14971 113371

BY THE COMPTROLLER GENERAL

Report To The Congress

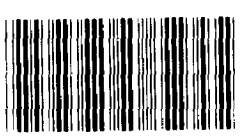
OF THE UNITED STATES

U.S. Nuclear Non-Proliferation Policy: Impact On Exports And Nuclear Industry Could Not Be Determined

The Nuclear Non-Proliferation Act of 1978 established new measures to prevent the diversion to weapons use of peaceful nuclear exports. It also created a policy to confirm U.S. reliability as a nuclear supplier.

GAO did not identify any export sales lost as a result of the Act, but did find indications that nonproliferation policies can influence export sales. Based on available data, GAO could not determine the impact of the Act on the competitiveness of U.S. nuclear exports. However, U.S. companies are at some disadvantage because importers perceive that implementation of the Act may result in delayed export licenses.

The United States dominated the nuclear export market through the early 1970s. However, foreign competitors, some aided by U.S. technology transfers, emerged to monopolize home markets and compete for third-country business. Further, the market has been depressed since 1974 and prospects for U.S. nuclear power plant exports have dimmed greatly. However, U.S. companies continue to view exports as important to sustain production capacity.



113371

01209

ID-80-42
SEPTEMBER 23, 1980

For sale by:

Superintendent of Documents
U.S. Government Printing Office
Washington, D.C. 20402

Telephone (202) 783-3238

Members of Congress; heads of Federal, State, and local government agencies; members of the press; and libraries can obtain GAO documents from:

U.S. General Accounting Office
Document Handling and Information
Services Facility
P.O. Box 6015
Gaithersburg, Md. 20760

Telephone (202) 275-6241

COMPTROLLER GENERAL OF THE UNITED STATES
WASHINGTON, D.C. 20548

B-199974

To the President of the Senate and the
Speaker of the House of Representatives

This report discusses the efforts of the U.S. nuclear industry to compete in a changing world market, the uncertain effect of nuclear nonproliferation policies on competition for exports, and some of the potential economic implications.

Our review was made pursuant to Section 602(e) of the Nuclear Non-Proliferation Act of 1978 which requires the Comptroller General to complete a study and report to the Congress on the implementation and impact of the Act on the nuclear nonproliferation policies, purposes, and objectives of the Act.

One of the national policy declarations specified in the Act is to take such actions as are required to confirm the reliability of the United States in meeting its commitments to supply nuclear reactors and fuel to nations which adhere to effective nonproliferation policies. This is an interim report which assesses the impact of the Act on the international competitiveness of the U.S. nuclear industry.

We are sending copies of this report to the Director, Office of Management and Budget; Secretaries of Commerce, Energy, and State; U.S. Export-Import Bank; and interested individuals and organizations in the public and private sectors.

Comptroller General
of the United States

COMPTROLLER GENERAL'S
REPORT TO THE CONGRESS

U.S. NUCLEAR NON-PROLIFERATION POLICY: IMPACT ON EXPORTS AND NUCLEAR INDUSTRY COULD NOT BE DETERMINED

D I G E S T

This report provides a perspective on U.S. participation in a changing world nuclear market, the effect of nonproliferation policies in that market, and some of the related economic implications.

GAO could not determine the impact of the Nuclear Non-Proliferation Act on the competitiveness of U.S. nuclear exports. The Act had no apparent influence on the award of five nuclear reactor orders to foreign suppliers in the 2 years after its March 1978 passage and did not prevent the sale of four reactors by a U.S. supplier. However, there were indications that nonproliferation policies can influence export sales. Industry officials and foreign customers have complained about the Act's export restrictions and resulting licensing delays but provided little evidence that it actually caused lost export sales. GAO did find that U.S. nonproliferation policies preceding the Act did play a part in the failure of U.S. suppliers to win orders in Brazil and Iran during 1975-77.

DECLINE OF U.S. DOMINANCE OVER NUCLEAR EXPORTS

U.S. companies dominated the nuclear export market through the early 1970s, gaining 86 percent of free-world nuclear power reactor exports during 1970-73. The United States also monopolized the supply of uranium enrichment services for free-world reactors. However, many foreign reactor vendors have emerged--some aided by U.S. technology sales--to capture their domestic markets, thus shrinking the market available to U.S. companies. Several foreign vendors have also competed aggressively for export sales,

reducing the U.S. share of free-world reactor exports to less than 50 percent for 1974-79. In addition, European and Soviet suppliers are competing for sales of uranium enrichment services. (See pp. 8 to 10.)

In the highly competitive nuclear export market, technology, economics, and politics may influence a customer's choice of suppliers. Divergence in nuclear nonproliferation policies is but one of the many factors. (See pp. 10 and 11.)

THE NON-PROLIFERATION ACT: AN UNCERTAIN IMPACT ON NUCLEAR EXPORTS

GAO found little evidence that the Nuclear Non-Proliferation Act actually caused lost export sales. However, nuclear industry officials and foreign customers have complained about the Act's export restrictions and resulting export license delays. In addition, U.S. nonproliferation policies preceding the Act played a part in the failure of U.S. companies to win reactor orders in Brazil and Iran during 1975-77. GAO concluded that the impact of the Act on the competitiveness of nuclear exports could not be determined. (See pp. 6 and 27.)

