

U. S. REPROCESSING AND NONPROLIFERATION POLICY

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ABSTRACT

On April 7, 1977, President Jimmy Carter announced a new U. S. policy which he said was aimed at protecting the world from the proliferation of nuclear weapons. His Presidential Policy stated that after full evaluation, he had concluded that the U. S. would “defer indefinitely the reprocessing of spent nuclear power reactor fuel.”¹ He said that the U. S. would do this in order to set an example for other nations so that they would do the same.

Except for the nuclear industry and anti-nuclear activists, Americans didn't particularly give a damn. However, the governments of Britain, France, Germany, Italy and Japan were publicly surprised and confused. In private, they were furious. They didn't think it made any sense!

Jimmy Carter's Executive Order also cut support for further work to support the Barnwell reprocessing plant or the construction of the Clinch River Breeder Reactor, and reformulated ERDA's research priorities away from nuclear energy.

History shows that this action by the United States radically changed the trajectory of the global role nuclear energy would play. The administration started to exert pressure that affected energy decisions by other governments and provided encouragement to opposition parties that chose to make a political issue of nuclear energy.

INTRODUCTION

Political scientists ask the question, “Why do nations make the decision to obtain nuclear weapons?” Nations don't. Leaders do. There is no example in history of a decision to initiate either research on nuclear weapons or production of them following parliamentary debate or a plebiscite. National security is a necessary condition, but from that point on, things become complex, and hinge more and more on personal views and ambitions, access to power, the use of power by those in power, and the timing of disparate events.

The adoption of a policy to stop the processing of spent commercial nuclear fuel, on the basis of economic and nonproliferation arguments, illustrates the process in living color. History shows how partisan and technically confusing arguments led Presidents into actions which changed the future for a once-promising energy technology.

NUCLEAR POWER IN THE MID-1970'S

How did nuclear power go from the darling of comic books and brochures as the dream of the future to a pariah that was mysterious, dangerous and feared? Safety and technical problems alone weren't enough to explain it. The U. S. decision to halt reprocessing did make a difference.

But biographies of presidents hardly even mention the issue. This is true of dozens of books about Gerald Ford and Jimmy Carter (and even Henry Kissinger and Zbigniew Brzezinski). In 1976 the time was ripe, but more important, a significant number of people with very different agendas moved to create change, and succeeded. Some acted with little knowledge of what that change would mean.

Nuclear power was in trouble in the mid-1970's. Not because of technical problems alone, although there were safety and fuel cycle issues that demanded improvements, but social and political motives turned out to be most critical. The emergence of concerns over possible diversion and proliferation from reprocessing and enrichment cannot be understood in depth without careful examination of its relationship to the future role of nuclear power. And it was that future that was the real target of the antagonists.

Government, electric utility companies and a growing nuclear supply industry had confidence that nuclear power would supply a significant fraction of all future electric power plants. Major universities had opened nuclear engineering departments. The oil embargo of 1973 had awakened public interest in energy, and from Earth Day in 1970, environmental damage had become the hottest topic of television news and talk shows.

The National Environmental Policy Act became law in 1969. In the Calvert Cliffs decision, the DC Court of Appeals forced every nuclear plant license, current or new, to include an Environmental Impact Statement. In every case the environmental equation was found to favor the nuclear plant. The price was delay, huge costs overruns, and the opening of an entire range of opportunities for people, for whatever their reasons, not only to become involved in the process, but to be able to affect its course.

People came at nuclear power issues from many directions. Various critics expressed concerns about safety, waste disposal and radiation. They encountered an Atomic Energy Commission that up to then had been accepted as the sole arbiter of nuclear issues. The AEC and the nuclear industry had the expertise, and believed that if they could state their case, the public would accept it. The Commission grudgingly established a process to open its licensing decisions and rulemakings to the public. Some groups took the AEC up on its challenge.

However, this new movement was not some natural upwelling of emotion that had been ground down in the past. This phenomenon was created by individuals, many of whom had very different points of view and a curiously broad spectrum of interests. But they were all "anti-nukes" to people in the nuclear world.

