The Nuclear Fuel Cycle
and
The Bush Nonproliferation Initiative

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for

World Nuclear Fuel Cycle 2004
World Nuclear Association/Nuclear Energy Institute
Madrid

1 April2004

INTRODUCTION

In February, the Bush Administration proposed new measures to prevent the proliferation of nuclear weapons—to prevent new countries or terrorist groups from gaining access to such weapons. Many of these measures affect the civil nuclear fuel cycle.

Today, I would lilce to review these measures in an historical context and explore their implications for the future.

The proposed measures fall into three groups:

- Measures to improve the existing nonproliferation regime;
- Measures to expand efforts to keep the weapons byproducts of the Cold War from falling into the wrong hands; and
- Measures to impose new controls on nuclear fuel cycle technology and materials.

It is the third of these that has the greatest potential to affect civil nuclear power programs and is likely to be the focus of the greatest controversy. We will discuss these three groups of measures in order.

IMPROVING THE EXISTING REGIME

The existing nonproliferation regime has a long history of trying to balance national and international interests, and commercial and governmental interests. It also consists of a mix of national and international rules and regulations.

The Bush Administration proposes four measures to deal with what it sees as an imperfect balance of means and objectives in the existing regime, largely focusing on fuel cycle technologies and materials:

- Stronger national laws and international regulations to criminalize proliferation, strengthen export controls, and secure sensitive material;

- Limit civil nuclear cooperation to those nations accepting the IAEA Additional Protocol;

- Increase the ability of the IAEA to take action against proliferation through a select committee of "governments in good standing," and to exclude nations being investigated from IAEA governance.

- Introduce new mechanisms to police and interdict proliferation through the Proliferation Security Initiative.

There are two important themes here that affect the fuel cycle: (1) The Bush Administration sees some nations as being safer than others for sensitive fuel cycle technologies, effectively introducing discrimination into the regime, and (2) it seeks mechanisms to force compliance with tighter controls, not merely encourage compliance.

Nonproliferation Criminal Code

The first regime measure is meant to improve the legal basis within exporting countries for prosecuting proliferation activities that violate international norms agreed to by the exporting country. It has been the case that citizens of some countries have participated in export activities, or provided consulting and other services, that have aided proliferation, only to be found to have violated no national law or regulation, or have been convicted but not punished. This has been the case in Europe and the U.S. as well as Pakistan, Malaysia and other nations.

The U.S. has offered to help develop a more uniform nonproliferation criminal code, but perhaps this would best be done under IAEA or UN leadership. The failure to date of the U.S. to convince Malaysia and other nations to tighten legal restrictions suggests that a multilateral approach will be essential.

On March 24th, the U.S. presented a draft resolution to the U.N. Security Council to criminalize the proliferation of chemical, biological and nuclear weapons materials to *non-state* actors, and to improve national export controls. If adopted, the resolution would be binding on all U.N. member states.

The IAEA Additional Protocol

The proposal to limit civil nuclear cooperation to those nations accepting the IAEA Additional Protocol, is meant to deal with a basic limitation in the IAEA system which limits inspections to the subset of facilities declared by a country as subject to inspection. This limitation allowed countries to build other facilities, potentially for weapons use, without IAEA oversight.

IAEA Governance

The third proposal, to introduce a special committee of the IAEA and to exclude countries under investigation from Board activities, would represent a significant shift in the philosophy underlying the NPT and the IAEA. By focusing on "governments in good standing," the Bush Administration would introduce its distinction between "good guys" and "bad guys" into the international regime.

While it is evident that some nations have, and will, abuse their rights under the NPT to develop the infrastructure underlying weapons capabilities as well as civilian nuclear power, there are a number of problems with introducing discrimination into the regime, beyond that already present in the distinction between the original weapons states and non-weapons states.

One is the fact that the persuasions of an international regime rest importantly on treating nations as equals. Second, who will decide who the "good guys" are? Third, even today's "good guys" may be tomorrow's "bad guys." At one point, the U.S. considered both Iran and Iraq as "good guys" while today it sees them as bad. Finally, many nations already point to what they see as nuclear weapons expansionism as a sign of U.S. noncompliance with the NPT, which might make the U.S. a "bad guy" under the international regime to some parties.