There were international sales of only 9 nuclear power reactors in the 2 years after passage of the Act. Romania ordered four reactors from Atomic Energy of Canada, Ltd., and Argentina ordered one reactor from Kraftwerk Union of West Germany. All five are to be natural-uranium-fueled, heavy-water reactors. U.S. companies do not produce this type of reactor and did not compete for these orders.

In the same period, a U.S. company was successful in selling four power reactors to South Korea. The customer's concerns over U.S. nonproliferation policies were overcome by contract clauses that permit cancellation in the event export licenses are not issued

timely and by introduction of a congressional resolution that would permit a variance to the existing uranium enrichment ceiling. (See p. 19.)

In the 3 years--1975 through 1977--preceding the Act, Kraftwerk Union and Framatome (France) won export orders for a total of 10 nuclear power reactors in four countries--Spain, South Africa, Iran, and Brazil. U.S. companies won orders for seven reactors in Spain and one reactor in the Philippines. During that period, U.S. nonproliferation policies were evolving and included certain provisions--restrictions on enrichment technology exports and control over reprocessing of U.S.-origin fuel--that became law in the Act. The evidence as to whether evolving U.S. nonproliferation policies hurt the ability of U.S. companies to compete for reactor export orders was mixed. Nonproliferation policies had no decisive impact on the awards to foreign vendors in the cases of Spain and South Africa. U.S. policies did, however, play a part in the failure of U.S. firms to market plants in Brazil and Iran. (See p. 21.)

Spanish electric utilities placed orders for nuclear plants with Kraftwerk Union in 1975 and 1977. Superior financing terms offered by the Germans were the decisive factor in these sales. U.S. companies argue strongly that U.S. nonproliferation policies have eroded their market position and will have an impact on future U.S. business opportunities in Spain. (See p. 22.)

South Africa awarded contracts for 2 nuclear units to Framatome in 1976. General Electric had initially been designated the successful bidder but found itself forced to withdraw following the breakup of its consortium arrangement with a European firm. By that time, concern had surfaced as to whether any U.S. nuclear vendor could obtain either U.S. Export-Import Bank financing guarantees or an export license in light of the political and human rights controversies between the United States and South Africa. (See p. 22.)

Iran ordered a total of six reactors from Kraftwerk Union and Framatome during 1975-77. These purchases were negotiated with each supplier individually in accordance with a national nuclear plan that allocated shares in the Iran market to German, French, and U.S. suppliers. U.S. companies could not obtain sales commitments from Iran during this period because of delays in concluding a U.S.-Iran agreement for cooperation on nuclear matters. A major factor that delayed the agreement was Iran's opposition to a U.S. demand for veto rights on the transfer of spent fuel for reprocessing, a key U.S. nonproliferation policy. The German and French reactors, however, are not likely to be completed. The new government has announced its intent to terminate the nuclear program. (See p. 22.)

Brazil reached agreement with Germany in 1975 to purchase at least two nuclear power plants as well as enrichment and reprocessing technology. The U.S. Government's 1974 declaration that future enrichment service contracts were contingent upon availability of U.S. enrichment capacity, as well as its policy severely restricting export of enrichment technology, strongly influenced Brazil to seek the agreement with Germany. Brazil's uneasiness over the reliability of the United States as an enrichment supplier, coupled with an interest in building a nuclear industry and acquiring energy independence, were decisive factors in this purchase. (See p. 23.)

U.S. PROSPECTS IN A DECLINING NUCLEAR EXPORT MARKET

Forecasts of future world nuclear power plant capacity have indicated progressively lower growth rates since 1973. A May 1979 Energy Information Administration report estimated that 1985 world capacity, excluding Communist areas, would amount to only 40 percent of the capacity forecast in 1973 and estimates for later years declined even more. By deleting

asking other suppliers to place a 3-year moratorium on exports of uranium enrichment or reprocessing technology, and continuing to embargo U.S. sales of sensitive technologies. The U.S. program of research and development on the breeder reactor was not to be affected.

Following the election, President Carter began to implement a tougher nonproliferation policy. In April 1977, he unveiled a set of coordinated policies for preventing proliferation. These policies would indefinitely defer commercial reprocessing and recycling of plutonium, restructure the U.S. breeder reactor program and defer commercial breeder use, and continue the embargo on exports of equipment or technology for uranium enrichment and reprocessing. In transmitting a proposed nuclear nonproliferation policy act to the Congress, the President noted that the act would require renegotiation of agreements for cooperation with foreign governments to bring them in line with the new act. After extensive hearings and deliberations, the Congress passed the Nuclear Non-Proliferation Act and it was signed by the President on March 10, 1978.

Present U.S. nonproliferation policies--and the NNPA in particular--make U.S. exports conditional upon a number of restrictions, including full-scope safeguards and the U.S. right of veto on retransfers and reprocessing, and restrict export of enrichment and reprocessing technology. The NNPA requires initiation of a program to renegotiate existing agreements for cooperation to bring them in line with the new NNPA requirements. Many agreements are not due to expire for 20 years or more, and the unilateral effort to renegotiate them has been an overall irritant to foreign governments.

In addition to these issues, certain earlier U.S. policies and actions had raised questions about the reliability of the United States as a nuclear supplier. The 1974 closing of the order books for U.S. enrichment services particularly shocked a number of customers. In addition, U.S. policies on such issues as human rights have hampered the export efforts of U.S. nuclear vendors.

