

Chapter 5

Nuclear Proliferation

5.1. Why This Chapter?

There are many interpretations on the evolution of national security policy. The age-old story of a blind man examining various places on an elephant with differing conclusions is valid. The approach I will take will be to discuss the *anecdotal aspects* of national policy in two areas, Nuclear Proliferation (Chapter 5) and Strategic Arms Control (Chapter 6). Some interesting things happened along the way to which I now return for introspection. I speak raw thoughts into a microphone with *Dragon Dictate*, which speech into WORD files. This is not a *peer-reviewed, coherent history or description* of what is *good policy*. I do not describe the pit-falls of one policy versus another, making one political party or person look thoughtful and the other self-serving. My roll model is Tom Graham, long-time, chief legal counselor for the Arms Control and Disarmament Agency. His excellent book, *Disarmament Sketches*, contains his personal recollections, without attempting to be the serious, complete history. These chapters are my personal memories in which I write vignettes and adventures, but they are not a coherent package. Some of my co-workers helped reduce errors, but the responsibility is mine. The technical side of these issues appears in my text, *Physics of Societal Issues: Calculations on National Security, Environment and Energy* (Springer 2007). I believe in the treaty process so nations can work together to develop coherent solutions to problems, without international cohesion the Earth will be less secure.

I failed to win a Science Congressional Fellowship in 1973, the 1st year of the program to place science PhD's into Congressional staffs. I applied a second time in 1975, gaining a fellowship because of my two papers in the *American Journal of Physics* on national security and energy. At the age of forty, I thought all things were possible. Not wishing to take an extra day off, I taught physics all day, took a 9 PM flights to LAX and Newark, bus to New York City, a day interviewing in a New York hotel, bus to the Newark, flew to LAX and San Luis, arriving at 10 PM. In 32 hours, I taught a day, interviewed a day, flew along the LA-SLO coast twice, crossed the U.S. twice, bussed twice between Newark and New York City. At age 78 this seems daunting, I don't think I will do that again. My fellowship was to place me in the newly minted Congressional Office of Technology Assessment. However, I was tempted by the new Senator John Glenn to be his Science Advisor, retaining the title of AAAS Fellow, but paid by the Office of Senator Glenn. I have good thoughts about John Glenn, he was a straight-up, honorable person, willing to ask questions about things he didn't know and lots of fun. My job was to be Glenn's lead staffer on energy issues with the Senate Interior Committee. The Interior Committee, soon to be called the Senate Energy Committee, chaired by Senator Henry "Scoop" Jackson.

Senator Glenn's other main committee was the Senate Government Affairs Committee (GovAf), then called the Government Operations (GovOp) Committee, and now called the Homeland Security Committee. This was the committee that Senator Joe McCarthy made famous with his witch-hunts of the 1950's. In January 1975, newly elected Glenn had been given the gavel by GovAf Chair Abe Ribicoff to look into the issue of nuclear proliferation following the Indian explosion of 1974. This was an unheard of assignment for a chair of a major committee to give a

first-year senator the gavel to chair his committee. This was probably done because Ribicoff was uncomfortable with science and because these were controversial issues, which Glenn's immense popularity would make it easier for investigation and legislation. This topic was timely for several reasons.

To make this story more understandable, I list my various jobs in Washington.

1972-2013: Arms/energy Cal Poly courses in Physics, Physical Science, Humanities and Political Science.
1975-77: Science Advisor to Sen. John Glenn, AAAS Science Cong. Fellow, Professional Staff Member.
1977-78: Special Assistant to Undersecretary of State Lucy Benson and Deputy Under Sec. Joseph Nye.
1979 summer: Advisor to Lou Nosenzo, State Department's OES Bureau on nonproliferation issues.
1983-84: Visiting Scientist at MIT's Program on Arms Control with Kosta Tsipis.
1985, June-September: Visiting Scientist on energy/buildings with Art Rosenfeld, LBL Nat. Laboratory.
1987: AAAS Science Fellow in State Department's Office of Strategic Nuclear Policy in PolMil Bureau.
1988 summer: Stanford Center for International Security and Cooperation.
1989 summer: Princeton's Program on Science and Global Security with Frank von Hippel.
1990-92: Professional Staff Member, Senate Committee on Foreign Relations with Chair Claiborne Pell.
1992-93: Professional Staff Member, Senate Committee on Governmental Affairs with Chair John Glenn.
2000-02: Study Director, Comm. International Security and Arms Control, National Academy of Sciences.
2005-06: Science Fellow, Stanford Center for International Security and Cooperation.
2009, January-May: Technical Advisor to the President of the Arms Control Association.
2002-13: Nonproliferation Review Panels at Los Alamos, Nevada, Oak Ridge National Laboratories.

5.2. An Energy Beginning

Devonian Shale came before Fracking

One of the reasons I chose to work with John Glenn for my fellowship year was that John was on the Interior Committee (soon to be the Energy Committee), which was chaired by *Scoop* Jackson. Glenn stated that he wanted to be proactive on energy and avoid overt politics. Energy issues were aflame in June 1975 when I arrived in the Senate, a year after the oil embargo of 1973-74.

The August 3, 1975 *Cleveland Plain Dealer* pointed out an Ohio problem: "Honeymoon appears over for Ohio's 2 Senators." Senator Robert Taft, Jr. of Ohio was up for reelection in a difficult race. Taft championed the idea that plentiful natural gas was available below Ohio in Devonian shale with such abundance that it could greatly assist U.S. energy supplies. But, Glenn had already added \$5 million to the government's natural gas budget for Devonian shale. In those days \$5 million extra was plentiful. But, Taft proposed a floor amendment to add \$35 million beyond the Glenn total of \$13 million. The reason this story is interesting now is that today's fracking natural gas from tight shale is an extension of the 1975 debate. Both are perceived as a new source of energy if environmental impacts can be controlled. After study, I came to the conclusion that the \$5 million amendment was about right, considering all the issues, with Glenn opposing the Taft \$35 million. My first trip to the Senate floor was on the issue of Devonian natural gas. I soon learned there were two sized chairs on the Senate floor, big chairs for senators and small chairs for staff. The votes were taken with the Taft amendment defeated by 75 to 19, mostly on party lines.

EPCA and ECPA Omnibus Energy Bills

“Once begun the dance of legislation, and you must struggle through its mazes as best you can to the breathless end--if any end there be.” [Woodrow Wilson, *Dance of Legislation*]

This was the golden age for energy legislation. The forces aligned in the same direction: 1) President Ford’s pardoning of President Nixon crippled the Executive Branch, enhancing Congressional stature to do more. 2) The oil embargo took place only a year ago, with more gasoline lines in the future. The public was ready for action on energy. 3) It was an era of political decorum with reduced political exaggeration, as Senate Democrats were led by Mike Mansfield and Senate Republicans were led by Hugh Scott.

The Energy Production and Conservation Act (EPCA) of 1975 was an omnibus energy bill that covered such topics as emergency energy powers for the president, CAFE automobile fuel economy standards, energy-standards for appliances, weatherization programs, the Strategic Petroleum Reserve and more. The House–Senate conference to align Senate and House bills was remarkable. The Senate was represented by 25 senators (25% of the Senate), joined by 7 congressmen (only 1.6% of the House). This was a good time for a congressman to flaunt power over a senator. The conference took place almost daily for 5 weeks in the fall of 1975. I will mention two issues that Senator Glenn played a key role.

Average price formulation for the control of domestic oil

The 94th Congress attempted to grapple with the inflationary effect of the fourfold increase in global oil prices and the pressure to raise domestic oil prices. As you might expect, Democrats from the Northeast used oil to heat their homes and wanted low prices, while senators from oil-producing states wanted higher prices. Senator Glenn established a price-average formula that allowed sufficient room so that the petroleum industry could utilize expensive enhanced-recovery techniques in a 3rd domestic pricing tier. On the one hand, the proponents of price regulation were concerned with the impact of higher prices on the economy, relative availability of future supplies at modest prices, and the excess profits of the oil companies. On the other hand, opponents of price-regulation were convinced that additional monies were needed to create new supplies, that regulation was inefficient, and that higher pricing would increase consumer conservation by decreasing demand. I favored higher prices that damped demand, but we had a sudden situation of billions of dollars of excessive, unexpected oil profits. By combining 5.1 million barrels/day of *old oil* at \$5.25 per barrel and 3.4 million barrels per day of *new oil* at \$11.28 a barrel, the average price is \$7.66 a barrel. (The average price was allowed to inflate at 10% per year.) Thus, the \$5.25/barrel *old oil* could not be sold at \$11.28 for *new oil*. The excess profit in 1975 dollars was considerable.

$$\text{Excess Profit} = 5.1 \text{ Mbbbl/day} \times \$6/\text{bbl} \times 3 \text{ years (by law)} = \$35 \text{ billion}$$

How did Senator Glenn attain this pivotal spot? The Senate was split into twelve for lower prices and twelve for higher prices. Since there was no way out of this deadlock, Glenn presented graphs of various price formulas to the Democratic Caucus. After 5 weeks they were looking for a compromise and this was it. After much talking the Senate conferees accepted it and the House followed. To get the full Senate to accept the compromise, there was a Senate debate between Senator Dewey Bartlett of Oklahoma, who was opposed, and John Glenn, who made the motion.

At the very end of the process, President Ford indicated that he might veto the entire EPCA package. The energy czar of the day, Frank Zarb, indicated he would like to come for a visit on Saturday. I was concerned that Zarb would walk in with 10 economics professors and a mainframe computer. This was 1975 and all I had was a slide rule and graph paper. How would I respond to “How did you get your results?” I dashed out and brought my first calculator for several hundred dollars that could only multiply, divide, sine and log. Now I was ready for Czar Zarb, as I placed the new calculator on the coffee table to show off Senate mathematical prowess. It soon became apparent that Zarb was most concerned about other EPCA provisions he needed, such as CAFE standards for cars, Strategic Petroleum Reserve for embargoes, better appliances, and emergency powers for the president. Zarb never once complained about the Democrats giving oil company profits to the masses. After Zarb left, Glenn looked at me and said, “Well he didn't fight very hard.” This was the biggest financial transaction of my life.

Conferees Kill Busing Curb that would Save Energy

The House adopted an amendment to EPCA by 240–201 to prevent the use of gasoline to transport students to public schools beyond the closest one to home to save energy. Of course, bussing is controversial, but the House bussing amendment was not energy policy, it was a response to de-segregating schools. How should one respond? I quantified the petroleum used for bussing: 10 years of schooling implies that 10/70 of our 1975 population of 210 million are bussed students, or 30 million. Recall that school is in session only 50% of the days, so divide by a factor of 2. Multiply 30 million students, times 10 miles per day, times 760 BTU/passenger mile, times 0.05, since 5% of students are bused, and divide by two times 5.5 million BTU per barrel. The results in 1,000 barrels/day, which is much smaller than the 16 million barrels/day consumed by the US in 1975. When I was asked how I obtained this result, I gave the calculations to my Senator inquisitor. I then was lectured on the side by senior staff to never give a calculation to the opposite side since that will allow them to berate you. Senator Glenn denounced the bussing amendment as a “charade” of trying to stop bussing for racial balance under the guise of energy conservation. Glenn said it would make as much sense to require that food stamp recipients obtain their stamps in carpools, or to forbid travel by car to buy a gun.