The Proliferation Security Initiative

The NPT and the IAEA system does not contain mechanisms for policing or sanctioning nations that violate nonproliferation norms. While the pressure of international disapproval should not be minimized, about the most the current system can do is to find an offending country in "non-compliance."

The Bush Administration proposes to supplement this with more aggressive actions, to police, sanction, or interdict actions or trade that could result in proliferation of nuclear weapons.

The Proliferation Security Initiative (PSI) operates outside the IAEA framework and is intended to interdict the kinds of shipments discovered in the case of Libya and Iran. The PSI might be referred to as embodying a doctrine of "multilateral pre-emption," with 16 nations agreeing to participate as of January of this year.

There are at least two difficulties with the PSI approach. The first is the evident conflict between the "right" to free nuclear trade under the NPT, and efforts to stop such trade when members of the PSI see a proliferation risk. Who will decide on the risk?

The second lies in the limited national and international legal basis for such pre-emption. While there will be cases in which there is a legal basis for intervention, it is likely that there will be little or no legal basis in many cases. Will the PSI approve of, or legitimize, extra-legal action by one member, such as the United States?

Limitations of the Historical Regime

All of these proposals are meant to strengthen or supplement the current international regime. However, the historical regime has severe intrinsic limitations in dealing with recent developments in the proliferation of nuclear weapons.

- The sources of nuclear know-how, nuclear materials, and manufacturing capability have expanded beyond the traditional suppliers' group;
- New nuclear suppliers and potential suppliers—India, Pakistan, North Korea, Iran and others—are not part of the suppliers' group and, in many cases, do not support the traditional regime;
- The original regime dealt with the "what" of proliferation—the equipment and materials—not the "who" of proliferation, a focus that may not be enough given new actors outside the historic regime.
- The old regime is limited to nations, not sub-national actors (even those acting in official national positions) or terrorists.
- Large multi-lateral organizations such as the IAEA have difficulty reaching decisions or taking action.
- The regime is permissive, not prescriptive, and relies on persuasion, not enforcement or compulsion.

These problems, and versions of the solutions proposed by the Bush Administration, have been highlighted by Dr. Mohamed ElBaradei, Director General of the IAEA. Most notable is a revival of the recurrent proposal to put fuel cycle facilities under international control, as discussed below.

POST-COLD WAR LEGACIES

The Bush Administration endorses efforts to keep weapons, weapons materials, and the human capital responsible for weapons, from the Cold War from going astray. And it seeks to extend such programs to other nations with fissile material or other weapons capabilities. This includes retrieving highly-enriched research reactor fuel that the U.S. and other nations provided in the early days of Atoms for Peace.

Unfortunately, the rhetoric on these subjects has not been matched by action. The Nunn-Lugar program budget has been cut, the Nuclear Cities initiative has been eliminated, and the HEU blend-down program with Russia, one that has so far destroyed 8,000 nuclear weapons, has been subordinated to commercial interests.

In part, this is the result of concerns by political conservatives in the Administration that any money flowing to Russia merely frees up resources that can be used for weapons programs or other purposes. It is also the result of putting U.S. intrusiveness, corporate interests, and the liability concerns of its civilian contractors ahead of eliminating the risks of weapons material or human capital going astray.

The cost of fixing these problems is small, compared to dealing with the problems later and compared to other security expenditures the U.S. is making. The U.S. could understand that Russia will maintain some level of nuclear deterrent as long as the U.S. does so, could fund security improvements without compromising sovereignty by excessive intrusiveness, indemnify its contractors itself, subsidize its own companies on the HEU deal instead of forcing Russia to do so, and stop requiring owners of research reactors to pay the costs of returning HEU to the U.S.

The solutions to the risks posed by Cold War legacies are quite practical, not rhetorical or ideological.

CONTROLS ON FUEL CYCLE TECHNOLOGIES AND MATERIALS

The nuclear fuel cycle has long been central to thinking about proliferation risks, dating from the Truman Administration's international proposals, to the Eisenhower "uranium bank" idea, to the Carter policy of denial in the 1970s, and, most recently, to the new Bush proposal to limit use of enrichment and reprocessing to the countries that already have large-scale facilities.