Canada's restrictions on nuclear exports are similar to those of the United States. However, France and West Germany, the two major U.S. competitors for light-water reactor exports, have less onerous restrictions. Essentially, they adhere to the Nuclear Suppliers Group guidelines, do not require full-scope safeguards or a unilateral veto right over retransfers, and exercise less restrictive reprocessing policies. U.S. industry officials assert that French and German export licensing procedures are less complicated and have not caused

AGENCY COMMENTS

The State Department agreed with GAO's basic conclusion that the impact of the Nuclear Non-Proliferation Act on the competitiveness of nuclear exports could not be specifically determined. However, the Department did not wish to imply that nuclear nonproliferation policies have no impact on nuclear exports.

The Department of Energy and the Export-Import Bank of the United States did not disagree with any of GAO's conclusions. Energy provided updated information relevant to the export market, and the Bank suggested alternate analysis methodology that might be useful to a study of this nature.

The Department of Commerce agreed that GAO's basic conclusion may be technically accurate but, nevertheless, misleading. Commerce asserted that some major export sales were lost primarily because of U.S. nuclear nonproliferation policies that prevented U.S. companies from competing for those sales. Since U.S. companies could not compete for those sales, GAO believes that the impact of the policies could not be determined. (See pp. 28 to 31.)

Contents

ABBREVIATIONS

AECL	Atomic Energy of Canada, Limited
EIA	U.S. Energy Information Administration
GAO	General Accounting Office
GE	General Electric Company
IAEA	International Atomic Energy Agency
MWe	Megawatts electricity
NNPA	Nuclear Non-Proliferation Act of 1978

CHAPTER 1

INTRODUCTION

The Nuclear Non-Proliferation Act (NNPA) of March 1978 established, among other things, a policy of confirming the reliability of the United States in meeting its commitments to supply nuclear reactors and fuel to nations which adhere to effective nonproliferation policies. Under the Act, the Comptroller General is required to report to the Congress on the implementation and impact of the Act. Since legislative history indicated a concern that the NNPA might adversely affect U.S. companies attempting to compete in the nuclear market overseas, we assessed its impact on the competitiveness of U.S. nuclear exports in comparison with those of other supplier nations. Specifically, we sought to determine whether, as a result of the NNPA, any nation had or appeared to have ordered civilian nuclear material or equipment from another nation and the economic and employment impact of such action on the U.S. economy.

Since passage of the NNPA, various countries have perceived the United States as seeking to impose its own standards on countries with quite different energy needs, wishing to unilaterally alter binding international agreements, and seeking to deny developing countries access to nuclear technology. Many countries question the reliability of the United States as a nuclear supplier and do not agree about the proliferation risks and economic benefits of plutonium reprocessing and recycling.

Whether these negative perceptions actually resulted in orders being placed with non-U.S. suppliers, however, is an extremely difficult question to answer. First, during the first 2 years after the NNPA was passed, only nine nuclear plants were sold as exports and U.S. suppliers sold four of them. The other five plants are to have heavy-water reactors, a type not produced by U.S. companies. Second, many factors, including price, financing, technological considerations, foreign marketing efforts, and foreign government intervention, affect the competitiveness of U.S. exports.

DEPRESSED WORLD MARKET

Only a few countries continue to pursue ambitious nuclear programs, and since 1974 there has been a downturn in new nuclear domestic and foreign orders because:

1. The world recession following the Arab oil embargo led to lessened growth in overall energy demand.

2. Environmental concerns have increased worldwide, lengthening the time period before a nuclear plant actually begins commercial operation and increasing the costs.

3. Safety concerns, brought to the fore most recently by the Three Mile Island accident, have resulted in increased time and costs for building a nuclear plant.

4. Studies have indicated that the cost of nuclear generation has increased relatively more than other forms of electricity generation.

5. Governments and utilities see increased risks in pushing forward with the nuclear option, and public debate is taking place in countries where previously there had been little or none.

U.S. reactor vendors and their major foreign competitors have turned increasingly to third countries in search of new orders to sustain their nuclear production capacities. Even a single sale represents a substantial export transaction. The Westinghouse Corporation's 1979 sale of two reactor systems to Korea will involve exports of about $1.4 billion, which includes related equipment and services of other U.S. companies. The reactor sold by West Germany to Argentina in 1979 had an estimated value of $1.6 billion. Although U.S. and foreign reactor vendors, architect-engineers, and component manufacturers continue to work on the backlog of orders placed in the early 1970s, they face an uncertain future.

NUCLEAR NONPROLIFERATION POLICIES

Since World War II, it has been U.S. policy to prevent the spread of nuclear weapons through secrecy measures, international cooperation, and export restrictions. Nevertheless, at least five countries have developed and demonstrated the ability to produce nuclear weapons. The most recent example was the "peaceful" explosion by India in 1974. This led the United States to reexamine its nonproliferation policies, culminating in the Nuclear Non-Proliferation Act of March 10, 1978. The Act and related administration policies impose new and more restrictive export requirements, including full-scope

safeguards, 1/ the U.S. right of veto on retransfers and reprocessing, 2/ and restriction of sensitive nuclear technology exports. 3/ U.S. companies believe that these requirements, along with a burdensome export licensing system, put them at a competitive disadvantage in the nuclear export market.

Policies before 1974

The United States in 1946 presented a plan to the United Nations for prohibiting nuclear weapons and placing sensitive peaceful nuclear activities under international ownership and control. When the plan was not accepted by the Soviet Union, the United States continued a policy of strict secrecy as a means of containing nuclear proliferation, but this did not accomplish the desired results. By 1953, the Soviet Union and the United Kingdom had developed nuclear explosive devices and other countries had established peaceful nuclear programs and many more were looking for help in setting up nuclear programs. Thus, it was clear that nuclear science could not remain an American monopoly and that its spread was inevitable.