The Appropriations Committee

The Appropriations Committee controls much more real money than all the authorizing committees put together. Rarely does a senator beat the Appropriations Committee, but John Glenn did it twice, on solar energy and fuel cells. In both cases, Glenn bested the old lions, Senators Robert Byrd and Ted Stevens. These legends in their day were not used to losing, so they resigned from the House-Senate Appropriations Conference in anger, showing the affront to the dignity of the Appropriations Committee. What makes the story more interesting is that Robert Byrd wanted to be elected Democratic Majority Leader, as Mike Mansfield was retiring. Byrd needed Glenn's vote, so I was bombarded with requests for Glenn to testify on these energy issues before Appropriations. Finally Glenn did so, it was a love fest, praise for all. Byrd became majority leader and our views on energy were taken into account.

My last energy effort in the Senate was to summarize what Congress had done on energy in the 94th Congress, as part of the congressional submission to the Democratic Leadership for its 1976

Convention. I wrote a sterile document that listed EPCA, ECPA and more. But the political process changed my boring, linear logic with additions like this:

“the impact of the Arab oil embargo of 1973 was so devastating and crippling to the American economy that its effect upon American people can hardly be overestimated. Whether the Nixon-Ford administration had been treating the problem with benign neglect that characterized their concern for so many other problems or whether they consciously refrained from any planning in order not to intrude into the profit-making of the oil companies is not known. Whatever the motive, however, the do-nothing policy beggared the American people to an awesome extent. Billions of dollars were lost in income and production and millions of lost jobs were where the economic legacy of the Nixon-Ford negligence. Not only was the domestic economy dealt one of the most paralyzing blows in many a decade but also the international impact eroded the standard of living of our friends and allies and our standing in the international community. Such a disaster need not have happened. Warnings were evident in among in abundance.... The magic charm of the free market was flawed, however, since the market was not free. The price was a monopoly price established without too much objection from US domestic producers by the Oil Producing Export Countries. The dislocation caused by price increases in turn played a significant role in the 9% unemployment level-the highest since the Great Depression.”

5.3. 1974 Indian Bomb and Global Proliferation

Like most of us growing up after World War II, we learned to live with the bomb. We didn't give too much thought to the idea of the proliferation of nuclear weapons because it seemed too distant to us. After all, our capable leaders, Roosevelt and Churchill, didn't want to focus on the concept of nuclear proliferation, first introduced to them by Niels Bohr in 1944. They were too busy fighting for survival. The Cuban missile crisis of 1962 did raise our concerns. Gina's teaching-principal recommended that we fill our bathtub with water during the missile crisis, and so we did. Today this seems a bit of a stretch as Champaign-Urbana was not a target and we were 30 miles from Rantoul Airbase. I accepted a postdoctoral fellowship at the Los Alamos National Lab in 1964 to work on *peaceful physics*, to explore nuclear physics and Mossbauer condensed-matter physics from neutron capture gamma rays. But then reality set in. The Chinese exploded their 1st fission weapon on October 16, 1964, followed by its 1st hydrogen weapon on June 17, 1967. As a peaceful post-doc with clearances, I heard the briefings to the lab staff on these events. There was great uncertainty in the global system. There were times when nuclear weapons were lost, such as the crash near Palomares, Spain on January 16, 1966. Two of the hydrogen weapons crashed by land, not exploding but spreading plutonium. The other two weapons were lost by sea, to be recovered with much effort. The last one was located with the help of a fisherman who saw where it entered the ocean. The Alvin mini-sub barely reached it before it could fall to the far deep. This experience convinced me that I wanted to return to the university environment, which we did at Carnegie Mellon University in Pittsburgh. I soon thought of other things.

On May 18, 1974 India set off a ten-kiloton nuclear explosion under the Rajasthan desert. This was a remarkable event because this explosion was the first nuclear explosion beyond those produced by the 5 nuclear weapon states, the winners of World War II; the US, USSR, UK, France and China. It seems these five nations, *the P5*, often had their heads in the sand, thinking that proliferation would not take place in their time frame. It took the 1974 Indian explosion to focus governments and world opinion on the dangers of nuclear proliferation and the plutonium economy.

5.4. Nuclear Export Legislation

Glenn's hearings on proliferation were timely because the Joint Senate-House Committee on Atomic Energy was in a crash mode. The Joint Committee defied the intentions of the Constitution as it was populated by equal numbers of Representatives and Senators. When JCAE reported a bill, it was the same bill to both the House and the Senate. That is not the way the system is supposed to work. However, because nuclear physics was mysterious and powerful, the Congress deferred to nuclear secrets and bad process. For this reason the Senate Foreign Relations Committee had not gotten involved with the proliferation issues, as it worked only on the strategic treaties. That, coupled with the fact that the Joint Committee was rather permissive, allowed a system that was too soft on proliferation, allowing the easier export of dangerous materials. The standing law of the time, the *Atomic Energy Act of 1954*, was the focus of our investigations. The Joint Committee was swept away after the election of 1976, putting the Senate Committee of Government Operations in the leadership role on proliferation issues with the Foreign Relations Committee.

The only reason I worked on nonproliferation was that Glenn's staffer for this issue, Roy Werner, broke his shoulder. Since Glenn was a first-year senator he did not have other staff to help him. Since Glenn and I had worked well on energy issues, he asked that I be his key staffer for work on nuclear proliferation. When Roy Warner returned 6 months later, the Government Affairs Committee (GovAf) staff asked that I remain in that role since Roy was not a scientist and he was not proactive. The original ideas in this area came from Paul Leventhal, Chairman Ribicoff's lead staffer on nuclear matters. Paul had a solid legislative background in this area, having split the Atomic Energy Commission into the development side in the Energy Research and Development Agency (later the Department of Energy and the National Nuclear Security Agency) and the regulatory side in the Nuclear Regulatory Commission. Because of his activism, Paul was feared by those who were in charge. Paul's idea was not to directly challenge the Atomic Energy Act of 1954 where GovAf had no rights, but to reorganize the government within GovAf to reduce proliferation problems. This approach allowed GovAf to have legislative purview to examine these issues. The Joint Committee protested when GovAf held hearings in January 1976, hearings that they had failed to do over the years. I wonder if Senator Ribicoff from Connecticut had calmed his neighbor, Senator Pastore from Rhode Island.

We began our hearings in January 1976. The Indian explosion of 1974 was the initial focus, with the passage of legislation to be considered later. My job was to contact the witnesses and get things organized. Who would testify was of the highest importance. My first call was to David Lilienthal, the first chair of the AEC from 1947 to 1950. Lilienthal had recently published an op-ed piece saying that mankind was going to be overtaken by roaches as nuclear proliferation would destroy civilization. He quickly let me know of his high concerns with salty language and I knew we had a strong witness. My second call was to Hans Bethe, the famous nuclear scientist. The third call was to a friend Herb York, the first director of the Livermore Lab. Herb had given a talk at Cal Poly when I started teaching on these topics in 1972. Lilienthal issued a newsworthy strong call to slow proliferation:

"I therefore propose as a private citizen that this committee, with its great prestige, call upon the Congress and the President to order a complete stop of the export of all nuclear devices, and all nuclear material, that it be done now, and done unilaterally. Further, unilaterally, the United States should without delay proceed by lawful means to revoke existing American licenses and put an end to the future or pending licensing to

foreign firms and governments of American know-how and the facilities paid for and created by American taxpayers' funds and American brains.

“This action taken alone will not solve the whole problem of proliferation. But it will put an end to our major part in it. For the fact is that we, the United States, our public agencies and our private manufacturers, have been and are the world's major proliferators. I consider the historical perspective, which I later summarize, to be distinctly relevant to the consideration of what we do now. It is the now, the present, and the immediate future, that interest me the most, and obviously of the most interest to the committee and to our fellow Americans in the cities, the towns and the farms of our country. Admittedly, any immediate embargo on the export of nuclear technology materials and plants would be drastic action, so drastic as to raise the question of America's moral position to take such a course. That moral position is a strong one as the history of American efforts demonstrates.”

The GovAf Committee took to heart Lilienthal's call to action. Nine months later Lilienthal wrote Glenn a letter:

“Your persistent legislative efforts, notably in recent days, have demolished the notion that nothing can be done by American leadership, clout and influence about the spread of nuclear weapons. That shocking weak-kneed attitude was expressed before your committee following my appearance last January. I am sure that the average man, when he knows the story and its implications for him and his children, will be as admiring of your legislative efforts as I continue to be.” Lilienthal came to the heart of the matter, and I am proud of Senator Glenn's efforts.

The hearings went on for months, producing a volume five inches thick. Hans Bethe initially agreed with Lilienthal, but then reversed himself. Another high point of the hearings had to do with the French export of a reprocessing plant to South Korea. When the lead State Department proliferation manager, Myron Kratzer, testified, he gave us a heads up that he was going to announce, that under heavy US pressure, South Korea had canceled the import of the French reprocessing plant. This was a major step forward to constrain the plutonium economy because the French had always talked about the sanctity of contracts being the most important issue. Finally, when push came to shove, the U.S. leaned mightily on the Republic of Korea. Glenn was prepared to ask the key question. Ad-Hoc Chair Glenn interrupted Kratzer and asked if it was true that the South Koreans came to their senses and canceled this reprocessing plant sale? The answer was yes. Glenn stated that at last “some sense of sanity” has returned to the burgeoning nuclear field. This interchange got excellent press, which is a big driving force for both Congress and the Executive Branch.

With political pressure rising, we got Republican Senator Chuck Percy to invite Secretary of State Henry Kissinger to testify before GovAf. Kissinger ducked the issue as to whether the US should have responded more strongly in 1974 when India exploded a nuclear device, with the aid of US heavy-water to produce plutonium in the Indian reactor obtained from Canada. Later, we were told by Kratzer at a Stanley Foundation Strategy for Peace workshop that U.S. non-action was a mistake. We assumed this passive decision had been made at the Nixon-Ford White House. There is a tendency for countries to want to get along with each other for benefit of other near term issues, so the U.S. did nothing.

It wasn't clear where the legislation was going to go. The Percy, Glenn, Ribicoff bill was one of reorganization, which would move functions out of the NRC to other agencies. Percy's name appeared first because that was his price to have his name on the bill. The Executive Branch

rightly considered this bill would bring on chaos. But on the other hand, the government didn't have any response to lower proliferation threats in the future. This uncertainty led to private discussions between the players in the secret room in the capital S407. The Executive Branch was invited to give proposals to the staff of the Joint Committee (Bill Parlor and Bill Asselstine, but not Staff Director George Murphy) and Government Affairs (Paul, Dave and Connie Evans). The Executive Branch rose to the occasion as they presented export criteria for future nuclear exports. Their lawyers had dotted the i's, but the criteria were too weak. The GovAf staff strengthened the criteria by requiring nuclear safeguards on all nuclear facilities in order to obtain a nuclear export license. This criterion is referred to as *full-scope safeguards*. This is equivalent to signing the Nonproliferation Treaty, but a nation doesn't have to humble its sovereignty by signing the NPT if it had those concerns. The second criterion tightened the rules governing the permission to reprocess to obtain plutonium, which was further tightened in the next Congress. We also constrained government-to-government transfers of high-enriched uranium (HEU). We tried to bring the GovAf bill to the Senate floor in the waning moments of the 94th congress in December 1976, but it was blocked from Senate floor consideration by opponents.

5.5. Sanctions Legislation

Over the years, Congress passed legislative sanctions to attempt to change nuclear behavior of other nations. This is a complex and dicey issue. Usually this assumes that the Non-Proliferation Treaty is the gold standard for the world. But the NPT allows the five nuclear-weapon states to have nuclear weapons and the other 185 nations not to have them. Is this a stable system? Probably not, but the alternative solutions don't have much traction. It is difficult to understand what other solution we can have in the near-term. Prior to 1976, the Congress had mostly abstained from getting involved with nuclear-sanction legislation because the State Department always wants flexibility to cut a new deal. This is easily understood because once you use legislative sanctions and the other side doesn't comply, there's not much you can do without flexibility. However, when the Indian explosion of 1974 took place, the US government took no serious action. The combination of the 1974 Indian bomb and the 1974 resignation of Richard Nixon increased the opportunity that Congress would pass sanction legislation.