Many of the issues we are discussing today about proliferation controls and the fuel cycle are not new, as some citations from the Acheson-Lilienthal report to President Truman of March 1946 reveal:

- "The development of atomic energy for peaceful purposes and the development of atomic energy for bombs are in much of their course interchangeable and interdependent.

- "...although nations may agree not to use in bombs the atomic energy developed within their borders the only assurance that a conversion to destructive purposes would not be made would be the pledged word and good faith of the nation itself.

- "... there is no prospect of security against atomic warfare in a system of international agreements to outlaw such weapons controlled only by a system which relies on inspection...

- "We are convinced that if the production of fissionable materials by national governments is permitted, systems of inspection cannot by themselves be made 'effective safeguards. . . to protect complying states against the hazards of violations and evasions."

The last point was central to the solution proposed by the Acheson-Lilienthal Committee.

The Committee distinguished between "dangerous" and "non-dangerous" activities, identifying uranium and nuclear fuel facilities, including "plutonium piles," as the crux of the proliferation danger.

The Committee called for an "international agency with exclusive jurisdiction to conduct all intrinsically dangerous operations." These included "all activities relating to raw materials, the construction and operation of production plants, and the conduct of research in explosives."

We have spent nearly sixty years reinventing this "international fuel cycle monopoly" solution, always unsuccessfully. To show how difficult it is, it is worth looking at the failures.

The Truman Approach

The first failed attempt was when President Truman, who endorsed the AchesonLilienthal report, turned to Bernard Baruch, a major contributor to Truman's political campaigns, to advance the ideas in the report. One of Baruch's first actions was, as Leonard Weiss reports, "to scuttle the idea of international ownership of the means of production of nuclear materials because it was not in keeping with the American free enterprise system." Truman later called choosing Baruch "the worst mistake I ever made"[1].

With the creation of the Atomic Energy Commission, the U.S. took the course of national secrecy and control, rather than multilateral oversight, ending the dreams of international control.

An arms race with the Soviet Union soon followed the 1949 Soviet weapons test, accompanied by the production of increasingly large quantities of fissionable and fissile material. The U.S., together with Britain, sought to buy up world supplies of uranium to feed allied weapons programs and deny access to such material to others.

During subsequent years, commercial firms in the U.S. chafed at the restrictions put on civil development of nuclear energy by the Atomic Energy Commission. During this period, it also became clear that U.S. could not indefinitely control nuclear activities and needed to find a way to influence future international developments.

Eisenhower and Atoms for Peace

These imperatives came together in Eisenhower's Atoms for Peace proposal. Central to the initial Atoms for Peace proposal was the idea of an international "uranium bank." Eisenhower's uranium bank proposal had two motivations. The first was to facilitate the expansion of civil nuclear power, but with international control of fissionable material, much as the Acheson-Lilienthal Committee had proposed in 1946.

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1 Leonard Weiss, Atoms for Peace, *Bulletin of the Atomic Scientists*, Nov/Dec 2003, p. 34

The second motivation was to limit the arms race with the Soviet Union. The U.S. and the Soviet Union would both contribute uranium to a "uranium bank," administered by a new "Atomic Energy Agency," in quantities that the U.S. could afford to give up without compromising the U.S. position in nuclear arms but which would limit further Soviet nuclear weapons development.

Eisenhower proposed that the uranium in the uranium bank be used to "provide abundant electrical energy in the power-starved areas of the world" and for other peaceful purposes. This was a brilliant formulation, uniting the goal of nuclear *arms* control with peaceful use of the atom.

Of course, the Eisenhower approach rested on what was ultimately a false assumption: that there was such a limited supply of uranium in the world that civil uses would automatically limit military uses. In addition, it was thought that uranium supply through an international agency would be enough to control what was done with that limited supply of uranium. For this reason, Eisenhower saw no need to control fuel processing technology or facilities, a departure from the earlier Acheson-Lilienthal view.

The Soviet Union, not surprisingly, saw the Eisenhower uranium bank as preserving an arms imbalance. The Soviets also pointed out that uranium could be used to make plutonium, which could also be used for weapons, and thus the uranium bank would not control the making of weapons by anyone who wanted them.