Some were seeking fame and attention. Some were critical of business - - of capitalism in total. Others were interested in “the system” and in the opening of that system to participation by groups and interests that had traditionally had no standing at all. It was the post-Vietnam period, and some activists were looking for new causes and new targets.

It was the Environmental Era. There was a euphoria about alternative and decentralized energy sources. Perhaps concerned citizens could force companies to do things in a more human way, like providing the path to energy conservation rather than more and more energy waste. Here was a way that “the people could take back the control over their lives.”

For the first time, people could break the stranglehold that huge companies had over them. For the first time, they could open up debate on these subjects, and at the same time, influence the government to force innovation “in the right direction.” The media was filled with articles and documentaries that showed how polluters could be stopped and where the right direction really was.

The electric utility companies were clobbered by the opposition to power generating plants and to air and water pollution from them. What had been a “necessary evil” became a costly responsibility and had to be eliminated. Utilities could no longer count on state utility commissions to support them or political contacts to recognize their concerns.

Scientists and engineers in favor of nuclear power were interested in improving it, in solving problems, in making it safe and more acceptable. Alvin Weinberg suggested power parks and a “nuclear priesthood.” Edward Teller was sure that if you put them underground, the public would no longer worry about them. There were honest differences of opinion among designers about which system was better. Competition! Let a hundred flowers bloom! Why not?

But critics could seize on opposing views as a lack of confidence and signs of real danger. And when India exploded an atomic bomb, the deadly link between nuclear power and nuclear weapons was finally revealed for all to see. As Ralph Nader put it, “The nuclear industry has been lying to the people in its pursuit of obscene profits!”

GOING AFTER THE FUEL CYCLE

The policy against reprocessing did not kill nuclear power by itself, but it proved to be a major coffin nail - - along with “energy source of last resort,” appointment of avowed opponents of nuclear power to DOE and key regulatory positions, and “public participation in decisionmaking”.

As with most significant changes in policy, a number of unusual things came together at an opportune time. There were people who knew what to do to enhance their positions and interests, as well as people who failed to see the significance of events as they were being driven into place. But nuclear power and reprocessing were not brought down by

any confluence of trends. It was people were shrewd enough and lucky enough to make things happen.

Ted Taylor, a former Los Alamos bomb designer, was profiled in a fascinating book by writer John McPhee: "The Curve of Binding Energy."² McPhee was impressed by Taylor's openness and willingness to explain patiently the technology, warts and all. Taylor had put in a stint at the IAEA, and was becoming deeply concerned about possible diversion of plutonium from commercial reprocessing plants, once they were built. Taylor knew how to design bombs, and his message was that any nation that could get its hands on plutonium could become the next nuclear weapons proliferator, and may could soon do it! Taylor was also confident that if nuclear power could be eliminated, the world's electricity needs could be met by solar, wind and other environmentally benign sources.

Taylor won some believers on Capitol Hill. Then, when the Indian bomb exploded, there was an audience to hear the wake-up call. Sen. Charles Percy rushed to New Delhi to talk with his friend, Prime Minister Indira Gandhi. He spoke to her about Pakistan. "You have just done something that will be destructive of your own security!" Her scientists had sworn that the test was of a peaceful nuclear explosive, but the rest of the world was not at all convinced. (Years before India's next blast in 1998, India had dropped the peaceful explosion story.)

Congressional staffers were energized. Bills were introduced. A coalition of interested legislators and their staffs saw an opportunity to make the world safer. The NRDC sued to demand programmatic Environmental Impact Statements on the breeder reactor and then on the entire question of civil reprocessing and recycle (Generic Environmental Statement on Mixed Oxide Fuels - GESMO).

PROLIFERATION CONCERNS FACE PRESIDENTS FORD AND CARTER

The world's nuclear scientists had been concerned about weapons proliferation from the start. The atom was born for war, and the dreams of the scientists were to harness it for peaceful energy. But this could only be done if the threat of the peaceful atom being diverted to weapons could be kept under control. So the proliferation issue was hardly new as the presidential campaign of 1976 began.