This opportunity became real for me when I received a phone call from Bill Ashworth of the Senate Foreign Relations Committee (SFRC). He had drafted an amendment, redrafted by Len Weiss to known as the Glenn-Symington amendment, which would deny military and economic aid to non-nuclear weapon nations that moved towards nuclear weapons production capacity. Congressman John Anderson (R-IL) also had drafted a version that did not survive. It was later amended to include nuclear explosions by nonnuclear weapon states. Exceptions were complicated by a power-sharing procedure between the Executive Branch and the Congress using the one house veto, which is no longer constitutional. Since Sen. Symington was in ill health, it was up to Sen. Glenn to get the amendment accepted by the Senate Foreign Relations Committee, then by the full Senate, and finally by the House of Representatives. Glenn was not even a member of SFRC, but his hero status gave him access to these bodies, to which I accompanied him.

It sometimes happens that those who pass legislation then have to implement it in the Executive Branch. This is precisely what happened to me a year later when in the State Department we

worked with the Congress to further amend this sanction amendment, and we had to deal with the nations where it was being applied. In this case it meant going to interagency panels at the Office of Management Budget, OMB, when State could not get agreement with the Department of Energy. See Section 5.9 below.

5.6. Senate Odds and Ends

A Trip to the Middle East

During the summer of 1976, our 3 senators (Glenn, Ribicoff and Percy), plus Howard Baker, and eight other senators took a nuclear investigative trip to Israel, Egypt and Iran. Israel was suspected of having a nuclear weapon. From the Christian Science Monitor, Israeli President Ephraim Katzer: “It has always been our position to prepare a potential for making atomic weapons. If we need them we will have them.” Egypt was jealous of this, and Iran was starting to invest heavily in peaceful nuclear power that could be subverted to weapons. I was eager to be Sen. Glenn's staff member for the trip, but my immediate boss, Len Bickwit, Glenn's legislative director, got the nod. In preparing for the trip, we tried to get the senators to travel without their wives to show a more serious intent, which Glenn presented to his fellow senators, but this failed. Senators Glenn and Howard Baker went to the gates of the Israeli Dimona reactor, but were denied admittance.

As part of the process, I dealt with various foreign governments. The most unusual one was India, since they knew that our legislation would probably cancel the US-India contract for nuclear fuel. I was contacted by the number-three person in the embassy and invited to observe Indian dances and go to the Indian ambassador's house for dinner. It was very nice but they knew and I knew that it was not going to have any effect on the process.

Enrichment Capacity

One element of proliferation policy is to have a guaranteed, stable supply of uranium fuel for reactors so that countries won't enrich uranium or reprocess plutonium to obtain reactor fuel. At this point, the gaseous diffusion plants in the United States were inefficient and out-of-date. The new technology of choice was the centrifuge. Since one of the three diffusion plants was in Portsmouth, Ohio, Senator Glenn's state, I and others estimated how much enrichment capacity was needed in units of separative work units (SWU). At this point there was a push for considerable nuclear power, supported by Vice President Rockefeller's request for loan guarantees. In 2012, we get one-half of reactor fuel from weapons uranium from Russia's dismantled nuclear weapons and the other one-half from US enrichment; and we export essentially nothing. In 1976, both domestic and international uranium requirements were in play. This was a time of growth for nuclear power, accompanied with an expansion in enrichment capacity. The ultimate legislation on nuclear exports, however, reduced the need for enrichment as our raised standards lowered the marketability of US fuel. The U.S. was in a bind on this issue. The NPT states that have nuclear weapon states were supposed to help nuclear-power programs of those nations that chose not to pursue the bomb. This is a controversial bargain because, on the one hand, the Eisenhower Atoms for Peace Program increased nuclear technology transfer and gave a political cover to hide clandestine weapon programs. On the other hand, it established the NPT Treaty and the International Atomic Energy Agency (IAEA) regime, though flawed, are

better than nothing. This is very complex. Since nuclear technology keeps advancing and getting easier, I think we're better off with the NPT/IAEA regime. It is true that technology transfer is enhanced with nuclear cooperation agreements, but ultimately political barriers will be larger than technical barriers as technology improves.

Nuclear Safety

Because of the GovAf proliferation hearings, we got wrapped into the nuclear safety issue. I was contacted by a Nuclear Regulatory Commission (NRC) staff member, Demetrios Baskedas, who complained about the NRC process to determine safety. To try and determine the truth, Sen. Glenn requested that the NRC allow an investigation at the NRC, staffed by Ellen Miller from the GovAf staff and myself. To do this we dealt with the NRC Commissioners and Ben Rusche, Director of the Office of Nuclear Reactor Regulation. I had been told that Rusche liked to squeeze your hand unmercifully when shaking. I was ready for him; I quickly brought up my left hand with my first knuckle bent and drove it into his knuckle until he said *uncle*. We get along just fine after that.

Over a 10-day period, Ellen and I interviewed three dozen NRC staff on due-process and technical issues, such as water hammers. The rebels and the NRC raised complex issues, many of which I was not familiar. A month later we held hearings on December 13, 1976 in GovAf on the results of our investigation. The five NRC rebels had equal time with the NRC staff and the Advisory Committee on Reactor Safeguards, whose staff half-filled the GovAf hearing hall. I am not sure who won the debate, but hopefully our open-process helped to iron out some of the technical difficulties.

Glenn for Vice President?

In 1976, Glenn and Representative Barbara Jordan gave co-keynote addresses at the Democratic convention in New York City. Glenn and Teddy Kennedy were the most popular Democrats of the day. John Glenn, Walter Mondale and Ed Muskie were invited to Plains, Georgia to interview for the spot of vice presidential candidate, and Frank Church was also considered. Mondale got the spot. Glenn had polled as the most popular Democrat in the US, but Ted Kennedy was more favored to be president, but he was not campaigning because of the accident at Chappaquiddick. Eight years later in 1984, Glenn campaigned to get the presidential nomination to oppose Ronald Reagan for his second term. The May 15, 1983 *Los Angeles Times* headline noted that "Glenn: Ohioan Overtakes Mondale in Survey." A matchup between Mondale and Reagan gave Reagan a narrow lead of 43% to 42%. On the other hand Glenn bested Reagan by 42% to 39%. So much for polls, as Glenn faded and Ronald Reagan won 49 of the 50 states against Mondale in November 1984. Glenn started out quite popular, but was viewed as too inexperienced, too much of an outsider and a drab speaker. After the early primaries Glenn was replaced by Gary Hart as Mondale's chief rival.

How was it to work for a genuine American hero? I liked him a great deal and found him to be open-minded and fun to work with. In my year and a half with Glenn, we passed 25 amendments, many of them minor, without defeat on the Senate floor. He was a centerist politician, from the right side of the northern Democratic Party. When entering a room with Glenn, heads would turn,

as if accompanied by a beautiful lady. I usually got good responses on the phone from famous people by saying I was from the Office of Sen. Glenn. His clean-cut look and center of the spectrum position allowed him to draw Republican co-sponsors. This is harder to do in 2012. I liked his wife Annie very much. Several times I joined her in the senator's wife balcony when I couldn't get onto the Senate floor. Annie had a long-term speaking disability, which she courageously overcame. John and Annie had gone to high school together when she first had that problem, but his love for her helped her to overcome this problem. When John was in orbit in 1963, Vice-President Johnson went to the Glenn house to talk to Annie and get some press. Annie didn't want this attention and asked John whether she had to go to the door. He responded you don't have to do that and don't do it. Lyndon Baines Johnson was denied that interview on their doorstep. I knew Annie in 1975-77 when she had this problem, however a few years later with proper therapy she overcame it. Bless her indeed.

A quote from a newspaper of the day: "John Glenn is what every mother would like her son to be." Two more examples of working for hero Glenn. The Energy Research and Development Agency (ERDA) was bothered by a man from Ohio who claimed to have invented a perpetual motion machine. He asked for time with Sen. Glenn and I was requested to do something with him. Clearly he wasn't going to get any face-time with the senator but I had to somehow calm him down and get him back to Ohio. I told the man that I would let him look at Sen. Glenn, who was chairing a nearby hearing. This visit to the Glenn hearing room fulfilled his dream. He was ecstatic after seeing the senator from the back of the room. I heard later that he was thrown off the returning airplane because his energy device looked like a bomb, which it wasn't. Another time we were invited to a fundraiser for Glenn. A dozen senators showed up but more importantly, Warren Beatty was there with Teddy Kennedy. The Democratic National Chairman Robert Strauss concluded, "the nation doesn't object to heroes."

An Offer to go to State

In January 1977, I gave an invited talk on non-proliferation policy to a meeting of the American Physical Society. Since this was a more complicated policy talk than I had given before, I took the trouble to write it up in some detail. I mailed a few copies out to friends. One of them went to Dan Poneman, my intern for the summers of 1975 and 1976. Dan was very sharp, as he later became the lead proliferation-staffer at the National Security Council under Bush-1 and Clinton, and he is now Deputy Secretary of Energy. At any rate, my APS paper was unexpectedly transferred at Harvard from student Dan to Professor Joe Nye, who was to be the lead on non-proliferation policy in the Carter Administration. I got a call from Nye to interview for a position as one of his two Special Assistants. The interview took place in the first-floor Transition Office in the State Department. I took copies of our hearing records and other materials to help Nye in his new job as Deputy Undersecretary on proliferation matters and to buttress my qualifications, an effort which was successful.

5.7. Joining the Carter Non-Proliferation Team

Jimmy Carter came out of nowhere. As a one-term governor from Georgia he bested relatively well-known *Scoop* Jackson and Frank Church both from the Senate Energy Committee on which Glenn had served. Carter had given a thoughtful speech at the United Nations in 1976 on

nonproliferation policy and the future of plutonium. It's interesting to point out that on October 28, just before the November election, President Ford changed his position by stating he would stop reprocessing spent fuel to obtain plutonium. It was clear that Ford did this because it had become a Carter issue, and he was behind in the election. Most people would not have known what it meant to stop reprocessing. When the Ford ban was announced, I was at a meeting at ERDA (now Department of Energy). I was examining where US exports of high-enriched uranium were going. The DOE people I was dealing with were shocked when we heard the Ford statement, responding, "this building will never be the same." The main thrust of nuclear power had always been to deploy breeder reactors because of the supposedly finite amount of economic uranium. We will investigate issue later.

I had not lobbied to get a job in the Carter administration nor had I submitted a resume. I was surprised by the call from Joe Nye. However, once interviewed, I wanted the job. I think Joe liked the approach of my APS paper, but I also know that he had been told that he had "a Congress problem," since Paul Leventhal had threatened banning of nuclear exports to nations that did not belong to the NPT. This would curtail US nuclear fuel exports, turning off some lights abroad. The Stanley foundation had brought together the various players from the Executive Branch, Congress, and Industry for a three-day workshop at Airlie House in suburban Virginia. At that event, Paul terrified some in the Executive Branch, such as Charles Van Doren of ACDA. It was clear that legislation was needed to replace the permissive Atomic Energy Act of 1954.