The United States recognized that its prestige as a world leader in nuclear energy development was at stake and decided to seek control of that which it could not prevent. President Eisenhower, in his 1953 "Atoms for Peace" address before the U.N. General Assembly, proposed increased international cooperation in the peaceful applications of atomic energy and called for the establishment of an international agency to

---

1/ A system to detect theft or diversion of nuclear materials, as applied by the International Atomic Energy Agency with respect to all peaceful nuclear activities in, under the jurisdiction of, or carried out under the control of a country.

2/ The chemical separation of usable uranium and plutonium from burnt, or spent, nuclear power reactor fuel.

3/ Any information (including information incorporated in a production or utilization facility or important component part thereof) which is not available to the public and which is important to the design, construction, fabrication, operation, or maintenance of a uranium enrichment or nuclear fuel reprocessing facility or a facility for the production of heavy water, but not including certain restricted data controlled by law.

regulate the use of atomic energy. Behind this shift in policy was the realization that, by assisting foreign nuclear programs, the United States might influence the nuclear policies of other nations, share in their technological developments, obtain guarantees on safeguarding nuclear materials, and hasten the adoption of broader disarmament measures.

The "Atoms for Peace" Program placed great emphasis on nuclear safeguards to prevent proliferation. Parallels between U.S. and European nonproliferation objectives for the past 20 years had their origin in the 1956 U.N. debate on establishing the International Atomic Energy Agency (IAEA). The Soviet Union, India, and many third-world countries openly opposed the IAEA inspection and verification system; the United States and most industrialized countries supported the safeguards.

Throughout the 1960s, the United States worked toward another nonproliferation milestone--the signing of the Non-Proliferation of Nuclear Weapons Treaty in 1968. The Treaty required its signers to submit all nuclear installations to IAEA safeguards. It also declared that countries have an "inalienable right" to develop, produce, and use nuclear energy for peaceful purposes, and it committed nuclear weapons countries to cooperate by sharing technology appropriate to peaceful purposes. In the 1970s, most competitors of the United States for nuclear reactor exports signed the Treaty, as the United States had in 1968. France did not sign the Treaty but officially stated intentions to behave as if it had signed.

Policies since 1974

Following India's test of a "peaceful nuclear device" in 1974, the United States and other supplier nations reassessed their nuclear export programs and established the Nuclear Suppliers Group. In 1978, after extensive negotiations, guidelines were published to govern member nations' exports. They included IAEA safeguards, physical security of nuclear equipment and materials, and right of supplier consent to retransfers to third parties. Although the United States was unable to persuade the other nations to outlaw sensitive exports or to require full-scope safeguards, the guidelines do urge that suppliers exercise restraint and the members agreed on a "trigger list" of nuclear equipment and materials which would be subject to the guidelines if exported.

Nuclear nonproliferation became a Presidential campaign issue in 1976, and in October then-President Ford published a lengthy statement announcing a new nuclear energy policy. Ford's initiatives included deferring spent-fuel reprocessing,

asking other suppliers to place a 3-year moratorium on exports of uranium enrichment or reprocessing technology, and continuing to embargo U.S. sales of sensitive technologies. The U.S. program of research and development on the breeder reactor was not to be affected.

Following the election, President Carter began to implement a tougher nonproliferation policy. In April 1977, he unveiled a set of coordinated policies for preventing proliferation. These policies would indefinitely defer commercial reprocessing and recycling of plutonium, restructure the U.S. breeder reactor program and defer commercial breeder use, and continue the embargo on exports of equipment or technology for uranium enrichment and reprocessing. In transmitting a proposed nuclear nonproliferation policy act to the Congress, the President noted that the act would require renegotiation of agreements for cooperation with foreign governments to bring them in line with the new act. After extensive hearings and deliberations, the Congress passed the Nuclear Non-Proliferation Act and it was signed by the President on March 10, 1978.

Present U.S. nonproliferation policies--and the NNPA in particular--make U.S. exports conditional upon a number of restrictions, including full-scope safeguards and the U.S. right of veto on retransfers and reprocessing, and restrict export of enrichment and reprocessing technology. The NNPA requires initiation of a program to renegotiate existing agreements for cooperation to bring them in line with the new NNPA requirements. Many agreements are not due to expire for 20 years or more, and the unilateral effort to renegotiate them has been an overall irritant to foreign governments.

In addition to these issues, certain earlier U.S. policies and actions had raised questions about the reliability of the United States as a nuclear supplier. The 1974 closing of the order books for U.S. enrichment services particularly shocked a number of customers. In addition, U.S. policies on such issues as human rights have hampered the export efforts of U.S. nuclear vendors.

Canada's restrictions on nuclear exports are similar to those of the United States. However, France and West Germany, the two major U.S. competitors for light-water reactor exports, have less onerous restrictions. Essentially, they adhere to the Nuclear Suppliers Group guidelines, do not require full-scope safeguards or a unilateral veto right over retransfers, and exercise less restrictive reprocessing policies. U.S. industry officials assert that French and German export licensing procedures are less complicated and have not caused

significant licensing delays. France, moreover, does not require prior consent before retransfers and does not require physical security measures, leaving this responsibility to the customer. U.S. company officials point to these differences as significant in dissuading foreign customers from purchasing U.S.-manufactured nuclear equipment and materials. In their view, U.S. nonproliferation policies and the NNPA represent a competitive hurdle in the present nuclear export market.