The Nuclear Nonproliferation Treaty had been signed by more than a hundred nations. The International Atomic Energy Agency in Vienna was an active force, not just a dream. The literature of nonproliferation and arms control was as rich as that on nuclear energy. Nonproliferation had been the subject of countless conferences and international meetings. Carter had hardly originated the issue. But he raised it in the 1976 presidential campaign on the theme that the Ford administration had failed to take serious actions to halt the threat of proliferation.

In fact, the Ford administration had become the victim of its own nonproliferation efforts. In order to urge additional nations not to build commercial facilities that could be used to obtain

nuclear weapons material, diplomatic negotiations had to be carried on at a high level and with great delicacy. Ford was actually taking serious steps, but he couldn't tell his own voters about them.

The keys to obtaining weapons material were plants that could either enrich uranium or reprocess used fuel and separate plutonium. The U. S. had an effective monopoly for years in low-enriched uranium for civil power plants, but Russia, Britain, and a group of European nations led by France, possibly to include Iran, were building enrichment plants.

Reprocessing had been done to separate weapons plutonium at Hanford and Savannah River in the U. S. and at similar secret plants in the U. K., France, Russia and China. Although plans were being made for huge commercial reprocessing plants that could each serve 30 to 50 nuclear power plants, only pilot-size or demonstration plants had been operated with power reactor fuel, and the performance left a lot to be desired.

There were international deals in the making. Britain, France, Germany, Canada, and of course the United States, were in the global marketplace trying to sell nuclear power reactors to the growing number of countries. Even developing nations saw it as a way to electrify their economy for the future and also reduce their dependence on imported oil and gas. No deal was possible without creative financing. The market was limited and competition for every possible sale was intense.

Potential customers of France and Germany asked for sweeteners that could ultimately give a developing nation independent control over its entire nuclear fuel cycle: sweeteners like uranium enrichment and reprocessing plants. The only problem is that it is possible to make nuclear weapons if you have highly enriched uranium or separated plutonium.

If a sovereign nation has control of a plant that can make these materials, it could secretly and suddenly divert the product from its civilian energy needs. Arms control experts pointed out that if it had already secretly prepared the rest of the parts needed for atomic bombs, it could become a nuclear weapons state almost overnight. Policy analysts focused on the possible lack of "timely warning" during which diplomatic efforts could be made to dissuade the potential diverter from "going nuclear."³

The Ford administration prohibited U. S. reactor makers from offering any deal that included enrichment or reprocessing, so U. S. vendors were losing the market to France and Germany. The French signed deals including reprocessing with South Korea and Pakistan, and were negotiating with Taiwan, South Africa and Iran. (Bernard Goldschmidt, who headed France's nuclear activities, said to me, "We were bandits in those days!") Germany was negotiating a deal for a series of nuclear power plants in Brazil, with enrichment and reprocessing facilities as sweeteners.

When briefed, Ford was very concerned. These nuclear power programs would be small for many years, and couldn't possibly justify a commercial reprocessing plant for decades!

Sec. of State Henry Kissinger secretly flew to Pakistan to meet with Prime Minister Bhutto. Pakistan's top nuclear scientist, Dr. Munir Khan, and U. S. diplomat Myron Kratzer sat on a wooden bench outside the office as the lengthy meeting went on. (Kratzer had also carried on extended behind-the-scenes negotiations with the South Koreans and in Taiwan.) But Kissinger left Islamabad unable to convince Bhutto to cancel the reprocessing plant.

Deputy Secretary of State Charles Robinson met with the President of Brazil, who finally gave him a promise to give up the reprocessing plant his scientists had won from the Germans, but only on the condition that no news would ever be released that he had given in to American pressure.⁴ France took the position that they wouldn't actually deliver the reprocessing plant to Pakistan but they would never renege on the deal themselves. Things would be allowed to drag until the Pakistanis would finally walk away.

So while candidate Carter escalated his charges that the Ford administration was failing to act to stop global proliferation, the Ford campaign could take no credit for any of its hard-won progress.