Joe Nye had been part of the 1975 Ford-Mitre study on nuclear power, which pointed to future problems. At the same time it had been my task to prepare a proposal for Senators Glenn, Ribicoff and Percy to request Office of Technology Assessment to examine proliferation matters. Since the new Secretary of State Cyrus Vance had been a member of the OTA panel, he was up to speed on the topic. One of the main OTA conclusions for me was that unilateral US action would not be successful to halt proliferation, and that only a multi-task, multi-nation approach of incentives and disincentives would work. The *OTA concluded* the following:

"What influence can the United States exert upon potential weapon states? *Finding.* In the long run two general rules apply: (a) Solutions to the proliferation problem will have to be found primarily, though not exclusively, through multilateral actions, and (b) The extent of U.S. influence will vary from country to country."

Nye was the lead for the Carter Administration for policies on non-proliferation. *Energy Daily* had this to say about the State team (Nye, Larry Scheinman, myself):

"One source at State says a lot of people are worried that the new actors on the proliferation stage are ACDA-types: negative toward reprocessing, pro-tandem fuel cycle, pro-controls.... Meanwhile a source at Allied-General Nuclear Services reports that some of the new team have asked to visit the company's unfinished reprocessing complex at Barnwell South Carolina within the month."

Gerard Smith, the former Chief Negotiator of the SALT Treaty and former head of ACDA, joined us at State as Senior Ambassador for Proliferation Affairs, in order to deal more closely with heads of states, but the policy levers were in Nye's office. This arrangement worked out amicably.

The main nonproliferation players were the State Department, the Arms Control and Disarmament Agency (ACDA) and the Department of Energy; this was the small group. A larger group consisted of a dozen agencies including the Nuclear Regulatory Agency, and the Departments of Defense and Commerce. Nye had been a prestigious Professor of Government from Harvard, who was able to enter a conflicted room and move it towards resolution. His two special assistants were Larry Scheinman, Professor of Government from Cornell, as well as an expert on the IAEA, and myself, who was to specialize on Congress and technical matters. I had never thought of entering the State Department, but I took the new roll as a chance to learn. It was similar to getting a second PhD in a new subject. At first I didn't like the State Department, but I grew to like the process and the people. In order to get the Secretary of State to sign a letter, you had to get 15 signatures indicating agreement on the substance. Science at times took a back seat to the needs of diplomacy.

During the campaign, Carter had stressed foreign-policy issues of strategic arms control, nonproliferation, and stability in the Middle East. The issue of nonproliferation split the State Department, between the country desks and subject matter desks. It was expected that feathers would be ruffled as the U.S. pulled back on commitments to help other nations obtain plutonium. At one point I was invited to the Bureau of European Affairs (the EU Bureau), as the EU-staff members wanted to check out the Carter nonproliferation policy. The EU Bureau staff complained that the building was run by people not schooled in foreign policy. Not true, as Nye and Larry were experienced international scholars, and the resulting Carter policies mostly remained in place, untouched over four decades through Democratic and Republican administrations because they made diplomatic and economic sense.

This chapter will not be a coherent discussion of nonproliferation policy, which is far more complex than strategic arms policy with the Soviet Union. The main difference is that plutonium and proliferation have economic consequences since large amounts of energy are needed to fuel modern economies. There are some 190 parties to the NPT treaty, whereas the START and SALT treaties primarily have but two members. The seminal discussion of the Carter non-proliferation policy was written by Nye (*Foreign Affairs*, April 1978, pages 601 to 623). I think it has stood the test of time, but at times we were under harsh attack from the nuclear industry, the environmentalists, foreign governments, states that had plutonium projects and more. I used a cube to display our political loneliness in the Secretariat, with six surfaces marked with those who opposed us [nuclear industry, Europe, Republicans, environmentalists, strategic arms, Soviets]. Perhaps we were correct since we produced a policy that stood the test of time. We saved the U.S. billions of dollars by abandoning the breeder and reprocessing. Over time, most countries followed our path by abandoning the breeder and using mixed oxide (MOX) fuels. We raised the standards for exporting nuclear fuel. Was it perfect? Of course not.

This is a simple description of the State Department organized chart. On top of the bureaucracy is the Secretariat, which has small offices but wields considerable power. The secretary and deputy secretary are known as S and D. The 3 substantive Undersecretaries of Political affairs, Economic affairs, and Security affairs are known as P, E and T. Lucy Benson was the undersecretary for Security Affairs and Joe Nye was the Deputy Under Secretary. Lucy had four special assistants to help her, and Joe had two. The Secretariat was on the 7th floor, facing south. T was located in the southwest corner in room 7208. It was our job to coordinate the work of the Bureaus of Oceans,

Environment and Science (OES), the Bureau Politico-Military Affairs (PM) and the Office of the Legal Advisor (L) , the Bureau of International Organizations (IO) and the country desks and bureaus. The OES Bureau was where most of the work was done, but it lacked technically-based career staff members since science was not a path to promotion. That was a good reason to have ACDA in the same building, as there were many competent scientists there. At first I did not like the idea of working in a large bureaucracy. I was used to research labs and university campuses and the Congress, which are all less formal. My photo on the State Department badge shows a somewhat grumpy me, because this picture was taken on my first day in State. I wasn't sure I was going to like my stay there, but I did. It was my job to keep on top of what was going on in State, Congress and abroad. And I met serious professionals who were less emotional and more rational. I now believe that the most interesting jobs in government are at the upper levels of the relevant departments and not in the Congress. On foreign-policy matters, the Congress has hammers to sanctions, financial constraints and setting criteria. But, if you have a problem with German foreign policy, you would visit the Foreign Ministry and not the Bundestag.

The nonproliferation transition team met several times in the 3 weeks before the inauguration of President Carter. It was a peppy group so I learned to speak up with substance. During this time I was still at work in the Senate, but I presume my additional part-time work in State was consistent with the Constitution. The Congress wanted us to move before we were ready. On March 1, 1977, Secretary Vance gave his first congressional testimony after his Senate confirmation. Joe Nye was out of town, so it became my job to brief Vance the night before and the morning of the hearing. I told him he had to oppose some legislation before the House, some of this legislation he seemed to like. In the morning, Vance asked me to ride with him to the hearing, to which I agreed. But then the Assistant Secretary for Middle East Affairs burst into the Secretary's office stating he had big problems with House legislation on anti-boycotts in the Middle East. Since Vance and the Assistant Secretary had to chat quickly, he asked me to find my own way to the House.

A dozen staffers surround Secretary of State Vance during the hearing, awaiting a call on their narrow expertise. The last third of the hearing was dedicated to nonproliferation issues to which Vance responded: "As you know the President has directed an urgent and comprehensive review of US nuclear export and nonproliferation policies.... In the course of these preparations we have been in direct touch with members of Congress and intend to be in close consultation with you as we complete our work. Our policy options will be submitted shortly to the President and I would expect decisions on them this month.... Meanwhile, we suggest that the concerned congressional committees not enact legislation in the nonproliferation area before giving full consideration to the Executive Branch's recommendations."

Things were going well until Congressman Larry Winn, Republican from Kansas, had a question. "Along the same line, why has the new administration made this apparent difficulty for the LMFBR (liquid metal fast breeder reactor) to non-proliferation." Things had been moving so quickly in State that I was quite sure Vance didn't know a lot about the breeder reactor. I knew I had to move quickly before Vance could speak and get himself into trouble. I tripped over a couple staffers, leapt to Vance's back and whispered into his ear, "take the question for the record." Vance replied, "I'm afraid I cannot answer that question." Congressman Winn responded: "Can you assure us that the domestic and international energy needs--that is my interest in that

subject matter--of the future will be positively balanced in the nonproliferation review that you just mentioned.” Vance responded “yes.”

We were now in the public hot spot for plutonium economy issues. The House Foreign Affairs Committee had its Findley-Zablocki amendment ready to go to block all nuclear exports, before we had decided exactly how this issue should be handled. I was given the Findley-Zablocki gossip by the out-going head of Congressional Relations. Nye was out of town in Bonn, Germany, trying to squelch the West-German offer to Brazil for gaseous-nozzle enrichment technology. The outgoing head of Congressional Relations accompanied me for my visit with HFAC Chair Clement Zablocki from Wisconsin. There was no time to consult with anybody. I had to act decisively on my own, without higher approvals. I quickly wrote a memo to HFAC Chief of Staff Jack Brady, with five tick-points and quotes from Secretary Vance’s testimony of March 1. The memo outlined the situation that State was in-process, and please don't mark this legislation up until we are ready to present Carter's full nonproliferation policy. Brady took me to meet Chair Zablocki. I gave him the memo and he berated me, saying hurry-up.

5.8. Nuclear Non-Proliferation Act of 1978 (NNPA)

We knew that Senator Glenn and his key advisor Len Weiss would soon push the Carter Administration to modify the Atomic Energy Act of 1954. We agreed with that conclusion, but we were concerned we might get pushed in the near term beyond what was pragmatic. Ultimately we agreed, but only after a year and a half of hearings, meetings and debates. My initial assignment was to be on a team of lawyers that would create President Carter’s presidential draft bill that would, of course, be greatly changed by the Congress or rejected entirely. The Executive Branch legal panel examined legal problems and solutions. The committee consisted of four lawyers and myself: Ron Bettauer from State, Pete Brush from DOE, Harry Marshall from ACDA, a lawyer from DoD, and on certain issues, Carlton Stoiber from NRC. I enjoyed working with these professionals, but we did disagree on some issues.

India had nuclear weapons facilities beyond those for peaceful power. Since the contracts to sell nuclear fuel to India from the US do not cover this issue, the US exports were legal, but unwise. If the new law required that all facilities be under nuclear safeguards, these exports would not be legal. The issue is can you add new requirements on former contracts. The answer is no, but the Congress can do whatever it wants and then the courts have to sort it out. In our Congressional hearings we learned from Adrian “Butch” Fisher, former Deputy Director of ACDA, the phrase “sic ribicus stantus.” This means a large change in circumstances, which has a large impact on national security, nullifying previous contracts to protect the nation. The four lawyers did not like “sic ribicus stantus” and they voted to allow the exports to India to continue because that is what the previous contract allowed. It was clear that the new law would require full-scope safeguards on all nuclear facilities in non-nuclear weapon states, but what about the old contacts? I disagreed with the four lawyers, and lost the battle. But the Congress went ahead and specifically disallowed nuclear fuel exports to India, but phasing it in over 18 months. Later the US cushioned the blow to the India by finding them a new supplier, France.

A second issue was to determine which nations would be allowed to reprocess US-origin spent fuel to obtain plutonium. Here again, the legal panel came up with softer criteria. Joe Nye gave

several speeches, pointing out that only mature nations would be allowed to reprocess since they would have larger nuclear power needs to be fulfilled. Sen. Glenn and Len Weiss inserted the criteria of *timely warning* into the legislation, which required that the Secretary of State to certify that, if these programs became military, that the US would have sufficient time to respond and fix the situation militarily before the U.S. could be meaningfully threatened. This was a tighter standard and useful. This is how the final NNPA, as amended by Glenn, states the timely warning requirement:

“Among all the factors in making this judgment, foremost consideration will be given to whether or not the reprocessing or retransfer will take place under conditions that will ensure timely warning to the United States of any diversion well in advance of the time at which the non-nuclear-weapon state could transform the diverted material into a nuclear explosive device;” [Sec. 131 subsequent arrangements (b)(2)]

At last we were ready go. Congress had told us, no surprises we want to know before Carter speaks. But the White House said they wanted to release the material when the President speaks and they knew that Congressional staffers would leak to the press before Carter could speak. How to square that circle? We decided to brief only those who were most intimately involved, the Glenn GovAf subcommittee and not the full GovAf committee. This angered the director of the full committee, who told us that we would be treated roughly in the full committee because of this slight. In the end this legislation blurred as the GovAf legislation was done at the full committee with Glenn as the Ad-Hoc Chair. We then briefed the relevant House members. The policy leaked to the front page before Carter could speak. I was concerned that the White House would be furious, but others told me that that this was acceptable since Carter would now have advertising for the electronic media.