OBJECTIVES, SCOPE, AND METHODOLOGY

The major objective of this study was to assess the impact of the Nuclear Non-Proliferation Act on the competitiveness of U.S. nuclear exports in comparison with those of other supplier nations and the resulting economic consequences. We broadened the study to assess the impact of nuclear nonproliferation policies as they have developed since 1974. We gathered information from the Departments of State, Commerce, and Energy and the Export-Import Bank of the United States; however, our major source of information was the U.S. nuclear industry itself.

We met extensively with officials of the Westinghouse Corporation and General Electric Company, the two U.S. reactor vendors who have successfully competed abroad. Two other reactor vendors that have thus far been unsuccessful in their export efforts also contributed information. We also met with major U.S. architect-engineering firms involved in nuclear projects abroad. Finally, we met with several U.S. manufacturers that have exported nuclear components or nuclear fuels. We were assisted in our efforts also by nuclear industry trade associations, including the Atomic Industrial Forum and the American Nuclear Energy Council.

The reactor vendors gave us information relating to the economic impact of a nuclear reactor order. Westinghouse was our major source of information and gave us access to selected information at the corporate headquarters in Pittsburgh and European headquarters in Brussels; we reviewed in detail documents relating to its effort to obtain nuclear plant orders in Brazil, Iran, Romania, South Africa, and Spain.

The term "nuclear industry" is a rather elusive concept, in that it does not represent a discrete number of companies devoted to producing materials and components for nuclear power plants. Rather, the industry largely consists of subordinate segments of diversified companies. For competitive reasons, these companies tend to be guarded in releasing information about their nuclear activities. The ambiguous nature of the nuclear industry carries over into the Government's commercial reporting activities. With the constraints on

information dealing with business activities, it was not possible to carry out a detailed objective analysis of the significance of exports to the U.S. nuclear industry.

Our case studies of the competitiveness of U.S. nuclear suppliers in Spain and Korea included visits to those countries, where we met extensively with officials of the U.S. Embassies and U.S. reactor vendors and architect-engineering firms. We also met with representatives of several Spanish architect-engineering firms associated with U.S. firms. Due to perceived sensitivity by the Department of State, we were unable to meet with officials of the Korean or Spanish Governments or any Spanish utilities. The Department of State determined that negotiations between those countries and the United States with respect to the nuclear nonproliferation issues were at a delicate stage and that our efforts could be counterproductive. Because of comparable sensitivities, we did not attempt to visit government or utility officials of Brazil, Iran, Romania, or South Africa.

CHAPTER 2

THE UNITED STATES NO LONGER DOMINATES THE NUCLEAR EXPORT MARKET

The United States no longer dominates the nuclear export market as it did through the early 1970s. Many foreign reactor vendors have emerged--some aided by U.S. technology sales--to capture their own domestic markets, thus shrinking the market available to U.S. companies. Several foreign vendors have also competed aggressively for export sales, offering third-country customers a choice of suppliers and technology and further reducing U.S. reactor exports. In addition, the U.S. monopoly on uranium enrichment services ended when the Soviet Union began selling enrichment to free-world countries, and the enrichment market became even more competitive with the entry of European suppliers. In the highly competitive nuclear export market, technology, economics, and politics may influence a customer's choice of suppliers.

DECLINE OF U.S. DOMINANCE

U.S. suppliers dominated the world market for commercial nuclear power reactors through the early 1970s. The United States also monopolized the world supply of uranium enrichment services for light-water reactors until 1975. But by 1976, a report for the Ford Foundation concluded that:

> "In sum, the international nuclear energy industry in 1976 is far different from the industry that existed even five years ago. In terms of operating reactors and enrichment facilities, the United States and U.S. corporations are in a commanding lead. But such figures reflect the past and not the present or future. A country wishing to purchase nuclear reactors can go to France, Germany or Sweden and obtain systems which are for all intents and purposes identical to those which could be obtained in the United States. One or more Japanese companies could and probably will enter this market in the near future. An importing country could also go to Canada and obtain a reactor based on a different technology. For enrichment technology or services, the country could go to France, Germany, the United Kingdom, South Africa, and perhaps even Belgium or Japan. If a country wanted reprocessing capacity very badly, any of these countries and probably others could provide it. In the fast breeder reactor area,

France, Germany, the United Kingdom, Japan, and the Soviet Union will almost certainly be in a position to sell demonstrated technologies several years before the United States."1/

The light-water reactor, fueled by low-enriched uranium and cooled and moderated by ordinary water, was the U.S. alternative to the more expensive gas-cooled reactors built by the Europeans in the 1950s. Westinghouse and General Electric (GE) have been the major manufacturers of light-water reactors, specializing in pressurized and boiling-water reactors, respectively.

In the late 1950s, Westinghouse and GE sold a total of five reactors for export to Belgium, Italy, Japan, and West Germany. The Soviet Union exported one reactor to East Germany, and the United Kingdom exported one reactor to Italy.

Westinghouse and GE each sold 11 reactors for export in the 1960s, while other countries, including the Soviet Union, sold 14. The 22 U.S. reactor exports represented 9,618 MWe of the 14,407 MWe capacity exported, or about 67 percent.

