Russia but in other countries with which the United States has even less influence. And weapon-usable material in the form of highly enriched uranium (HEU) and plutonium exist not only in national armories but also in the fuel cycle in non-weapon states such as Japan. Fortunately or unfortunately, other states have at least as much vulnerability to INE or stray nuclear weapons as does the United States. They have, perhaps, less ability to concentrate on this threat because they face other existential threats to their countries or to their governments. Whether or not a world without nuclear weapons is stable, surely a world in which the United States and Russia each have a few hundred nuclear weapons, and other states have a smaller number, would be desirable for all of the nuclear weapon states, and, in view of the possibility of worldwide environmental catastrophe from the use of nuclear weapons and the certainty of worldwide economic and political disruption, all have an interest in the vast reduction of nuclear weaponry.

*Recommendations:*

*2.1 Create separate and joint studies on the worldwide impact of a nuclear exchange, even of 100 nuclear weapons targeted for maximum destruction against population centers.*

*2.2 Create individual and joint working groups on prompt demilitarization of surplus nuclear weapons, and the path to transferring the weapon-usable material to civil stockpiles or elimination.*

### **3. Responsible stewardship of whatever nuclear weapons exist, in order to prevent their unintended use or theft, while ensuring their performance in the deterrent role.**

Nuclear weapons that are to be preserved in the forces should be cared for to maintain them safe, increasingly secure against the threat of theft or intentional explosion, and reliable if called upon for their use as a deterrent or response. The Stockpile Stewardship Program in the United States is an example of what can be done, but evidently the other states of the P5, Russia, the UK, France, and China have their own approaches to maintaining their nuclear weaponry, largely by inspection and remanufacture. The concern of the nuclear weapon enterprise for maintaining their financial support, skilled personnel, and for motivating that support and those people has led to excesses, with which I am most familiar in the United States. Facilities have been portrayed as essential to the stockpile stewardship mission, when they were only nice to have, and might in fact detract from that mission. Other facilities have been blindly scoped and put into the program without planning or concern that their cost escalated by a factor four or ten, and without detailed analysis as to what would be needed in an age in which no new nuclear weapon capabilities were needed or sought.

In this regard, I support the recent delay of at least five years in the planning for the CMRR nuclear facility (Chemistry-Metallurgy Research Replacement) at Los Alamos and note once more that a facility that will take ten years to build and become operational, if essential, must have interim capabilities that perform the same role, and that there should be an option to maintain such interim, short-term capabilities indefinitely into the future.

There is a new recognition of the evolution of the threat to nuclear weapons. Security systems were built in the first place to prevent the theft and eventual use of nuclear weapons, but they must be extended to prevent the detonation in place if they were intercepted in transit or even on its launcher. And although such capabilities might be incorporated in some future warhead design, they are needed sooner than that to protect existing weapons, and much can be done in modifying weapons in transit or the containers in which they reside for safeguarding.

#### *Recommendations:*

*3.1 Initiate detailed independent analyses of minimum cost programs for maintaining a much smaller number of nuclear weapons, informed by cost-benefit measures, taking into account particularly the interval before new facilities could be put into operation. This would include*

*explicit consideration of interim facilities, of limited life, perhaps replaced after 20 years, compared with the approach of a 60-year operating life.*

#### **4. Safeguarding of nuclear-weapon-usable material the world over, to prevent the building of national nuclear forces or of improvised nuclear explosives.**

The Nunn-Lugar program, initiated in 1992 and regarded now as an icon of achievement, is under threat, and not solely by President Putin's announcement that Russia will henceforth handle improved security of its weapon-usable material without U.S. engagement. The 2012 Seoul Nuclear Security Summit reinforced the U.S. initiative to put all weapon-usable material and weapons under safe control within the next four years, but implementation lags. It needs greater resources and commitment.

Even the Nunn-Lugar program in Russia had a limited return on investment because of the political benefit of employing U.S. contractors at a time when employing Russian firms and individuals would have helped more in building capability there and would have provided greater effectiveness.

The need is urgent. Acquiring some tens of kilograms of HEU in this day of Web access to information, common industrial technology, and easy transport, could lead to a nuclear detonation in a city or port.