President Carter released the findings of the interagency process and presidential review on April 7, 1977 on “Nuclear Power Policy” and on April 27, 1977 on the Carter legislation on the “Nuclear Non-Proliferation Policy Act of 1977.” I had a catbird seat for these events in the White House in Jody Powell’s office with Jessica Mathews. We used some of Nye’s speeches and testimony for Carter’s statement to stop the plutonium economy of breeders and reprocessing, but to continue the US role in low enriched uranium exports, pursuant to the promises in the NPT. However future exports of US origin nuclear fuel would be diminished because of the higher US export standards for nuclear exports. An example of this was a modest shift from light water reactors (LWR) that needed enriched fuel to the Canadian CANDU reactors that used natural uranium fuel with heavy water (HWR).

It was interesting that the initial Carter nonproliferation bill was somewhat soft on safeguards and plutonium reprocessing, but the news media portrayed it as a strong bill. I recall Myron Kratzer stating that if he had submitted such a bill, he would have been panned. A year later, the Nuclear Nonproliferation Act of 1978 (NNPA) got it correctly, as it strengthened safeguards and made it more difficult to obtain plutonium. This is far from a perfect solution but it's a step in the right direction. There were considerable complaints about NNPA, but after 30 years it has remained without too much softening (such as India under President G.W. Bush).

It had been my job to write testimony and accompany State Department officials. From March 1 and October 3, 1977, eight of these testimonies were with Nye, and one each with Secretary Vance, Deputy Secretary Warren Christopher, Undersecretary Lucy Benson, and Deputy

Assistant Secretary Lou Nosenzo. There were a few tense times when I had trouble getting a State official on the right day. One time we had to fly Lou Nosenzo on the Concorde to appear before Senate Energy, and another time, Len Weiss and I had a debate on these matters. The negotiations on NNPA were conducted for the Senate by Len Weiss, acting alone, as *The Architect of NNPA*, and for the Executive Branch by Lou Nosenzo, the *Architect of the Nuclear Suppliers Group* (1975-6). Nosenzo was accompanied by Ron Bettauer, Harry Marshall, and Pete Brush. This resulted in many changes to the original bill that Glenn introduced at markup. Indeed, it was those changes that became the heart of the NNPA.

The ratification of the Treaty that returned the US Panama Canal Zone to Panama was a bruising battle. Because of this, Senator Glenn had been warned not to bring the NNPA to the Senate until things calmed down. However the Senate and State staff knew that there was only a small time window to ratify NNPA. The only way to get around this Senatorial block was to have President Carter look Senate Majority Leader Byrd in his eye and tell Byrd that he needed NNPA to bring continuity to the Carter nonproliferation policy. It was my job to coax this conversation into being, working with Jessica Tuckman in the White House. In spite of these warnings about an angry Senate, NNPA passed the Senate 91-0 on February 7, after adopting a few of Senator McClure's amendments that didn't change the basic bargain. On February 8, 1978 my present boss Joe Nye wrote a letter to my former boss John Glenn (as well as Senators Charles Percy, Claiborne Pell and Frank Church).

"I want to let you know how personally grateful I am for your role in the passage of S.897, the Nuclear Non-Proliferation Act of 1978. After almost three years of work, you have every right to be proud of your achievements. The final legislative product, arrived at by open and honest communication between both branches of government, reinforces my belief in the conduct of foreign policy as a shared responsibility. You, and your staff members, Len Weiss and Len Bickwit, are to be commended for your foresight and patience and leadership."

In a rare move, the House of Representatives accepted the Senate bill without changing a word, saving time it would take to produce a House-Senate version. This happened because the bill was complex and represented very careful compromises. The reason laws are written in stilted language is due to the combat and compromise. It became my task to determine the list of attendees for the signing ceremony in the cabinet room. Since Senator McClure had worked hard in opposition to the bill, I felt he could attend, which was not universally appreciated. Carter's statement has some elements of Nye's February 17, 1978 speech *Nuclear Energy: The Middle Path*, which ended the plutonium economy, but did not ban nuclear power until the alternatives were mature. Amory Lovins, the soft-path energy guru, was less than pleased that we stayed in the middle path in 1978.

My task was to reduce the complexity of the new law into a cable that would be sent to all embassies. I was chosen to do this, rather than the lawyers, because lawyers have a hard time removing the caveats, whereas a physicist has no trouble retaining the larger terms of an equation, and ignoring the smaller factors. The March 1978 cable still was complex with these subsections: procedures, incentives, immediately applicable export licensing criteria, full-scope safeguards, criteria for new and amended agreements for cooperation, events requiring termination of US nuclear supply after the date of enactment, subsequent arrangements for reprocessing and handling of spent fuel, licensing of nuclear components not specifically covered in the legislation,

export licensing procedures with a view to expediting the export licensing process, fuel assurances incentives initiatives.

The Europeans were livid. The NNPA required the renegotiation of agreements for nuclear cooperation. It required that Euratom and the U.S. begin negotiations, or Europe would not get nuclear fuel. This did not go down well in most of Europe, which did not believe that the US Congress could or should unilaterally require negotiations to change conditions in existing contracts. The embargo went on for about 6 months until Euratom met very briefly with the U.S. and then walked out. Lou Nosenzo had his hands full. The signing of NNPA by President Carter created an embargo on nuclear materials from the date of signature in March to July 1978. Carter and French President Valery d'Estaing agreed to a compromise (NY Times June 29, 1978), in which

“the Common Markets Executive Commission can open preliminary talks with the Carter administration on bringing the existing supply agreement into line with the recently approved US NNPA.... Under the new agreement, the Common Market Commission will be barred from even discussing the real source of the quarrel between the United States and Europe over nuclear fuel, which is Europe's determination to develop a nuclear industry based on plutonium in defiance of President Carter's stated wishes.”

It was clear that Paul Leventhal's idea of turning off the lights of Europe to tighten laws on plutonium was a daydream. My calculations in the Senate showed that only 3% of France's electricity, 8% of Germany's electricity and 9% of Japan's electricity could be affected, and only in the near-term. And how would Japan and Germany take this US hardball play? Japan had only recently joined the NPT in 1976, and they expected the US nuclear-umbrella to remain after they joined the NPT. But, the embargo forced Europe and Japan to focus on plutonium and ultimately tighten their export policies. That is why they call it diplomacy. Later the Europeans and others agreed that we should have higher standards for nuclear exports.

Sen. McClure added an amendment, which required the Government Accounting Office (GAO) to investigate implementation of NNPA. Three months later, two GAO investigators showed up at State to chat with Lou Nosenzo and myself for a full day. GAO ultimately gave the STATE/DOE/ACDA team high marks. I returned for the summer of 1979 to help Lou Nosenzo produce two Presidential reports, as called for by NNPA.

5.9. The End of US Plutonium Economy

All reactors produce plutonium. A typical 1-GW PWR power reactor produces 300 kg of plutonium per year. This plutonium is *reactor-grade plutonium* since it contains 20% Pu-240, with the remainder mostly Pu-239. The Pu-240 in reactor-grade plutonium makes it much less useful for nuclear weapons, as it emits copious spontaneous neutrons that can cause *pre-initiation*, similar to *pre-ignition* in cars. However, the facilities that produce reactor-grade plutonium can produce *weapons-grade plutonium* with less than 6% Pu-240 if the fuel remains a shorter time in the reactor. This is too expensive for commercial light water reactors, but not so for research reactors, heavy water reactors and other reactors. Thus, under the guise of *peaceful nuclear power*, *military nuclear power* can become established. This is the approach that India and Israel have taken. Even if nations are following the rules of the road, it is possible for plutonium to be misplaced and end up in the wrong hands. After the oil embargo of 1973-74, many felt that

nuclear power was going to alleviate the oil embargo situation. President Nixon made the liquid metal fast breeder reactor a major response to the oil embargo. This is ridiculous because oil is for cars and electricity, at that time, was not for cars. One has to consider economics. Government subsidies were going to help the nuclear industry along the way.

With this backdrop, it became the Carter administrations situation to address it. From the beginning we knew we were going to take decisive action. But we had to go through the policy process between January and April, 1977. The February 11 issue of *Energy Daily* concluded that the

“State Department strikes at the breeder. Schlesinger's independence and energy policy is threatened. A bruising fight has erupted inside the Carter administration on the fast breeder program. The contest pits the arms-control community, entrenched in the State Department and the Arms Control and Disarmament Agency against James Schlesinger and his energy policy team at the White House. It is widely believed that the end result will be further reductions in the amount the government will spend on the breeder reactor, cutting perhaps into money allotted for the Fast Flux Test Facility and the Clinch River demonstration plant.”

My job as special assistant was to protect the boss, Joe Nye. For that reason I drafted 20 letters to invite policy input from the important Chairman and ranking-minority members of the key committees of the House and Senate. Only one committee responded (House Armed Services Committee), but at least we asked. These non-answers became crucial when the House members asked to meet our boss, Under Secretary Bensen, to complain about Joe Nye, as they were concerned about what State was doing. Congressmen Mike McCormick, John Anderson and several others came calling. I made sure that Benson and Nye had copies of the letters to these Congressmen, to point out that they did not answer our request for policy inputs. The March 9 issue of *Energy Daily* pointed out that “Nye clashes with Congressman in stormy meeting.” We also had stormy meetings with Senate Energy Chair “Scoop” Jackson and Deputy Chair Frank Church, both strong supporters of the breeder reactor. The *Energy Daily* further commented: “State Department locks out nuclear industry views. The nuclear industry claims to have run into a stone-wall in its efforts to provide input to the study of nonproliferation now ongoing at the State Department [Presidential Review Memorandum 15] at President Carter's behest... Nuclear industry officials are incensed that Nye will not extend them the courtesy of a meeting and, at least, take the time to listen to the industry views on reprocessing.” This is only partially true as we met with Chauncey Starr, President of the Electric Power Research Institute and many others from industry. The actual PRM-15 meetings were confined to government employees, as is usually the case.

We also had stormy meetings with engineers and scientists from the Oak Ridge National Laboratory who designed the Clinch River Fast Breeder Reactor. Nye and I flew to Knoxville, but bad weather kept us in Knoxville. Some 40 engineers came to Knoxville in spite of the bad weather. I had brought along the *American Physical Society* report, *Nuclear Fuel Cycles and Waste Management (Reviews of Modern Physics, January 1978, p. S1-S185)*, which quantified some of the arguments. It was our view that light water reactors could be sustained for many decades and longer. There is an economic horse race between the cost of uranium resources, the amount of uranium available, the demand for additional nuclear power and the higher capital cost of breeder reactors.

Nye, myself and two others visited the almost-complete Barnwell reprocessing facility owned by Allied General Nuclear Services Corporation (AGNS). We flew to South Carolina in the AGNS corporate jet, but made sure State paid our airfare at the commercial rate. The PUREX process was to be used to separate plutonium from uranium and its fission fragments. The AGNS design was different from that at military reprocessing plants, as it was less flexible but more contained. As a warm-up we visited the military reprocessing plant at Savannah River, which was directed by Senator Strom Thurmond's father-in-law. The plant was a sight to behold, with huge caverns, controlled at great distances to protect the operators. The Barnwell facility had not yet been activated, so we could see it more closely. The Barnwell facility never operated because two presidents opposed it. On October 28, 1976, President Ford opposed reprocessing, and on April 7, 1977, President Carter made a stronger statement. The history of commercial reprocessing in the United States does not inspire confidence, as there were spillages of radioactive materials and facilities that never opened. Over the years only three countries continued to reprocess commercially: France, Britain, and Japan, with Russia keeping the option open. Ultimately the Carter Administration offered to make the Barnwell plant a location for non-radioactive safeguards experiments that did not separate plutonium from uranium.