During 1970-73, U.S. companies captured 86 percent of the capacity exported to the free world, but this share declined below 50 percent for 1974 through 1979. The following chart shows the U.S. share of nuclear power plant export sales to the free world in the 1970s.

	Reactor exporter		MWe capacity		
Year	United States	Foreign	United States	Total	U.S. percent
1970	2	0	1,529	1,529	100
1971	10	1	9,578	10,270	93
1972	7	0	6,202	6,202	100
1973	5	4	4,133	6,942	60
1974	8	8	7,505	15,424	49
1975	7	3	6,980	10,460	67
1976	1	2	970	2,814	34
1977	0	5	0	5,700	0
1978	2	2	1,800	3,000	60
1979	2	3	1,980	3,878	51

1/ Joskow, Paul L. "The International Nuclear Industry Today--The End of the American Monopoly"; Foreign Affairs, July 1976, pp. 788-803.

During the 1970s, the Soviet Union received export orders for 28 reactors having a total capacity of 12,000 MWe. Most of the orders were from East European countries, but customers included Finland, Cuba, and Libya.

The virtual U.S. monopoly on enrichment services for the free world's light-water reactors ended abruptly in 1974 when the Atomic Energy Commission was required to make a number of new foreign contracts conditional until U.S. enrichment facility capacity could be increased. The Soviet Union began selling enrichment services to countries which had begun to question whether the United States would be a reliable supplier in the future. Later, two European consortia developed uranium enrichment capabilities; France, Italy, Belgium, Iran, and Spain formed EURODIF and the United Kingdom, the Netherlands, and West Germany formed URENCO. These consortia now sell enrichment services in competition with the United States, and the available supply exceeds present world needs. The excess capacity may exist well into the 1990s, enabling customers to switch suppliers easily. Several contracts for U.S. enrichment services have already been canceled.

FACTORS AFFECTING NUCLEAR EXPORT COMPETITION

Technology, economics, and politics may influence a customer's decision to select a particular nuclear supplier. The process of soliciting and evaluating bids for nuclear reactors is very complex, generally secretive, and may stretch over many months or even years, making it difficult to determine the effect of any specific competitive factor.

Customers have a choice of at least three types of reactors based on different technologies and a variety of sizes. They also have a choice of at least 10 reactor suppliers that have competed for export orders. The reputation and reactor operating records of these suppliers can be competitive factors. For customers seeking to develop their own nuclear power capabilities, the supplier's willingness to license and help develop technology and to use locally produced components can be important.

Economic competition is generally based on an evaluation of the unit cost of electricity to be produced during the life of the reactor. The evaluation considers such variables as the capital cost of the power plant, operating costs including fuel, and financing costs. However, in some cases the variables, particularly financing by the supplier's government,

may be more important to the customer than the overall cost evaluation. Project financing has been a matter of intense competition between supplier countries.

Political factors are basically a reflection of relations between the governments of the purchaser and the competing suppliers. These factors may range from simple marketing efforts on the part of high government officials to complex multilateral issues, such as divergence in nonproliferation policies. The following U.S. actions in recent years could impede competition for nuclear exports.

--The Nuclear Non-Proliferation Act requires that certain conditions be met before approval of export licenses. Countries with significant self-developed projects may object to the requirement for full-scope safeguards. Countries that plan to participate in reprocessing and breeder reactor projects may seek suppliers that do not restrict retransfers of nuclear materials. And countries that have been suspected of nuclear weapons activities may not submit to the uncertainty of the U.S. nuclear export licensing system due to anticipated delays and high probability of rejection.

--A January 1979 Executive order requires an environmental impact assessment to be prepared for nuclear facility exports, further raising the possibility of delay or denial for nuclear export licenses.

--Human rights policies place constraints on Government support and financing for exports to countries having records of abusing human rights.

--Restrictions have been placed on exports of strategic items to Communist countries.

--The Foreign Corrupt Practices Act has raised uncertainty in international transactions because of the difficulty perceived by some of distinguishing between illegal bribes and legitimate commissions.

THE RISE OF FOREIGN COMPETITORS

Canada, Sweden, the Soviet Union, and the United Kingdom have independently developed their own nuclear technology. Other countries, notably France, West Germany, Italy, and Japan, have relied to some extent on purchases of U.S. technology in developing their nuclear industries. Technology licensing and exchange agreements benefited U.S. companies in

the form of royalties and component sales and permitted U.S. suppliers to participate in markets where they might have been excluded by buy-national policies or by other factors, such as U.S. human rights policies. However, the arrangements had an obvious disadvantage; customers became competitors, excluding U.S. suppliers from their domestic markets and challenging U.S. suppliers in foreign markets.

Westinghouse: licensing the pressurized-water reactor

At the end of 1979, 26 of the 71 power reactors operating in the United States were Westinghouse pressurized-water reactors. In the remainder of the free-world market, 96 of 188 light-water reactors operating or on order were Westinghouse-designed. But 61 percent of the 96 were sold not by Westinghouse but by licensees. These statistics indicate that the licensing of technology to foreign competitors was a factor in breaking U.S. domination of reactor exports.

Westinghouse stated that it makes every effort to sell reactors directly to foreign utilities. In developing countries, these efforts may include assistance to identify local industrial capability for producing certain components. In industrialized countries, such as France, the direct sale option was not open; France simply would not import a nuclear power plant. Westinghouse's solution to this problem has been to seek a license arrangement to obtain limited participation in an otherwise closed market.

