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Nuclear Proliferation and Power:

Choices for the Future

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NUCLEAR PROLIFERATION AND POWER: CHOICES FOR THE FUTURE

The world is faced with the sobering reality that within a decade nuclear weapons may be found everywhere, in abundance. Terrifying as the thought may be, one estimate is that by 1990 nuclear reactors will produce enough plutonium for 30,000 Hiroshima-sized bombs per year - in the Third World alone. We must explore ways to contain the spread of nuclear weapons and access to nuclear weapons material. If we are to survive, mankind must find the key to controlling nuclear weaponry without denying nations the chance to satisfy their energy needs. Nations, while pursuing energy needs, must work collectively to align their policies with their stated goals for nuclear non-proliferation. The result of such an effort during the next decade will stand as a monument to our wisdom or our folly.

Among the myriad causes of our nuclear dilemma, five seem paramount: international failure to control the spread of nuclear devices; energy demand which exceed supplies; rising terrorism; the nature of nuclear power development; and proliferating knowledge about nuclear technology.

At the United Nations Atomic Energy Commission's first meeting, in June, 1946, Bernard Baruch proposed the creation of an International Atomic Development Authority, to "provide the mechanism to assure that atomic energy is used for peaceful purposes." The ensuing debate produced no agreement. From Baruch's speech to today, we have a long record of failure and near-failure at the international level. Nuclear test ban treaties, even with a loophole allowing "peaceful" underground explosions up to 150 kilotons (or ten times greater than the Hiroshima bomb) have failed to garner the support of all nations. Even the Non-Proliferation Treaty (NPT) does not command universal support. Many countries - including some in the nuclear club and others knocking at its door - are not signatories. There is no international control of the dangerous aspects of the nuclear fuel cycle, especially uranium enrichment and plutonium reprocessing. No attempt has been made to internationalize storage of nuclear waste. Safeguards are neither strengthened nor enforced. We have failed, so far, to bring national policies into accord with pronouncements of goals of nuclear non-proliferation. In the scramble for international prestige, national honor, and regional hegemony, nuclear weapons have become deadly pawns, the possession and proliferation of which bring instability and fear, rather than security, to a troubled world. The result is a balance of terror which may become unbalanced by proliferation.

The road to international agreement and control has become more difficult in the face of an increasing energy shortage. The 1973 energy crisis, with its ensuing OPEC boycott and sky-rocketing energy costs, thrust many nations toward the development of nuclear power and the breeder reactor to meet their future energy needs. Developing nations face enormous pressures to assure energy sources for their growing economies and populations. Some developed nations have a sophisticated nuclear industry which reflects the investment of billions of dollars, thousands of jobs, and the export advantage of a marketable product in great demand.

The energy shortage has promoted the belief that a wide-scale development of nuclear power is the only way to close the gap between energy demand and energy supply. The breeder reactor has evolved from conscious decisions and the direction of nuclear energy development in the past decade. A reactor which produced more plutonium than it used and the development of a reprocessing technology to reuse material from the "back end of the fuel cycle" became increasingly attractive. Inadequate alternate sources of energy coupled with the presumed shortage of uranium deposits made the breeder even more alluring.

But the breeder introduces huge amounts of pure plutonium into the fuel cycle and severely taxes the capacity of the international community to control the spread of nuclear weapons capabilities. At present, international safeguards cannot cope with the demands which plutonium societies will place upon them. Thus the energy problems of the world have become inextricably intertwined with the threat of nuclear annihilation.

This threat reaches beyond the motives of any existing government. International lawlessness and terrorism are endemic in our world. Individuals and groups turn regularly to any available means to achieve their goals - without regard for morals or responsibility. They operate beyond the pale of restraint or responsibility, heedless of diplomatic pressure, triggered by events over which no nation or group of nations can exercise complete control.

In Argentina terrorists invaded and took control of a nuclear power plant - fortunately one that was not yet operational. Air liners have been hijacked by a single individual. In 1968 the freighter Scheersburg was "relieved" of a load of 200 tons of treated uranium - enough to make 30 nuclear bombs. If a clique of Moluccan fanatics can take over trains and schools in Holland; if an elite commando group can pull off a daring Entebbe raid; if a handful of terrorists

can overrun the Olympics; then who is to say that our present system of protecting nuclear materials is beyond the reach of terrorists or of the revolutionary groups which may overthrow governments. Such forms of international lawlessness present a constant threat to nuclear security.

Heretofore, we have felt some security from the specter of terrorist control of nuclear weapons because of the nature of nuclear technology. The data was forebodingly difficult for all but a few scientists, and the material was so dangerous to handle that workers commonly manipulated it with remote tongs from behind the protection of lead shields and special glass many feet thick. The cost of enriching fuel to reach explosive levels put the process out of reach of most countries, let alone individuals.