The Senate Acts on the Breeder Reactor and Reprocessing

The amendments to block the Clinch River Breeder Reactor and the Barnwell Reprocessing Plant were offered by Senators Ted Kennedy and Dale Bumpers. It became my job to staff these amendments. My first task was to write floor statements for Senator Ted Kennedy. Jim Devine and I went to Kennedy's office. I was told there was only one desk available, which was Kennedy's desk and he was out of town. After two days of writing, Kennedy appeared, I shook his hand, I gave him the speech and we went out the door.

I was told that the amendments were going to be debated and voted that afternoon and we must move quickly. I wrote a letter from Secretary Vance to Senator Robert Byrd, the majority leader, giving the Carter nonproliferation positions:

“The President's April 7 and April 27 statements on nonproliferation and nuclear power established for the first time a realistic basis for controlling the spread of nuclear weapons capability abroad. One of the crucial elements of this policy is a clear and unambiguous decision by the United States to cancel all construction and licensing of the Clincher River Breeder Reactor project. It is our recommendation that we pause before commercializing this next generation of nuclear technology, which in its current form would greatly increase the risk of nuclear weapons proliferation. We have launched a major diplomatic effort to persuade others to similarly avoid premature commercialization, and to join in an International Nuclear Fuel Cycle Evaluation program in which we would jointly explore ways to make future breeders more proliferation-resistant or find other alternatives that would satisfy our collective energy and national security concerns. I'm encouraged by the initial responses of the countries which have been invited to join the evaluation program.”

Since time was very short I gave the letter to Nye, who carried it in to Secretary Vance for his signature, without the usual 15 signatures of approval. I thought everything was fine until I heard that Senator Byrd was furious about the letter. We certainly needed the majority leader on our side, so I ran over to Byrd's office in the Capital to repair the damage. What I did not know was that our introductory “Dear Senator Byrd” is used for personal letters, while letters to the Majority Leader that are to be shared with the entire Senate should be addressed “Dear Majority Leader Byrd.” Sen. Byrd was known for having a short-fused temper. I walked into his magnificent

office by myself, alone with Byrd, took my lumps and apologized profusely. Byrd remained firm on stopping the breeder.

The Carter Administration won on the Bumpers Amendment to block reprocessing at Barnwell. It was easier to block noxious plutonium reprocessing than to shift energy production from the breeder. Recalling that 1977 was just four years after the oil embargo of 1973-74, the Kennedy amendment to block the breeder reactor failed. Ultimately the breeder survived the House and Senate compromise, setting up Carter's first veto. A *New York Times* editorial commented:

“Capitulation to Congress now would open the entire policy to charges of hypocrisy.... [Halting the] Clinch River Breeder Reactor is a symbol of the American commitment to this cause. It demonstrates that Washington is not motivated by commercial considerations, as some Europeans have charged. The fact that a few nations are going ahead with small demonstration projects and that France is even proceeding with plans for the world's first commercial size breeder are not good reasons for the United States to continue work on a breeder reactor, already regarded as obsolete, unduly expensive and probably unnecessary.”

The *Washington Post* lead editorial said,

”The Clinch River legislation richly deserved to be blocked and it also raises sufficient important policy questions to have induced Mr. Carter's first veto, an action the President had evidently hoped to avoid taking at all this year.”

After 35 years later, what has happened? It's clear we saved the nation billions of dollars. The most successful breeder programs are those of France with the *Phoenix* and *Super Phoenix*, but both are unsuccessful and shuttered. The French, Russian, German and Japanese breeder programs have produced essentially no meaningful amounts of electricity over the years. There has been reprocessing over time, primarily because countries don't know what to do with their spent fuel. If they reprocess it, the radioactivity is placed in vitrified glass rather than spent fuel rods, but still you must bury it. British and French reprocessed Japanese fuel rods, but at a very high cost. After decades of work, the Japanese are completing their large Rokkasho reprocessing plant. The Carter administration agreed in 1977 to the opening of the small Tokai Reprocessing plant, keeping Japan in the NPT regime.

5.10. Foreign Response to the Carter Non-Proliferation Policy

There were many high-level meetings with countries that wanted to reprocess or enrich nuclear fuels. Each one was different and dramatic. We will not spend time discussing the issues with Japan, Germany, Romania, South Korea, Taiwan, India, Pakistan, Brazil, Argentina, South Africa, and others. Today's conflicts with Iran, North Korea, India, Pakistan, Israel and others show that these issues continue. World reaction was mostly unfavorable towards the Carter policies. Joe Nye wrote a letter to a counterpart in the British government, Patrick Moberly, requesting Britain go slowly on plutonium. The British House of Commons then voted resoundingly to approve the Windscale nuclear reprocessing plant. UK Foreign Secretary David Owen rejected the call for the United Kingdom to defer a decision on plutonium until after the International Nuclear Fuel Cycle Evaluation (INFCE) was completed.

International Nuclear Fuel Cycle Evaluation (INFCE)

Deep study was needed to sort out the proliferation issues. This began with the introduction of INFCE at the US State Department in October 1977. President Carter and Secretary Vance welcomed the technical experts from 40 nations, separated into eight study groups: 1. natural resources, 2. enrichment, 3. fuel assurances, 4. reprocessing, 5. breeders, 6. spent fuel, 7. fuel conservation, and 8. advanced research on fuel cycles and reactor concepts.

Each of these eight categories had delegates from State, Energy and ACDA. I was the State Department representative to INFCE-8, which examined new fuel cycles such as the thorium cycle and research reactors. INFCE-8 was chaired by South Korea, Romania, and the U.S. This required the bureaucracy to produce technical papers from within and outside the government. We had formal meetings in Vienna and in Washington DC. George Cunningham, DOE's director of nuclear-power programs, was to give the main US paper on the economics of nuclear power for the various cycles. All of a sudden, Cunningham was requested to meet with the President of Austria since the Austrian Parliament was about to ban nuclear power in Austria. This is especially interesting because the IAEA, which deals with nuclear power, is located in Vienna. Because of this change, it became my task to give Cunningham's paper. There were other surprises, such as tracking down the South Korean co-chair on an airplane to change a sentence. The final results of INFCE-8 concluded that the thorium cycle had non-proliferation advantages, but considerable investment would be needed to make thorium competitive with the uranium cycle. That is the way things stand today, namely thorium is only used in a few situations.

“Joe Nye and Walter Marshall crossed swords over plutonium at Uranium Institute meeting.” The UK's Marshall and EPRI's Chauncey Starr devised an approach called Civex, to make separated plutonium more radioactive with Pu-238, making it more difficult for terrorists to use. The *Energy Daily* of July 13, 1978 described the debate:

”Joseph Nye, Deputy Undersecretary for Security Assistance, Science and Technology at the State Department, is an elegant and urbane man. Although he has been a diplomat only in the Carter Administration and is soon to return to a teaching position at Harvard, he is the archetypal diplomat. Ready smile, a quick wit and a pervasive charm serve him well as the chief spokesman for President Carter's anti-proliferation policies, policies, which have infuriated US allies around the world. Walter Marshall, Deputy Director of the UK Atomic Energy Authority, is a big bluff, untidy roly-poly man in appearance, and to some extent in style the antithesis of Nye. They also do not agree on very much when it comes to nuclear power in general, and plutonium in particular. At this week's Uranium Institute meeting in London, they squared off before a large gathering of nuclear representatives from around the world in a confrontation that promised high drama. Both men are too civilized for direct verbal fisticuffs, but the confrontation was the highlight of the two-day Uranium Institute meeting, and the difference in style as well as philosophy gave an air of theater to the exchanges on proliferation.”

In an appendix to Nye's *Nuclear Power: the Middle Path* speech of February 17, 1978, there are estimates of how long US uranium reserves would supply the US fleet of light water reactors (LWR). The *Energy Daily*, March 9, 1978 quotes our results:

“Assuming a price of \$50 per pound, he calculates that probable reserves of 2.4 million tons will sustain 480 LWR's at currently projected nuclear capacities, leveling out after 2000, the uranium would last through 2011. If uranium reserves are larger, as he believes they are, 4.3 million tons of potential reserves will sustain 860 reactors to the year 2044. In addition, uranium reserves can be stretched by advanced thermal fuel cycles as well as by lower tails assays.”

These time estimates look more plentiful today since the U.S. peaked at 100 LWR's, much less than the 480 or 860 reactors given above. And now considerable uranium is imported from purchase of decommissioned Russian warheads turned into nuclear fuel.

Salzburg International Conference

The *American Seminar* gathers together decision makers in Salzburg, Austria to increase communication for improving diplomatic outcomes. Nye was invited to address the *American Seminar* held in August 1978 on the Carter non-proliferation policy, along with the decision makers from 20 other European countries. Since the issues were technical, such as plutonium and the breeder, Nye invited me to attend with him. Unfortunately, other negotiations prevented Nye from coming at the beginning of the conference. It was held in a superb location, the Schloss Leopoldskron, where the film, *The Sound of Music*, was filmed in 1964. I was not on the agenda since they wanted to wait for Nye. Only the Denmark delegation supported the Carter policy, everybody else was displeased since they wanted the supposedly cheap plutonium electricity.

Of the five Americans in attendance, including former chair of the AEC, Glenn Seaborg, I was the only one in favor of the Carter policy. The director of the French nuclear weapons program, Bertrand Goldschmidt and was there, as well as over 100 other dignitaries. I listened patiently to the anguished voices from Europe and did not interrupt. Finally, when the Carter policy was misquoted too much, I raised my hand and said that I disagreed with much of that was being said but I didn't wish to derail the program. I suggested we meet at the large fireplace after dinner and I would explain my position. To my surprise, practically all the dignitaries showed up. The French diplomats were very much in evidence. The Germans agreed with the French but hid behind the French because of other considerations. My opposite debate partner was the grandson of General Foch of World War I fame. I think I held my own, at least the Danes told me I did so. My main approach was to suggest that the mythical nation of Raritania wanted to use its peaceful power program to obtain plutonium for nuclear weapons for weapons. What would the Europeans do about that? How could this have been avoided with weak regulations? On the other hand, Foch talked of less regulations and the need for energy. Thus, we were in non-intersecting spaces. The ten-day event had charming moments with hikes in the Alps and dancing in the grand ballroom of the Schloss.

I discussed the Carter non-proliferation policy with Chilean Nuclear Regulatory Commission, consisting of an Army general, an Air Force general and a Navy admiral, overlooking the Pacific in a villa. This visit was five years after General Augusto Pinochet overthrew the Chilean government of Salvador Allende in September 1973. The presidential palace was still covered with plywood after the Chilean Air Force attacked the palace. Our final press conference brought these events home, as the reporters seemed constrained in their questions. I didn't ask the academics tough domestic questions, as I didn't want to put them in jeopardy.