Some anti-nuclear activists are quick to point out that it was Ford, not Carter, that first stopped nuclear reprocessing. But there were important nuances in the two statements. Crucial to the issue and to the findings of the research for this book, were the significant differences between what President Ford announced and what President Carter formalized five months later.

It was known that President Ford had requested a secret top-level government study that could lead to an administration policy on nuclear power and the nuclear fuel cycle. But no one in the commercial industry had access to it, and no one had been asked to appear at any hearings or even provide input specifically for it. Nevertheless, that seemed OK to the nuclear industry. Ford was solid; he had good advisors and staff, and he had not been making an issue of nuclear power anyway.

Then five days before the election, Ford did say something! In a campaign speech in southern Ohio, Ford said, "Controlling proliferation has to take priority over economic interests." And so, he said, he would put a hold on the startup of the new commercial reprocessing plant at Barnwell, South Carolina, until international safety and security issues were resolved.⁵

This was a surprise! Even so, there were reasons not to panic. Perhaps it could be taken as campaign rhetoric, and it was late in the campaign. Though Carter had scored points, nuclear proliferation still was not a hot-button issue. In fact, the real surprise was that Ford said anything at all.

Ford's words included a clear statement that he wanted to see nuclear power go ahead, but that with his advisers, he had concluded that efforts to stem proliferation had to take precedence over what they saw as mainly a domestic economic issue.⁶ They felt that within three years the problems with international safeguards could be successfully worked out.

SIGNS OF WARNING FOR THE NUCLEAR INDUSTRY

Anti-nuclear activists had placed nuclear shutdown initiatives on the ballot in five states. Environmentalists were increasingly vocal about radiation and nuclear waste, and safety issues kept popping up in the newspapers. Nuclear power was seen as “going down politically,”⁷ and the constituency which supported it was small and almost silent. In Congress, there were outcries against funding for nuclear waste handling facilities at Barnwell that sounded like, “We’ve got to stop the “Barnwell Bailout!”⁸

The Barnwell plant was already facing a couple of years of licensing hearings before it could win a license to start operations. And Ford said that we would consult with other nations to strengthen international safeguards for controlling plutonium. Who could argue with that? And on careful reading, the Ford statement left wiggle room. No one really could expect Ford to go out on a political limb for something like nuclear reprocessing, but the wording of the policy statement could actually allow Barnwell to start up without any additional delay.

Was Ford’s statement that he would delay reprocessing only a political response to Carter? The people who worked on it say it was not; that it was an honest attempt to buy time for technological progress and international consultation on nuclear material safeguards. But anyone who believes that a policy announcement in the last month of an American presidential campaign is not political hasn’t read any books or seen any movies. Then came the election, and Ford lost.

How about Carter? He campaigned against Washington and against politics as usual. But as I studied Carter and listened to expert analysts discuss him, I came away convinced that Carter weighed the politics of everything he did. He just wasn’t very good at it. He didn’t have the feel for the American electorate of a Johnson or a Truman, or even of a Gerald Ford, who had served almost two decades in the House of Representatives. Carter’s political judgments were driven by his belief that he could figure out “the right thing to do.” And since it was right, once he could explain it to the people, they would come along with him.

During the campaign, candidate Carter had used nuclear proliferation in two major speeches, and he often mentioned his concerns along with his nuclear engineering training when on the stump. His naval service under Admiral Hyman Rickover had been the platform for the book that he used to kick off his campaign: “Why Not the Best?” (But when the book first appeared, Rickover didn’t remember him.)

Even early in the campaign there were rumors that Carter had been meeting with anti-nuclear activists. But after all, the nuclear industry people figured, this was a political campaign, and he had to be open to all kinds of ideas. Anyway, Jimmy Carter had served in the Nuclear Navy. When and if the responsibility of office came to him, he would surely have to be realistic.

Even before the election campaign began, a group of distinguished scholars with support from the Ford Foundation had begun studying the issue. They worked hard, and prepared a report titled “Nuclear Issues and Choices.”⁹ It was also known as The Ford-Mitre Report because

the Ford Foundation funded it and the Mitre Corporation administered it. The Japanese fearfully called it “The Black Book” because of the color of its cover.