But technological developments have destroyed most of these built-in safeguards. No lead shield is needed to handle pure plutonium. You can safely carry it in your briefcase. It does not need enrichment; it only needs to be separated from other wastes. Once separated - a process which is fortunately still reasonably expensive and technologically sophisticated - it is easily converted into explosive devices.

The information once so guarded and classified that major national efforts went into developing a bomb is now reasonably available in unclassified documents. The explosion of knowledge provides the conduit through which increased prospects of proliferation pour in upon us. Recently, as an independent study, a Princeton undergraduate designed a functional atomic bomb solely from information which is publicly available. He estimates his bomb could be built for \$2000 plus the cost of the plutonium. He initiated his project to determine how difficult it would be for a terrorist group to build a bomb. His project was so successful that part of his college paper is now classified, and he has been approached by foreign governments for copies. The nuclear scientists who evaluated his work say his bomb is more sophisticated than the Hiroshima bomb. But even without the technology, plutonium is a threat. It is so lethal that it could be distributed through the water system of a city or the ventilation system of most buildings with lethal effect - and no explosion would be necessary at all.

We should remember that the back end of the breeder reactor's fuel cycle produces plutonium in great quantities, mixed with other wastes more dangerous to handle. Once separated from those wastes and ready for recycling - at the point where the plutonium can be used as a fuel - the plutonium is only a few days or weeks and a few dollars away from being a nuclear bomb of enormous destructive capacity. Those few weeks are

far too short for normal diplomacy to work.

This combination of international lawlessness and the availability of nuclear materials and technology creates the opportunity to destroy the world. As nuclear knowledge and nuclear energy proliferate, this danger will become more acute, until, I fear, the odds will soon favor our annihilation rather than our survival.

We need a comprehensive international policy, with maximum adherence and participation, to reduce the prospects of proliferation. We cannot hope to eliminate proliferation of nuclear weapons entirely, but we must do everything possible to reduce the probability of such proliferation. Let us consider some concrete steps nuclear supplier nations, non-nuclear countries, and international organizations might take.

The agenda for action is demanding. We need to re-examine our commitments to breeder reactor programs, explore alternative technologies, assess the prospects for an international fuels assurance program to guarantee the availability of nuclear fuels, eliminate incentives for nations to acquire reprocessing capabilities, devise an international nuclear fuels leasing system, analyse the possibilities of internationalizing the fuel cycle, stimulate the development of non-nuclear energy in nations around the world, establish international safeguards against terrorism, and launch diplomatic efforts to achieve the goals of non-proliferation.

I believe we have not come too far down the plutonium road. We must collectively re-evaluate our basic assumptions and original projections. We should take the time necessary to examine fuel cycle alternatives to the breeder and reprocessing, in quest of technologies which minimize proliferation and physical protection risks. President Carter has deferred indefinitely the commercialization of reprocessing and is restructuring the U.S. breeder reactor program with the hope that a more proliferation-resistant technology can be developed. The development of such a technology is worth the investment of many millions of dollars and should be the goal of major investigative research programs by all concerned nations.

One of the basic assumptions we should re-examine is the *raison d'etre* for a plutonium economy. From about 1973 forward, projections of plans for future nuclear power increasingly focused on the development of the breeder reactor and reprocessing technology. The assumption has been that reprocessing would begin when there were sufficient light water reactors

to justify the large facilities needed to make reprocessing economically feasible. Plutonium would be recycled in light water reactors until the fast breeder reactors were introduced. The breeder would then generate large amounts of plutonium. The additional risks of widespread use of plutonium were justified in the minds of its advocates because it was presumed to be economical and necessary, given energy demand projections and estimates of uranium deposits. It now appears that projected demand curves were extremely high and estimates of uranium supplies low.

Advocates of breeder and plutonium fuels have underestimated world-wide supplies of uranium deposits and exaggerated the energy demand for the next decade. Known uranium supplies have increased about 6% per year on a world-wide basis during the last decade. During the past three years, energy demand projections have been revised downward. For example, official targets for 1985 for European Economy Community nuclear capacity have declined from 200 gigawatts in the 1974 projections to 74 gigawatts in 1977, a decline of 63%.