There is a common thread showing that nervous nations want to attain nuclear weapons, proving that the NPT regime has problems and is under attack. The U.S. is part of the problem. If we were totally compliant to the spirit of the NPT process it would not solve all problems, but it could make things better. Ultimately it may just be asking too much of humanity to have five nations with nuclear weapons, while 180 nations do not have the bomb. Perhaps this concern is the

driving reason why some senior political leaders think we must go to zero nuclear weapons. Otherwise, why else would Paul Nitze, George Kennan, Henry Kissinger, George Shultz, Sam Nunn and Bill Perry promote a world without nuclear weapons. No one knows the path through the clouds to the top of the mountain without nuclear weapons. Nuclear weapons are small and can be hidden. Much of the technical ideas are available, but it still takes nations a long time to develop nuclear weapons. Iran started its path toward the bomb in 1975 under the Shah of Iran, Mohammed Reza Pahlavi. Iran is getting closer but they have not yet succeeded over four decades. Saddam Hussein spent some \$10 billion, trying many enrichment technologies for uranium and reactors and reprocessing for plutonium, but he failed to make much progress. However, South Africa was successful with a much small program. Nevertheless the barriers to the bomb get lower every year as advancing technology makes the path easier.

Nuclear Economics

I made various economic estimates, but soon adopted the model created by Greg Canavan, a White House Fellow from Los Alamos. The three biggest economic factors are (1) the amount of uranium ore available as a function of cost for thermal reactors for nuclear power, (2) the capital cost of a breeder as compared to the capital cost of a light water reactor, and (3) the growth rate of nuclear power. Canavan originated a model with three intersecting graphs: comparative economics, geological resources, and nuclear growth. If uranium was cheap and plentiful and there was little growth in nuclear power, the breeder would not be competitive for hundreds of years. If uranium was in short supply and expensive and the breeder capital cost was cheap, the breeder would be competitive fairly soon. My estimates were that the breeder wouldn't be commercially competitive until about 2050 using the parameters of 1978. If I redid these calculations today, the commercialization date would be far into the future. For those that want to know more about nuclear economics, see Chapter 16 of my *Physics of Societal Issues*. Over the years, nuclear power companies have asked for my 1978 estimates, which I have provided.

Without a plutonium economy, we need spent fuel storage.

In 1978 nuclear power made up 8% of the US grid, it is now about 20%. The breeder reactor had been the preferred approach by DOE. But without the breeder, what was going to happen? The Carter Administration came to the conclusion that, in the near term, the U.S. would increase the storage capacity of spent fuel ponds. Safety analysis raised no alarms, as it was assumed that underground geological storage would keep the spent fuel ponds un-crowded, avoiding excess heat if the cooling water was lost. The Carter solution was to obtain funds for the underground repository by taxing nuclear electricity by 1 mill per kilowatt-hour, or 0.1 cents per kilowatt-hour. In those days, nuclear power cost 40 mills/kWh, or it amounted to a 2% tax. When this policy was presented at a press conference, I was the lone State Department person among many DOE persons. Since the policy was driven initially by foreign affairs plutonium concerns, it was necessary to discuss proliferation problems that were on the horizon. By paying this tax, the U.S. was to take legal possession of the spent fuel. After 35 years, Yucca Mountain is not accepting spent fuel and the future is uncertain as where to place it. Compared to other dangers from energy production, the danger of placing older, spent fuel in Yucca Mountain is minimal, a topic where politics leads science.

Since it was going to take decades to establish an underground repository, we needed a near-term solution. It was decided that the Island of Palmyra, 1000 miles southwest of Hawaii, would be the first repository for nuclear wastes. I don't think that was the wisest choice, but it was politically safe. My replacement, Dick Scribner, became the State-lead on this issue after I left the State Department. With the choice of Palmyra, I'm not sure how serious we were on this issue. Over the years African nations and Russia, beyond the Urals, have indicated they would receive the nuclear waste. I think the Russians are serious, but they wanted to retain the right to reprocess the spent fuel for plutonium without a US veto, an issue that was unacceptable to the U.S.

Thirty years went by with an over-accumulation of spent fuel. There is a potential problem if too much younger spent fuel is placed in the ponds, giving too much heat. If a pond lost its cooling water in such a densely-packed pond, it could cause melting and perhaps a fire, spreading radioactivity. This was discussed in a seminal paper in *Science and Global Security* (2003, Bob Alvarez et al) for which I was a reviewer. I commented that their basic results appeared to be correct, but the paper would have been more helpful if it had addressed some mitigation approaches. The National Academy of Sciences agreed with the Alvarez results, pushing the U.S. towards placing older spent fuel rods into above ground storage. The nuclear waste issue has become so politicized that the NAS is needed to comment since DOE's responses have been politicized. Above-ground, air-cooled storage is an interim solution. Because fuel rods contain about 1% plutonium, we need a better place to keep plutonium away from mischief for long term. As long as we have 20% nuclear power in an era of climate change from burning carbon, it is most likely that the U.S. will continue with these plants until they are decommissioned. In the meantime we should explore the alternatives.

5.10. Other Actions to Enhance Non-Proliferation

Enhanced Non-Proliferation Sanctions

We were in office for two months in 1977 before Senator Glenn and Len Weiss drafted language to strengthen the Glenn-Symington amendment that would cut off military and economic aid to nonnuclear weapon states that moved towards nuclear weapons. The new amendment would require sanctions if a nonnuclear weapon state set off a nuclear explosion, with shared powers between Congress and the President to determine exceptions. Around Washington this was called the Israeli nuclear explosion ban. I considered it generic-country legislation, but the Israeli embassy was concerned.

My task was to obtain a State Department position on this issue. It became clear that the lawyer for the Politico and Military Affairs Bureau, Jim Michael (L/PM), was dead-set against the amendment. Since our Under-Secretary Office (T) and the PM Bureau were split on the issue, it was to be decided by Secretary Vance. However both Secretary Vance and Joe Nye were out of town, and it became my task to debate the seasoned lawyer Michael in front of the Deputy Secretary Warren Christopher. To my happiness, Christopher accepted the words of the non-lawyer and agreed that State should accept the amendment.

The next step in the process was to obtain a unified position for the Executive Branch on the Glenn amendment. Larry Scheinman and I went to OMB to debate the Department of Energy on

this matter. The result at OMB was ambiguous, as the OMB lead person concluded that State and Energy could independently testify before the Senate. This was unusual, since the Executive Branch likes *to speak with one voice*. At the hearing, Undersecretary Lucy Benson represented State and Mr. Giambusso represented Energy. The Foreign Relations Committee and Benson-Giambusso arrived at a compromise. My memo of May 11, 1977 to Benson shows some of the complexity:

“You and Mr. Giambusso agreed to dropping your reservations about the removal of the multinational criteria if SFRC would do the following:

- a. Allow exceptions for reprocessing which were exceptions to pure plutonium reprocessing for international evaluation programs, and
- b. Soften the Presidential waiver so that it would not follow the language of Section 669 (‘reliable assurances that the country in question will not acquire or develop nuclear weapons’) but instead follow the waiver of section 503 of the President's bill (‘not jeopardize the U.S. non-proliferation objectives’)

Were these sanctions useful? I know Larry Scheinman felt they had some merit in that they could paint the Congress as the bad cop and thus help diplomacy to make progress. India did not test again until 1998, 24 years after the 1974 Indian explosion. Randy Rydell, a sanction advocate, concluded that the sanctions were useful in holding back the bomb for that period of time. On the other hand, the detractors said sanctions are useful only once because you stop talking to the nation when you sanction them and you no longer do diplomacy if there is no one to talk to. Others have said, Congress only has a hammer and that's all they have to use so they will use it. I agree there are limits to sanctions but if you get all the major nations working together, then sanctions can be powerful.

Saddam Hussein invaded Kuwait on September 14, 1990, followed by the U.S. and allies Desert Storm invasion on January 16, 1991. For many years the nongovernmental community warned that Saddam was working towards the bomb, but the intelligence community didn't pick up on it. Sen. Glenn's staffers Randy Riddell and Leonard Weiss had developed a stronger sanctions law by 1992. The Senate Foreign Relations Committee had an agreement between Chairman Pell and Ranking Minority Member Helms that something should be done. Since GovAf had been working on sanctions for a long time, they were an excellent partner for SFRC. The hearings were held in SFRC with Senator Glenn the lead witness. The follow-up witnesses were Hans Blix of the IAEA and lead inspectors David Kay for IAEA and Bob Gallucci for the UN. After Glenn and before Blix, the SFRC adjourned to vote. When we reassembled Blix was nowhere to be found. Luckily I had seen him enter the office of Senator Pete Domenici, so I burst into Domenici's office and dragged him back to SFRC. Without Blix, the hearings would not have been as successful.

It took several years before the Nuclear Proliferation Prevention Act of 1994 became law. The sanctions list was more inclusive than in Glenn-Symington sanctions, as it included a ban on dealings in government finance and loans and on doing business in the U.S. The NPPA also had useful enhancement reforms for the IAEA, but which are difficult to adopt. In 1998, India and Pakistan each exploded 6 devices, triggering the Glenn-Pell-Helms sanctions, costing India billions of dollars. During the first year, most other nations joined the US sanctions, but this weakened with time. After a year, President Clinton started softening the sanctions, and President

George W. Bush removed the sanctions entirely after entering office. I saw up-close the tension in State over this issue. As the study director for the National Academy of Sciences study on *Beyond START* arms control, I asked for a meeting in State on this issue. The meeting was chaired by Assistant Secretary Bob Einhorn, who was staffed by State arms controllers and the India and Pakistan country-desk staff. It was clear that the broader goals of diplomacy were undercut by sanctions, and it was clear that the broader goals of diplomacy undercut nuclear-proliferation goals.

Nuclear Supplier's Group

At the end of the Ford administration, Lou Nosenzo devised a way to stiffen national standards for nuclear exports, outside of the IAEA, which could only monitor and not legislate. This became known as the Nuclear Suppliers Group, those nations that were involved with nuclear commerce, now about 40 nations. It became Joe Nye's task to lead this negotiation in the Carter Administration. Progress was made to require full-scope safeguards and constrain exports of enrichment and reprocessing facilities. On January 11, 1978 the nuclear supplier guidelines were forwarded to the IAEA. With time, exceptions have been made, which weakened the process.

1978 South African Test Site, Possible 1979 Explosion, and 1991 Abolition

The US had exported high-enriched uranium for a research reactor to South Africa. Working with the Germans, South Africa was building two nuclear power plants and developing gaseous nozzle enrichment. On August 6, 1978 the Soviet Acting Ambassador Vladillen Vasev went to the White House with a message from Chairman Leonid Brezhnev. Soviet intelligence showed that South Africa was preparing to detonate a nuclear device in the desert. Brezhnev asked Carter to help stop it. Brezhnev also sent appeals to the British, French and West-Germany leaders. These 5 nations worked together to convince South Africa to promise that "no nuclear explosive tests will be taken now or in the future."

On September 22, 1979, a Vela satellite bhang-meter picked up a signal over the South Atlantic that appeared it might be a 3-kiloton explosion. On July 15, 1980, the *Presidential Office of Science and Technology Policy* concluded that the light signals recorded by Vela were *probably not from a nuclear explosion*. Leonard Weiss (*Middle East Policy*, Winter 2011) and others disagree with this conclusion. Weiss concluded with the following:

"This raises a general policy question. The Iraq War has shown the harm that can result from the politicization of intelligence in favor of a desired policy outcome, public support for which would otherwise be problematic. In the case of the Vela event, U.S. administrations on both ends of the spectrum have sought to ignore or demote the value of legitimately collected and analyzed intelligence information out of fear of negative political repercussions. Obfuscating or denigrating hard intelligence data to avoid a political problem can be as dangerous to national security and democracy as inventing bogus intelligence to smooth the way into war. Both tactics are designed to mislead the public and are therefore antithetical to democratic governance. It is time for the US government to open up its files on the Vela event and end a 30-year charade."