This book was provided to President Carter in February 1977, just after he took office, and just in time to become the basis for his nuclear policy. While the work was scholarly, it was never subjected to any outside review or debate. In fact, that step was specifically avoided.¹⁰ A number of members of the Panel were selected for posts in the Carter administration¹¹

The Panel was constructed of economists, geologists and arms control experts, but specifically excluded anyone from the energy or nuclear industries or any anti-nuclear activists. It was the Panel’s position that if industry experts were included, they’d have to have activists, and this would polarize things, just like in every other study. They were confident that they could listen to presentations by various interests and read the pertinent literature.¹² Then, when they arrived at their conclusions, there would be no need to expose them to outside review before providing them to the President. Their report would be the most scholarly and unbiased analysis available.

While formulating their position, they were very selective about the inputs they used. Operating without publicity, they invited various experts from the weapons laboratories, activist groups and the nuclear industry to present views. However, there is no evidence that they ever subjected their proposed conclusions to outside review or debate by any of these persons. They were self-satisfied that they had found an appealing solution, a wise and almost obvious compromise that should solve the major dilemma without creating any major dissatisfaction with the affected constituencies. They discounted warnings in written reports and interviews that their compromise would have serious negative impacts.

The basic position that was accepted by the Panel, the Carter Administration, and some leading committees in Congress (as well as by a number of influential people in the Ford Administration who had not even heard about the Ford/Mitre study) was that reprocessing offered little or no economic benefit, so if it also carried additional proliferation risks, it was logical to avoid it. It appealed to Carter because it sounded like a “comprehensive solution.”

On April 7, 1977, President Jimmy Carter announced a new U. S. policy which he said was aimed at protecting the world from the proliferation of nuclear weapons. His Presidential Policy stated that “after full evaluation” he had concluded that that the U. S. would “defer indefinitely the reprocessing of spent nuclear power reactor fuel.”

The Carter policy was supposed to prevent proliferation, but it didn’t seem to do that. It was supposed to allow nuclear power to go ahead, but it actually put a dark cloud over its future. It was supposed to be something that other nations would be persuaded to go along with, but there didn’t seem to be much chance of that. In fact, it radically changed the entire premise on which nuclear power development had been based in the U. S. and the rest of the world.

Carter's advisors had told him that reprocessing was the way to separate plutonium, and that atomic bombs could be made from separated plutonium. What's more, their studies had told them, reprocessing to recycle the plutonium as nuclear fuel wouldn't save much money, and rather than the world running short of uranium, and there was much more in the ground than previously believed. So if there were no significant economic need, and the technology increased the risk of proliferation, obviously it made no sense to go ahead with reprocessing.

ECONOMICS

The analyses that showed reprocessing to be uneconomical were simple projections of the cost of MOX (a mixture of recycled plutonium and uranium) vs. standard low-enriched uranium. The arithmetic was correct. The projections were straight lines that reached equal cost in some future year. But this approach ignored real economic factors like spent fuel storage capacity and costs, changes in fuel costs and the uranium market with and without the policy change, costly delays in disposing of radioactive waste, and the impact of losing public support for nuclear energy. This, in fact, was the goal of some groups that lobbied for a policy to stop reprocessing.

Ironically, the Environmental Impact Statement was supposed to enlighten the public (and policymakers) about the real economics and potential environmental impact of any major Federal action. The process simply did not happen in this decision.

REACTOR-GRADE PLUTONIUM

Plutonium of "weapons-grade" is the material that nations have chosen for their nuclear arsenals. It is mostly Pu-239, with generally less than 8% of other plutonium isotopes. These other isotopes emit much more radiation and heat, and some undergo spontaneous fission. Plutonium extracted from spent fuel of commercial power reactors has about 20% or more of these other isotopes, and is called "reactor-grade" or high-burnup plutonium.