There are other serious flaws leading to the need for a reassessment. There is reason to question whether recycling plutonium in light water reactors will be economically advantageous. At most, it now appears marginal. Nor does such recycling assure plutonium independence. Finally, evidence suggests that disposal problems would be exacerbated, not alleviated, by the reprocessing of waste. Certainly there can be no question that proliferation of weapons-grade material to the point of ready availability is causing serious reappraisal among top U.S. government officials and citizens alike. There is growing belief among many that technologies which utilize the "back end" of the fuel cycle pose serious problems.¹

1

The nuclear fuel cycle includes all facets of the process of obtaining uranium, mining, milling, converting it to a fuel by the enrichment process, and then utilizing it as a fuel - this is the so-called "front end" of the cycle. The "back end" of the nuclear fuel cycle includes any reuse or reprocessing of the spent fuels and separation of plutonium from other nuclear wastes, plus providing for a permanent waste storage program with adequate environmental safeguards.

In sum, the problems of proliferation, the question of storage, and the rising doubts about economic feasibility of plutonium usage should prompt us to solve our energy problems by other means than the breeder reactor with its companion reprocessing technology. Re-evaluation of the basic assumptions underpinning plutonium economies has widespread international ramifications.

We need to fully explore alternative technologies. We should encourage the use of heavy water reactors and the conversion of light water reactors to heavy water. We need to find ways of increasing once-through uranium utilization for remaining light water reactors. Developing non-plutonium breeders is a possibility. The development of thorium reprocessing technology could greatly assist nations rich in thorium deposits. Finally, we must control the spread of laser enrichment technology and centrifuge technology. As we develop alternatives to the reactor, we can also implement programs to encourage nations to turn away from the plutonium technology.

A successful system of nuclear non-proliferation should probably include an international-level assurance program which would guarantee supplies of non-weapons grade nuclear fuels on a timely, adequate, reliable, and economic basis. Natural uranium and enrichment services must be reasonably priced and free from interruptions due to political or foreign policy interference. Parallel policies among suppliers of nuclear materials should avoid placing any reactor exporter at a commercial disadvantage damaging to common non-proliferation interests. An international fuel assurance system can and must remove incentives for nations to acquire full fuel cycles, prevent discrimination against consumers who fulfill their non-proliferation obligations, and discourage dependency of buyer nations upon possibly capricious supplier nations.

Such a program must be buttressed by multinational agreements in which suppliers substantiate guarantees to buyers by backing each other's fuel contracts. It should also assure fuel supplies to reactor countries which have no indigenous fuel capabilities and resources. An International Fuel Bank, perhaps under the auspices of the International Atomic Energy Agency (IAEA), is needed. As an added assurance, regional nuclear fuel repositories, storing perhaps a year's working inventory of fuel per country, might be developed to insulate users from potential interruption of their access to enriched uranium.

Creating incentives to reduce the non-nuclear nations' desires to acquire reprocessing capabilities would help facilitate non-proliferation.

Dealing with the spent fuels from the back end of the cycle is a critical problem. A system of leasing nuclear fuels, rather than selling them, could require the return of used fuels to the supplier nation or to a multinational fuel reprocessing center. This would eliminate any reason for a non-supplier nation to reprocess plutonium and use it as a fuel. By keeping plutonium out of the hands of non-suppliers, such a program would substantially reduce the chance of weapons-grade material being stolen or diverted for terrorist uses.

User nations would have no need to store wastes and spent fuels or to build and operate uranium enrichment plants for energy programs. Any reprocessing plant construction, then, would signal an attempt to provide weapons-grade uranium for a nuclear armament program. In such a leasing system, supplier nations or organizations would own and lease nuclear fuels at a fee based upon the energy content of the spent fuel, when it was returned to the supplier.

In the absence of a workable leasing program, the IAEA could establish multinational regional centers to produce enriched uranium, reprocess used fuels, store fissionable materials, convert such materials into nuclear fuel elements, temporarily store spent fuels, and permanently manage disposal of radioactive wastes. Such an internationalization of the complete nuclear fuel cycle is well worth our consideration.

At the back end of the fuel cycle, adequate storage for spent fuel and nuclear wastes is urgently needed. Providing storage would further alleviate the pressure for reprocessing capability. The adoption of a leasing arrangement or of international control of the cycle would reduce this pressure for reprocessing capability while minimizing the problem of security at waste depositories by reducing the number of such sites.

There is no need to deny needy nations the use of nuclear energy, and it would certainly be gratuitous for nuclear states to propose such an arrangement. What is essential if proliferation is to be kept at a minimum is to prevent the spread of reprocessing technology and thus limit the availability of weapons-grade uranium or plutonium.

It is hardly necessary to say that non-nuclear energy alternatives need to be developed to the maximum. Providing non-nuclear states with economically competitive supplies of coal, oil, and synthetic fuels can reduce their need for nuclear power. Technical and financial assistance to develop indigenous energy sources should be provided, perhaps through IAEA. All these non-nuclear initiatives can help discourage states from

acquiring nuclear weapons capabilities.