Ultimately, the multinational control of fissionable material was abandoned and national competition to supply the world with the benefits of civil nuclear power broke out. The U.S. Atomic Energy Act was amended in 1954 to allow private industry to develop nuclear power. Large amounts of previously secret information, including plutonium extraction, were released in connection with the 1955 U.N. Conference in Geneva.

Instead of waiting and working through the U.N. and the new IAEA (established in 1957), the U.S. wrote bilateral Agreements for Cooperation with many nations. The first of these was with Turkey, the second with Israel; many more followed. The U.S. supplied heavy water to India, which the latter ultimately used in a Cirrus reactor from Canada to make plutonium for nuclear weapons. Other nations followed the U.S. in an industrial competition to supply reactors.

The U.S. did not provide fuel cycle facilities in its export activities, instead using its monopoly in uranium enrichment to provide fuel for reactors it sold (Russia is doing much the same today). Other would-be reactor suppliers, such as France and Germany, could not supply fuel. To compete with the U.S., they instead included fuel cycle facilities as sweeteners in reactor sales. France and Germany considered or negotiated sales including pilot reprocessing or enrichment plants to Brazil, Iran, South Africa, Pakistan, South Korea and others. France supplied a research reactor to Israel that was used to make plutonium for weapons. Russia assisted North Korea in developing its Yongbyon Nuclear Research Center, which ultimately used a research reactor to make plutonium. The U.S. and other industrial nations trained the nuclear engineers who ultimately directed national weapons programs.

Instead of being the primary vehicle for controlling the spread of sensitive nuclear materials and technology, the IAEA was forced to play catch-up with nationally-backed nuclear sales. In some ways, the Nonproliferation Treaty (NPT), which entered into force in 1 970, was less an instrument of control over nuclear activities than a partial codification of the international status quo. Indeed, the U.S. entered into more than a dozen Agreements for Cooperation with nations that had not signed the NPT.

The Carter Policy

By 1976, it became clear to the U.S. that the rapid spread of nuclear fuel cycle technology and materials posed a grave proliferation threat. The main focus of the U.S. was on plutonium, given the very limited spread of enrichment technology at the time.

A number of efforts were made before President Carter took office. The Congress passed the Symington Amendment to the Foreign Aid bill, cutting off U.S. aid to countries importing or *exporting* enrichment or reprocessing equipment without guarantees of safeguards on all nuclear power activities.

In 1976, Senator Abraham Ribicoff proposed a market-sharing approach to reactors sales to eliminate the need for sales of enrichment and reprocessing technology in reactor competitions. He also threatened "a cutoff of enriched uranium fuel to *supplier* nations that refuse to join in meeting basic nonproliferation objectives."

In response to a question following his April 1977 announcement of changes in U.S. nuclear policy, President Carter echoed Senator Ribicoff, saying: "If we felt that the provision of atomic fuel was being delivered to a nation that did not share with us our commitment to nonproliferation, we would not supply that fuel."

The 1978 U.S. Nuclear Nonproliferation Act codified this approach, promising assurance of supplies of low-enriched uranium fuel in exchange for acceptance of stringent and retroactive new U.S. conditions on U.S. supplied nuclear materials and technology. These conditions would also apply to other supplier nations using U.S. materials or technology.

In 1979, I co-authored an article in the journal Foreign Affairs critiquing the new U.S. policy, because it would not work and would likely be counter-productive.[2] At this time, the U.S. was rapidly losing its monopoly control of the enriched uranium fuel cycle and its actions would only accelerate the development of independent enrichment capabilities. Indeed, I called attention to the enrichment activities of Pakistan in the 1979 article.

Moreover, the heavy-handed U.S. approach would drive even its allies to larger commitments to plutonium fuels, then seen as a substitute for the enriched uranium for which many were dependent on the U.S. This was the exact opposite of what Carter wanted.

The Bush Fuel Cycle Proposals

The recent Bush Administration proposal is, in many ways, the Carter policy writ slightly larger - adapted to a world in which the U.S. *appears* to share control of the nuclear fuel cycle and fuel cycle technologies with only a few other countries.