Although the secret was kept for decades, it is definitely possible to make nuclear explosives from reactor-grade plutonium. That does not mean that it will happen that way, nor that stopping the separation of plutonium would stop proliferation. Producing plutonium is expensive, but the plutonium represents only a few percent of the costs of a weapons system. It is not likely that a nation would spend a huge amount of its resources and put them all at risk by using undesirable plutonium from power reactors when better material could be manufactured secretly. But that was the scenario that the policy was designed to stop.

By and large, engineers and scientists engaged civilian nuclear power programs had not put much attention into proliferation. People working on reprocessing had, but in terms of the necessity for material safeguards and not in weapons design. These areas were classified, and the assumption was that the right experts were on top of the critical issues. The reasoning was that there was going to be a lot of plutonium in reactor spent fuel and the government was not interested in it. There must have been good reasons why not!

Dr. Michael May, former director of the Livermore National Laboratory wrote in an article in American Scientist:

“In general, reactor-grade plutonium has been left in the reactor long enough (three to six years) to accumulate a significant proportion of the higher and more radioactive isotopes. It is poor stuff for nuclear weapons because the heat generated by its radioactivity makes weapons construction more complicated and handling more difficult. Also, neutrons resulting from spontaneous fission during storage can make a weapon’s yield unreliable. No nation has chosen to use it. Nevertheless, reactor-grade plutonium could be used to make weapons.”

The late Carson Mark was Director of the Theoretical Division at Los Alamos. He said, “I wrote papers on the explosive properties of plutonium isotopes. That was news to some people. I said that the high neutron source did not prohibit the possibility of making meaningful explosives. Whether anybody would want to is a separate question.

“We made one experiment with highly irradiated plutonium (a special test carried out in 1962). It has been misinterpreted as proof that you can make weapons out of reactor-grade plutonium. That thing really wasn’t a weapon. It was a very small explosive. It couldn’t have been predetonated, and the yield was very small.

“And the reason for the test, which was met by the test, was to ensure that our calculations of that material [nuclear cross sections] weren’t mistaken. We knew it would explode. We calculated that it should behave a certain way. We confirmed that it did behave about that way.”¹³

Nevertheless, Ted Taylor, popularized his message in magazine articles”

“You can design reliable nuclear weapons with any mixture of plutonium isotopes. Contrary to the widespread belief of nuclear engineers who have never worked on nuclear weapons, plutonium from nuclear power plant fuel can be used to make all types of weapons. The connections between nuclear technology for constructive use and for destructive use are so closely tied together that the benefits of one are not accessible without greatly increasing the hazards of the other.”

To a nation that message sidesteps the realities. "Design" is one thing. Equipping a military force, fabricating and storing nuclear weapons at the ready (including on a submarine) is something different. And engineers who actually know about nuclear weapons know the difficulties and drawbacks of trying to use reactor-grade plutonium.

The conclusion is that it is not impossible to build nuclear explosives with high-burnup plutonium, but the drawbacks for an actual weapons system are so serious that no nation has chosen to do it.¹⁴

If a nation requires nuclear weapons to attack or threaten others, or to deter attacks by others, it must have more than a couple of weapons. They must be reliable in order to be sure that a threat can be carried out. They must be stored so that they are ready at any time. A single bomb could cause great damage, but its military value to a nation is a different question indeed. Obviously, plutonium must be safeguarded from theft by terrorists, but this is a different threat than government diversion from civilian fuel.

WHERE WAS THE RESPONSE?

The nuclear industry did not see the policy coming, and totally failed to mount an effective public counterattack. The weapons laboratories did not offer any response to the confusing and limited information, and were effectively precluded from communicating their views to the public. The breeder reactor development program (a key target of President Carter) continued to fight for survival. Supporters of nuclear power in Congress kept it alive for a few years, but by 1981, Republican-led budget-cutting committees finished off what the Carter strategists had started.

One part of the Carter policy was the International Fuel Cycle Evaluation. The U. S. called upon all the other nuclear nations to take part. Its purpose was "to buy time to explore alternatives to reprocessing." It cost three years, without finding any. And in 1978, Congress passed the Nuclear Nonproliferation Act that enforced Carter's policy.