Westinghouse presently has nuclear equipment technology licensing agreements in France, Japan, Italy, Belgium, Sweden, Spain, the United Kingdom, and South Korea. Generally, licensees pay Westinghouse an initial fee plus a royalty for each sale. Licensing agreements are typically for 10 years duration.

General Electric: licensing the boiling-water reactor

GE's boiling-water reactor is second only to Westinghouse's pressurized-water reactor in worldwide use. At the end of 1979, 26 of the 71 power reactors operating in the United States were GE reactors. In the remainder of the free-world market, 38 of the 188 light-water reactors operating or on order were GE-designed boiling-water reactors. About 37 percent of the 38, however, were sold not by GE but by licensees.

GE negotiated broad nuclear systems licenses in Europe and Japan more than 15 years ago. These agreements provide licensees with complete access to engineering and manufacturing organizations and provide for transfer of nuclear technology through documents, consultation, and training, according to GE officials. In 1975, GE negotiated "technology development agreements" with all its licensees and technical associates. It said that the original licensor-licensee relationship--an essentially one-way flow--is evolving into a technical partnership between GE and its international reactor associates. While there are benefits from association with other reactor manufacturers, their sales obviously diminish export opportunities for General Electric.

Other licensing arrangements with foreign nuclear industries

Certain other U.S. companies have joined in foreign ventures or have licensed technology to foreign manufacturers. For example:

--The Babcock & Wilcox Company jointly owns a fuel facility and has agreements with Sumitomo Electric and Furikawa Electric in Japan. Until 1978 the Company also held an interest in Babcock-Brown Boveri Reaktor, a German reactor manufacturer.

--Combustion Engineering entered into joint ventures with the German firm Klein, Schnazlin, & Becker AG and with the British Rolls Royce firm and Northern Engineering Industries.

--Rockwell International has a majority partnership of 55 percent with the French firm Creusot Loire in Rockwell Valves, S.A., to make valves for nuclear plants in France.

Foreign competitors in the export market

Kraftwerk Union (West Germany), Framatome (France), Atomic Energy of Canada, Ltd., ASEA-Atom (Sweden), and Atomenergoexport (Soviet Union) are the U.S. suppliers' major competitors for the world nuclear reactor export market. In the late 1960s and in the 1970s, each company sold reactors to countries which were potential customers for U.S. manufacturers.

West Germany

West Germany purchased a small nuclear power reactor from GE at an early stage in its nuclear program. West Germany's

two major reactor manufacturers built their reactor businesses on technology purchased from U.S. reactor vendors. Kraftwerk Union has sold 21 reactors in Germany; 11 of these have been completed. Babcock-Brown Boveri Reaktorbau GmbH has sold two reactors in Germany; neither has been completed.

Kraftwerk Union, a joint venture entered into in 1969 by AEG-Telefunken and Siemens, has been called the most powerful and formidable foreign competitor for nuclear reactor exports. It originally held licenses from both Westinghouse and GE. The Westinghouse license was terminated in 1969.

Siemens sold Germany's first commercial reactor export to Argentina in 1968, the only heavy-water reactor constructed by Germany to date. From 1969 through 1975, Kraftwerk exported eight reactors totaling 7,934 MWe capacity to the Netherlands, Austria, Switzerland, Iran (2), Brazil (2), and Spain. It did not sell another reactor for export until 1977, when it sold four reactors to Iran. The fall of the Shah's government to the Islamic revolution, however, effectively negated these sales. In late 1979, Argentina selected Kraftwerk to supply a second heavy-water reactor.

Babcock-Brown Boveri is of U.S. and Swiss origins. It was founded in 1971 to adapt the Babcock & Wilcox pressurized-water system to West German and other European market requirements. This company obtained one export order from Luxembourg. In 1978, Babcock & Wilcox sold its majority interest in the venture to a German firm.

France

Like West Germany, France bought a U.S. power reactor in the very early stages of its nuclear program. Framatome, France's only light-water reactor manufacturer, built its reactor business on technology purchased from Westinghouse. Framatome has sold some 40 plants in France; 7 of these were in operation at the end of 1979. Framatome is jointly owned by the French steel company Creusot-Loire, the French Atomic Energy Commission, the French Empain-Schneider group, and by Westinghouse, which has a 15 percent interest.

Under the licensing agreement, Westinghouse provides Framatome with new technical information as quickly as Westinghouse develops and sells the products of such information. Framatome has unrestricted use of this technology in France, but must obtain Westinghouse approval to export it to certain countries. Westinghouse must obtain U.S. Department of Energy authorization for transfers to countries not generally author-

ized to receive light-water reactor technology. Framatome's technology license with Westinghouse expires in 1982 and it is reportedly aiming to develop its own pressurized-water reactor design.

In 1967, the French Groupement Constructeurs Francais sold one gas-cooled reactor to Spain. The French did not sell another nuclear reactor for export until 1974, when Framatome sold two 910 MWe reactors to Belgium and two 900 MWe reactors to Iran. In 1976, Framatome sold two 922 MWe reactors to South Africa. Framatome aggressively competed for sales to such countries as Mexico, South Korea, Spain, and the People's Republic of China.

Sweden

Sweden purchased three pressurized-water reactors from Westinghouse, but it primarily produces boiling-water reactors of its own design. Sweden's Allmanna Svenska Elektriska Aktiebolaget-AB Atomenergi (ASEA-Atom) developed its technology independently of U.S. and other reactor manufacturers. ASEA-Atom has sold nine reactors in Sweden; five of these are operating.