Another essential step in controlling proliferation is to improve our defenses against theft, diversion, or sabotage of nuclear materials and facilities by terrorist groups. These safeguards, under the IAEA, should include stricter international standards for the physical protection of nuclear materials, installations, and the transport of nuclear materials. One possible consideration is an international nuclear security force to protect international shipments of nuclear materials, including wastes containing plutonium. In any event, we must bring the various IAEA safeguards systems up to a uniform standard, with emphasis on personal inspection. We should also improve technologies, instrumentation, and equipment for national and international safeguard systems. A more accurate material accounting system at all levels should give us an accurate tally of nuclear materials and plutonium resources at any time. Finally, we need to establish international procedures which would give us the means to respond quickly in the case of the theft, diversion, or sabotage of nuclear materials or an attack on nuclear facilities.

In addition to considering these steps in the areas of energy problems and terrorist access, we should examine efforts which could be taken in international affairs to control proliferation. Although the post-World War II efforts have not been very successful, we should explore all possibilities that still exist in this area.

First, diplomatic initiatives to reduce general world tensions and resolve specific conflicts between nations could reduce the pressure on non-nuclear nations to acquire nuclear weapons technology. A second important step would be strong efforts to encourage more nations to ratify the Non-Proliferation Treaty and to forswear the use of nuclear weapons. The NPT represents an international system in which states agree that their security interests are best served by avoiding the further spread of nuclear weapon capabilities. The essence of the treaty is a compromise in which discrimination between nuclear and non-nuclear nations is accepted in the military sphere in return for nuclear fuel assurances, and energy benefits in the civil sphere. Beyond the NPT, we need to conclude a comprehensive nuclear test ban treaty which reduces the level of "peaceful" underground explosions to well below 150 kilotons.

Concerning exports, it is important that nuclear supplier nations limit the export of nuclear materials to natural uranium and low enriched uranium and that they prohibit the export of weapons-grade enriched uranium and plutonium, except as a constituent of fabricated nuclear fuel. It may

also be necessary to ban exports of nuclear power reactors that require highly enriched uranium as fuel. Further, the world needs at least a three to five-year moratorium on the export of reprocessing plants. In essence, supplier nations should not export technology, plants, or equipment or provide technical and financial assistance for the construction and operation of facilities to enrich uranium or produce plutonium. Progress in negotiations among the nuclear suppliers in this respect is encouraging but need to be extended through legislative action to support the concept that the best international export policy for reprocessing plants is not to export them at all.

Another policy option - extreme but useful for discussion - involves exercising international sanctions against violators, once an agreement is reached on universal international non-proliferation policies. Diplomatic pressures exists which nations could apply to other countries to bring them into compliance with the stated goals of non-proliferation. Nations which construct and operate enrichment or plutonium production facilities in violation of NPT commitments or IAEA safeguard agreements, nations which develop and test nuclear explosives, nations which provide a haven for nuclear saboteurs might all be the target of such sanctions. Nuclear supplier nations could apply sanctions or take other action against such nations and against any supplier nation which helps a non-nuclear state acquire the capacity to produce weapons-grade nuclear materials. States could cut off nuclear assistance or economic aid to non-weapons states which would not either ratify the NPT or agree to IAEA inspections of their nuclear facilities. Such a course, while being both extreme and hard to realize, is still worth some consideration.

Conclusion

In conclusion, nearly everyone today sees the danger of continued nuclear proliferation. We admit its danger. Now is the time for our nations to examine old assumptions, accept the new realities of proliferation, and bring policy in line with rhetoric. In our world, nations must work together to establish a fuel assurance system which guarantees energy supplies without increasing weapons-grade fuels. We must explore the need for an international fuel bank, a leasing system for nuclear fuels, and internationalization of the entire fuel cycle. We must encourage the development of a less dangerous nuclear technology than the breeder and of non-nuclear energy sources. We need a basic re-evaluation of the breeder reactor program. International safeguards against terrorists must be strengthened. On the diplomatic front, we must take initiatives to reduce world tensions, reduce the need for nuclear weapons, encourage more nations to join the Non-Proliferation Treaty, reduce or eliminate "peaceful" nuclear tests, curb exports of enriched uranium,

plutonium, and reprocessing plants, implement a moratorium on nuclear export sales, and consider sanctions against nations violating the NPT:

We must pledge ourselves to this and more. For our children and their children, we must act now to reduce, perhaps someday to eliminate, the spread of nuclear weaponry which today so tragically shadows the future.