Although Ronald Reagan rescinded the Carter policy in 1981, the industrial momentum and confidence had been lost, and no efforts were made to revive reprocessing in the U. S. Other nations did go ahead, but political opposition, not just to reprocessing but to nuclear power itself, grew worldwide.

President Clinton put parts of the Carter Policy back in place in 1993. Perhaps its impact can be seen in the role the U. S. has played in efforts to eliminate excess weapons plutonium. Pressure from activists has precluded actions that could be seen as "legitimizing reprocessing." This has delayed and even prevented adoption of cost-effective and perhaps vital actions that could reduce international nuclear tensions and aid in cleaning up radioactive legacies from old weapons programs.

The delays and political opposition to America's high-level waste repository efforts will be hard to explain to future generations. Spent fuel can be disposed of just as safely as HLW; the presence or absence of plutonium has no significance to safety or

environmental performance of the repository. In 1980, nuclear scientists felt that burying any spent fuel without extracting the plutonium for its fuel potential would be an environmental crime and an unforgivable waste of natural resources. Now, the most important thing is to demonstrate that the nation is capable of putting any HLW in any form deep in the Earth, but political opposition has grown, and the program is three decades behind schedule.

In May 1998, almost exactly 24 years after the 1974 wake-up call, India tested again. Despite days and nights of U. S. pressure and top-level negotiations, Pakistan reciprocated. The nonproliferation regime had been breached again. As this is written, an uneasy truce exists between two embittered neighbors in South Asia. India still talks of national security with reference to China, and only mentions Pakistan with reference to Chinese export of weapons technology. Pakistan talks of India. Both repeat the familiar attacks on unfair domination by the five nuclear states. And North Korea remains a nuclear question mark.

What impact has U. S. policy against reprocessing had on these nations and their weapons programs? What about their energy futures? The startup of THORP in Britain was delayed for years by formal public inquiries. In France, commercial reprocessing and recycling is a reality, but costs and public opposition have almost halted breeder reactor development. The full-size Japanese reprocessing plant also faces dangerously climbing costs and politicians continue to bicker about the whole advanced nuclear power development program.

One thing is clear: the dream of the contribution that nuclear energy might make has come a long way, but it is now on hold. Fear of proliferation and opposition to the use of plutonium fuels has had a hand in this disappointment. When history is written in the future, the U. S. policy against reprocessing may become more than a footnote.

¹ Carter Policy Statement, The White House, April 7, 1977, Papers of the President, 1977

² JOHN MCPHEE, "The Curve of Binding Energy (A Journey into the Awesome and Alarming World of Theodore B. Taylor)," Farrar, Straus and Giroux, New York (1974)

³ JOSEPH NYE, IAEA Salzburg Conference, May 1977; F/M

³ Charles Robinson, Rossin Interview (taped and transcribed)

⁵ GERALD FORD, Portsmouth, Ohio, Oct. 28, 1976, Ford Library, speeches of the President

⁶ Gerald Ford, Rossin Interview (taped and transcribed)

⁷ Greg Canevan, LANL, Rossin Interview (taped and transcribed)

⁸ Jerry Halvorsen, (Washington rep for AGNS), Rossin Interview (taped and transcribed)

⁹ "Nuclear Power Issues and Choices" Report of the Nuclear Energy Policy Study Group, Spurgeon M. Keeny, Jr., Editor, Ballinger, Cambridge, MA, 1977

¹⁰ Spurgeon Keeny, Rossin Interview (taped and transcribed)

¹¹ Spurgeon Keeny, Harold Brown, Joseph Nye, Rossin Interviews (taped and transcribed)

¹² Spurgeon Keeny, Tom Neff, Larry Ruff and Milt Klein, Rossin Interview (taped and transcribed)

¹³ MICHAEL M. MAY, "Nuclear Weapons Supply and Demand," American Scientist, v 82, Pg. 526 Nov-Dec 1974

¹⁴ PETER JONES, former Director of Aldermaston Laboratories, UK – Speech notes