This means eventual elimination of the HEU from nuclear weapons and the nuclear-weapons sector, beginning with its early down-blending to LEU which is eminently usable and valuable in the civil nuclear fuel cycle. It also means the permanent disposal or consumption of the separated plutonium from nuclear weapons and the much larger amount that exists from the reprocessing of civil reactor fuel.

##### *Recommendations:*

*4.1 Make explicit plans for investments for early down-blending of HEU from the weapon stockpiles of the world, and for improved security of HEU and plutonium.*

**5. The realization of the benefits of nuclear fission to the civil society—nuclear power, medical isotopes, industrial instruments, and the like—while avoiding such activities contributing to the acquisition of nuclear weapon capabilities.**

The United States has its problems in building new civil power reactors because of their high cost and in view of the wide availability of low-cost natural gas produced from shale formations by hydraulic fracturing (fracking). But nuclear power is moving forward elsewhere, whether economically optimum or not. The United States was pioneer in the development and deployment of civil nuclear power, with 104 operating power reactors of the world's 440. The U.S. Nuclear Regulatory Commission (NRC) although imperfect, is the model for the rest of the world as an independent and competent regulator. But the United States, perhaps because of the influence of industry and lobbyists within the administration has not fully assumed a leadership role in the solution of problems facing the world's nuclear industry and in the strengthening of barriers to nuclear weapon acquisition by way of the civil nuclear program.

First, the United States should reaffirm its policy of not reprocessing spent fuel from its light-water power reactors and should oppose rather than encourage the costly and futile efforts in Japan and the nascent efforts in South Korea to reprocess LWR fuel. The United States should explicitly recognize that reprocessing has an important and even essential role in breeder reactor economy, and that breeders may have a fundamental role in future civil nuclear power, if that sector expands beyond the availability of terrestrial uranium ore that is consumed only to the extent of about 0.5% in the LWR power plant. An economical and safe breeder reactor would expand the utilization of uranium by a factor hundred, so research on breeder reactors and associated fuel cycles should be encouraged, but premature deployment should be opposed. The United States should place its civil reactors under IAEA safeguards, with innovations at acceptable cost by the implementation of sampling, remote sensing, proper information security, and the like, but with appropriate contributions to IAEA in order to defray the additional cost.

And the U.S. should move to provide technical and political support for competitive, commercial mined geologic repositories (shared repositories) and, as a preliminary, to move spent nuclear fuel from the at-reactor spent fuel pools to dry-cask storage at the reactors and ultimately to a few centralized locations from reactor sites that have been closed.

These measures to avoid reprocessing LWR fuel would prevent the accumulation of additional “civil plutonium” and commerce in that plutonium for shipment to fuel fabrication plants, and the shipment of fresh MOX (mixed oxide) fuel to LWRs, during which phases the plutonium is unprotected

by an intense field of radioactivity and could be separated from the MOX by simple chemical means, or more simply diverted in transit to the MOX plant.

*Recommendations:*

*5.1 Under the government's responsibility for spent commercial nuclear fuel, the U.S. should make the investment to move it into dry-cask storage from the at-reactor spent fuel pools and plan for a few centralized locations for casks from reactor sites that will have closed.*

*5.2 The U.S. should join with others in detailed consideration of the building and operation of several commercial, competitive mined geologic repositories, including international rights to provide security if local measures are inadequate.*

*5.3 The U.S. should more forcefully oppose reprocessing of LWR fuel and the separation of plutonium, instead committing that fuel to dry-cask storage and to emplacement in a mined geologic repository.*

*5.4 The U.S. should join with others in a program to advance the state-of-the-art of simulation and modeling of breeder reactors and their associated fuel cycles, with the purpose of identifying through computer modeling and small-scale experiments breeder concepts that will be cheaper and safer than light-water reactors. These would use integrated fuel-cycle systems to avoid the possibility of use of the fissile material in weapons.*

*5.5 The U.S. should join with other states in providing incentives for the use of solution-fueled or other liquid-fuel reactors of small power to provide a more efficient system of obtaining fission-product-based medical isotopes.*

In all this, I counsel against the “realist” approach to prioritize what needs to be done and to work only on the highest priority items. We have enough capability to move in all of these sectors, and presidential leadership, extending through the cabinet secretaries and the leadership of agencies, should initiate these programs and ensure that there is progress, while making the case to the Congress that the national security interest is paramount.