On July 10, 1991, South Africa signed the NPT and destroyed its 6 nuclear weapons. On July 23, 1993, a group of 30 of us from the Executive Branch, Congress and the non-governmental organizations were invited to the South African embassy to hear Waldo Stumpf, CEO of the

Atomic Energy Corporation of South Africa, give the historical perspective. He claimed South Africa's main national security concerns were the Cuban troops in Angola and the presence of the Soviet Union. South Africa hoped to draw the United States into deterring the Soviets if the Soviets considered attacking South Africa. It didn't seem that nuclear weapons would be useful in a war in Angola. And the Soviet Union is a long distance for South Africa to attack without ICBMs. Thus, South Africa's motives seemed to be based on weak logic. What I really think is that the South Africa military leaders wanted sophisticated nuclear weapons, even though they had no particular purpose. Stumpf quoted the IAEA's Hans Blix, saying "The IAEA team has found no evidence to suggest the original inventory is not complete."

A.Q. Kahn's Nuclear Walmart Store

It was on our watch that State first heard about A.Q. Kahn. In 1978 we were briefed that Kahn had taken Eurochem centrifuge plans from the Netherlands to Pakistan. From what I read, the Intelligence Community knew this earlier, and failed to act in a timely manner. At any rate, I was asked to estimate when Pakistan might obtain its first nuclear weapon. I used the usual approach, called *worst-case analysis*, to determine that a first weapon was possible within two years. Since then there've been other cases like this and the answer is often two years. We know that Pakistan exploded their first device in 1998, so they must have obtained one in about ten years or more, not two years. Another example of bad prediction, driven by fear, was by the panel on North Korea weaponization, chaired by Donald Rumsfeld. They predicted that North Korean nuclear missiles could attack the United States in 2003, which is already more than 10 years late. A.Q. Kahn later created the nuclear Walmart, selling centrifuge designs and parts to Iran, North Korea, and Libya. This has had a major impact beyond the weapons; Kahn proved that uranium enrichment can be a faster path to weapons than plutonium, and centrifuges can be more easily hidden than reactors for plutonium. This shifts the main thrust of the Carter policy from reactors and plutonium to centrifuges and uranium. This shift makes controlling nuclear weapons more difficult because reactors are easy to detect from orbit. Centrifuges use smaller amounts of power and can be hidden in underground facilities. Technology advances makes nuclear proliferation control more difficult, our only hope is the thin reed of multilateral diplomacy.

Does NEPA Apply Abroad?

Mediation of potential environmental damage is primarily based on the National Environmental Protection Act (NEPA) of 1970. NEPA created the requirement for Environmental Impact Statements to compare damages by alternative approaches. EIS's have reduced the environmental impacts, but it is also true that EISs cost time and money. On balance the nation is better off with EIS's than without them, but we shouldn't misuse the process for political or financial gain. NEPA can affect non-proliferation policy because exported reactors can cause environmental damage in foreign countries, and that affects the State Department. If we require ultra safety, we don't fulfill our obligations under NPT Article IV, and we remove ourselves for the global process. But then, the U.S. lost its export business, so the issue disappeared. For non-nuclear weapon states to abstain from nuclear weapons, the five nuclear-weapon states were committed to assist with peaceful nuclear power in the nonnuclear states. If we ignore health/safety, then we will hurt the environments of importing nations. NEPA refers to man's environment, without stating whether it begins (or not) at the US border. This issue has long terrified the Justice and

Commerce Departments because a broad interpretation could prevent US exports in all areas. As you can imagine, this is a politically sensitive issue.

The Justice Department was concerned that the NEPA's reach might be determined by the Supreme Court. For this reason, secret domestic negotiations took place in the former Executive Office Building for two weeks during 1978. The participants were the State Department and the White House's Council on Environmental Quality (CEQ). It was to be an adversarial, legalistic debate, which would be presented only by the two delegation heads. The rest of us could pass notes, but must remain silent. CEQ was represented by its Chair, Charles Warren, and its Deputy Chair Gus Speth. State was led by its Legal Advisor Herb Hansell, his deputy and two of us from State. We were not allowed to discuss the progress within the bureaucracy. This means that I could not tell my superiors, who had very high clearances, what was going on in these unclassified discussions.

The battle on *NEPA Applied Abroad* was great theater to watch with good debate between an experienced labor-negotiator Herb Hansell and the senior California legislator, Charles Warren, who created the important Warren-Alquist legislation that led the nation by creating the California Energy Commission. After two weeks, this process created the concept of Environmental Reports on significant exports, which had no previous status in law. This was a compromise between rigorous EIS's and the present law that had no requirements. President Carter could not implement this by law so it was implemented with an Executive Order. President Reagan removed this requirement with an Executive Order upon taking office.

As part of this process, State testified before Senator Edmund Muskie's Senate Environment Committee. Four of us went to the hearing in Deputy Secretary Christopher's limousine. Suddenly the loudspeaker in the car blared, "The Deputy Secretary needs his limousine." Suddenly we were unceremoniously dropped at the corner of 10th and Pennsylvania. My companions were blown away since we were slightly late and we knew the Environment Committee wouldn't want a solution other than EIS's on exports. I threw myself in front of a cab, so we arrived only somewhat late. Senator Muskie did not disappoint. His staff and my friend, Haven Whitesides, had Muskie loaded with questions. Secretary Vance resigned in 1979 after the US helicopters crashed in Iran, on which he had not been consulted. Muskie then replaced Vance as Secretary of State. I wondered what Muskie thought of the proliferation issue once he was Secretary of State rather than Chair of the Environment Committee.

Burning Classified Books

In 1977, I became aware of a forthcoming Senate hearing, chaired by Senator John Glenn. The hearing described government selling of unclassified nuclear documents by the National Technical Information Service (NTIS), such as the *Los Alamos Primer*, *LA-1*, to citizens of the Middle-East. I called nuclear-weapon designer Ted Taylor to ask how useful *LA-1* was for beginning weapons design. He responded that it was indeed useful and that something should be done to prevent the government from this dangerous practice. This is consistent with McPhee's book in which he asked Taylor, "what sort of person could read and understand the *Los Alamos Primer*?" Taylor responded, "anyone who had a fairly good grade in an introductory course in reactor engineering or reactor theory, even at the introductory level." As the State Department

point-person on this issue, I arranged an interagency meeting with the NTIS director. He reminded me that we couldn't burn declassified papers, such as *LA-1*, since Freedom of Information requests require the government to issue unclassified documents. But he did agree to stop the NTIS advertising of *LA-1* and other items in NTIS catalogs, but he would have to sell to requests under the Freedom of Information Act. Since I was constrained from burning books, this seemed the best outcome and I considered the case closed.

I forgot about *LA-1* until 1992, when I saw an ad in *the Bulletin Atomic Scientists* for *The Los Alamos Primer* (Univ. California Press). The author, Robert Serber, added editorial comments and updated information, and nuclear historian Richard Rhodes added a nice introduction. I immediately called Taylor and asked him about the seriousness of the reborn *LA-1*. Taylor's response was that time moves ahead and that these equations were now too well-known to be of concern. In retrospect, Taylor was correct, as *LA-1* is a series of back-of-the-envelope calculations that are common fare in the physics community. One does not expect great accuracy from these calculations and one does not learn the most serious secrets, which are the technical tricks and manufacturing processes that make nuclear weapons small, safe, reliable and predictable.

The same can be said of Howard Morland's article, *the H-Bomb Secret*," published in the November-1979 *Progressive*. Also see *Born Secret: The H-Bomb, the Progressive Case and National Security* by Alex DeVolpi, et al, Pergamon Press, 1981. At that time most of us did not know that this critical information had already been declassified. I thought Hans Bethe was correct in opposing publication of these proliferating ideas, but publication was legal because *UCRL-4725* and other sensitive documents were already in the public domain. Taylor was shocked by the declassification of *UCRL-4725*, stating that "the erroneous declassification of *UCRL-4725*...is the most serious break of security I am aware in this country's post-World War II nuclear weapons develop programs."

Progressive editor, Erwin Knoll, justified publication as follows: "We hope the debate over [the H-Bomb Secret] will be a beginning of a process in which all of the nuclear policies pursued by our Government will be held up to public scrutiny and review." I wish I could agree with this sentiment, but I have not seen that Morland's article advanced the debate over nuclear weapons. However, excessive secrecy has prevented meaningful debates on many issues, such as the Excalibur x-ray laser pumped with a nuclear weapon, the airborne laser, the number of nuclear weapons needed for deterrence, the capability of Soviet defenses, etc. Closed government bodies, such as the Defense Science Board and the DOE/NNSA, often fail the nation by not being critical when the physics, strategy and economics of projects are untenable. Classification keeps bad science hidden from public view.

But printing *how-to methods* for making botulism and nuclear weapons isn't helpful either. Prior to publication in the *Progressive*, I suggested to Knoll that he publish a *Christian Science Monitor* cartoon along with Morland's article to give the other side of the argument. To my surprise Knoll published LePellry's cartoon of a burning city after a nuclear attack. A beleaguered journalist appears on the ground, holding a newspaper with the headline, "I published How to Build an H-bomb to prove we have freedom of the press."

Leaving Washington

After 3 years, it was time to leave Washington. The *Energy Daily* of May 18, 1978 commented as follows: “A major turnover in the State Department's nuclear staff is in the offing. Government sources confirmed this week that Joseph Nye, Lawrence Scheinman, Philip Farley and David Hafemeister will all be leaving by the end of the year. Nye is the deputy to the Under Secretary for Security Assistance, and Scheinman and Hafemeister are his two major assistants. Farley is an assistant to Gerard Smith, Ambassador to the IAEA and nonproliferation specialist at the State Department. Nye, Scheinman and Hafemeister are all returning to academic posts, government sources say, with the possibility of a loss in tenure reportedly being a major factor in their decision to leave. Farley is returning to retirement. Nye probably is identified with the initial development of Carter's nonproliferation policy more closely than anyone else.”

It was time to decide my future. Carter's 1978 popularity was still high, but soon to sink with high inflation and capture of our embassy staff in Iran. I wanted to have a life where I could be both a professor and contribute on a variety of topics. The basic solutions put forward by the Carter administration are mostly followed today, in spite of the many complaints. The breeder reactor and plutonium fuel are not used today for economic and proliferation reasons. We saved the nation billions of dollars. The Reagan administration initially said it was going to make changes (Science, 25 June, 1982, pg. 1388). “President Reagan has approved a significant revision of US nuclear nonproliferation policy through a broadening of the terms under which US allies may reprocess nuclear fuel supplied by the United States.” The only country that has had its US-origin spent fuel significantly reprocessed is Japan. This was done at a huge economic penalty as Japan paid France and UK large sums to do this. The breeder reactor programs in France, UK, Germany, Japan, and Russia are moribund. Perhaps the biggest change in policy took place under President George W. Bush, when he agreed to give India the quasi-status of a nuclear-weapon state, to obtain nuclear fuels without all of its facilities under safeguards. If this precedent is not repeated, this will not be too dangerous, but will it be repeated? The newer proliferation problems of North Korea and Iran are primarily not based on peaceful power programs. There has been progress as South Africa, Argentina, Brazil, Ukraine, Belarus and Kazakhstan have pulled back from their nuclear weapons status. The programs in India and Pakistan have been slowed by sanctions, but they now have about 100 weapons each. Israel's program has been in existence since 1960 and remains a major inconsistency for the United States. The world is more aware about the technical aspects of proliferation through Carter's International Nuclear Fuel Cycle Evaluation (INFCE) and its successors. The IAEA is very slowly increasing its standards for declarations and inspections on plutonium and enriched uranium. Certainly we are not out of the woods but the many strengthening actions helped. I am now greatly concerned that political differences in the U.S. will prevent the implementation of cooperative nonproliferation policy between the nations of the world.