- "The world's leading nuclear exporters should ensure that states have reliable access at reasonable cost to fuel for civilian reactors, so long as those states renounce enrichment and reprocessing.

- "The 40 nations of the Nuclear Suppliers Group should refuse to sell enrichment and reprocessing equipment and technologies to any state that does not already possess full-scale, functioning enrichment and reprocessing plants."

The first of these policy statements represents a positive inducement, like the Carter offer of guaranteed fuel supply. However, the second is quite restrictive and would prevent Australia, Canada, Spain and other quite safe countries that are also close U.S allies in nonproliferation from building fuel cycle facilities.

It is understandable that the U.S. does not want to appear to discriminate, but many will suspect commercial motives in the second leg of the Bush policy statement. By limiting new competition, U.S. companies would benefit. The latter might also hope to secure government support or subsidy on national security grounds.

Like the Carter policy, the two legs of this policy are mutually contradictory. If the primary objective is to ensure that recipient nations have access to low-cost sources of supply of fuel from suppliers acceptable to them, then the U.S. should encourage multiple new sources of supply from proliferation-safe countries, without U.S. strings attached.

The U.S. needs to understand that, for many nations, it is not the first choice for secure low-cost supply of enriched uranium fuel. Nor do European enrichers have the spare capacity to meet increased world needs.

The proposed U.S. limitation on choices of supply are *more* likely, not *less* likely, to induce countries to make new commitments to enrichment or reprocessing facilities, or to give credence to claims from countries such as Iran or Brazil that they can be a alternative supplier to other nations.

IS THE NUCLEAR FUEL CYCLE RESPONSIBLE FOR PROLIFERATION?

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[2] Thomas L. Neff and Henry D. Jacoby, "Nonproliferation Strategy in a Changing Nuclear Fuel Market," *Foreign Affairs*, Summer 1979, p. 1123,

Perhaps the most fundamental question, not just about the Bush proposals, but about the long history of proliferation concern about the nuclear fuel cycle is what role it has actually played in proliferation.

In theory, the construction of nuclear fuel cycle facilities could be a cover for a weapons program. Or, as Ernie Moniz and I argued in a 1978 article, national fuel cycle facilities put nations closer to weapons without having to actually make the decision to commit to them, a process we called "latent proliferation."[3]

However, the fact is that the civilian fuel cycle has *not* been a significant contributor to proliferation. Those nations that wanted nuclear weapons have gone straight for them.

Israel, India and North Korea used research reactors. Pakistan stole centrifuge technology and applied it directly to its weapons program; it did not justify the program as civilian in nature. Iraq had a centrifuge program, fully destroyed by international inspectors after the Gulf War, without any civil nuclear power justification. Iran spent nearly twenty years on a clandestine enrichment program but only when this program was discovered did it claim it was for civilian purposes. Libya had centrifuges but no civil nuclear power program.

Clearly, reprocessing and enrichment technologies are serious proliferation dangers, but the civilian nuclear fuel cycle has, at least to date, not facilitated weapons proliferation. Nor has it been used for cover in a weapons program. If so, proposals to ensure "access at reasonable cost to fuel," or to severely limit who can supply conventional fuel, may not help with the real problem.

While there have been serious leaks of technology from the traditional supplier nations, which need to be stopped, the new proliferation problem arises from the fact that the basic technology for reprocessing and enrichment has already leaked. Moreover, the world-wide spread of engineering and materials capabilities, combined with computer-controlled manufacturing able to produce huge numbers of precision parts, means that would-be proliferators can out-source most of their activities in ways that are difficult to detect or stop.

These problems are very difficult to attack. It is perhaps understandable that governments seek to define problems in ways that are easier to solve, or to define them in ways where the solution is beneficial to them or their industries. But we should not believe that we are actually solving the real problem.

I believe it is too late, perhaps by several decades, for the restrictive fuel cycle approach taken by the Bush Administration. Instead, we will have to focus on the regional conflicts that cause nations to choose nuclear weapons, and we need to do so in ways that respect the interests of those nations and their neighbors.

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[3] Ernest J. Moniz and Thomas *L* Neff, "Nuclear Power and Nuclear-Weapons Proliferation," *Physics Today,* **April 1978, p. 42.**