ASEA-Atom is a joint venture of the Swedish firm ASEA and the Swedish Government-owned AB Atomenergi. It has exported two reactors, both to Finland. In early 1978, ASEA-Atom's reactor export efforts were curtailed by Swedish nonproliferation policy. Export restrictions prevented ASEA-Atom from offering Swedish uranium supplies with reactor sales and also prohibited reactor sales to nonsigners of the Treaty on Non-Proliferation of Nuclear Weapons.

Canada

Atomic Energy of Canada, Ltd. (AECL) sells a heavy-water CANDU reactor which uses natural uranium as a fuel. AECL developed the CANDU reactor independently and has sold 25 in Canada, 11 of which were operating at the end of 1979.

AECL sold its first CANDU reactor for export in 1963. It has sold eight reactors for export, India (2), South Korea, Romania (4), and Argentina. Canada recently reduced its forecast of domestic nuclear energy growth and officials have stressed the need to export reactors to offset sagging domestic business and to keep the Canadian industry and expertise in place. As a result, AECL has campaigned aggressively for exports to Argentina, Romania, and other countries.

Soviet Union

The Soviet Union built and operated a light-water-cooled, graphite-moderated reactor by 1954, and six more were operating by 1958. In the 1960s the Soviet Union built two graphite reactors as well as two pressurized-water reactors, one boiling-water reactor, and a small fast-breeder reactor. In the 1970s the Soviet Union activated 16 reactors, with a capacity of about 8,360 MWe, and it has some 21 reactors of various types (18,765 MWe capacity) under construction.

The Soviet Union's first nuclear exports were to Soviet Bloc countries in Eastern Europe. In 1956, Atomenergoexport exported its first reactor--a 70 MWe pressurized water reactor to East Germany. Subsequent exports were all basic 408 MWe pressurized water reactors--two to East Germany in 1965, two each to Hungary and Bulgaria in 1967, and one to Finland in 1969, the first outside the Soviet Bloc.

Atomenergoexport reactor exports in the 1970s went primarily to Soviet Bloc countries--11 to Czechoslovakia, 6 to East Germany, 2 to Bulgaria, 2 to Poland, 2 to Hungary, one to Romania, and 2 to Cuba. There was one additional export to Finland in 1971, and one order from Libya in 1979.

The Soviet Union established a reputation as both a severe adherent to nonproliferation policies and a reliable supplier of fuel services; it requires reactor customers to buy Soviet fuel and to return spent fuel for reprocessing.

Soviet policy since 1975 has encouraged sales of reactors and components outside the Soviet Bloc, and Atomenergoexport has attempted to sell reactors to the Philippines, Libya, and and Turkey. Spurred by the confusion in U.S. enrichment policy (see p. 53), the Soviets were supplying 55 percent of the European Economic Community's uranium enrichment services by 1977.

Potential competitor countries

Three countries whose firms have especially strong potential for entering the export market are Japan, Italy, and the United Kingdom.

Japan has purchased 9 reactors from U.S. companies and one from the United Kingdom; the remaining 12 nuclear plants operating in Japan were built by Japanese licensees of U.S. vendors. In 1967, GE signed licensing agreements with two Japanese electrical manufacturers--Hitachi, Ltd., and Toshiba Corporation--and Westinghouse signed a licensing agreement with Mitsubishi

Heavy Industries, Ltd. The three licensees have orders for seven additional plants. Japan has not exported reactors, but the slowdown in domestic orders and the strong industrial base of its companies provide a great incentive to enter export competition.

Italy has four nuclear plants in operation. Reactors for two were supplied by U.S. companies; one was supplied by the United Kingdom; and one was supplied by Italy's Finmeccanica Group, a government-owned consortium of Italian nuclear companies. Italian companies have orders for an additional five plants in Italy and have competed for exports to Turkey, Iraq, and Indonesia.

During the 1950s and 1960s, the United Kingdom activated 26 nuclear power plants. Most of these were powered by gas-cooled reactors manufactured by either the U.K. Atomomic Energy Authority or the Nuclear Power Group, Ltd. In the 1960s, the British began to build an advanced gas-cooled reactor manufactured by The Nuclear Power Group and by the Nuclear Power Company, a wholly owned subsidiary of Britain's National Nuclear Corporation. The latter company is jointly owned by the U.K. General Electric Company, the U.K. Atomic Energy Authority, and a group of private industrial companies known as British Nuclear Associates. Since 1975, four large advanced gas-cooled reactors have been activated and another ten ordered.

British reactor exports have been limited to small gas-cooled reactors to Italy and Japan in the late 1950s. The more economical light-water reactor prevailed in the export market. In fact, there has been debate within the United Kingdom whether to switch to light-water reactors. In 1978, the U.S. firm, Combustion-Engineering, formed a joint venture with the British Northern Engineering Industries and Rolls Royce to market pressurized-water reactors in the United Kingdom and for export. In addition, Westinghouse concluded an agreement with the British National Nuclear Corporation in December 1979 to license reactor technology for use in the United Kingdom.

CONCLUSIONS

The United States captured 86 percent of the free world's reactor export orders during 1970-73 and monopolized the supply of uranium enrichment services for free-world reactors until 1975. That dominance has since declined. The U.S. share of free-world reactor exports slipped to 47 percent during 1974-79, and Soviet and European suppliers are competing for enrichment sales.

Many foreign reactor vendors have emerged--some aided by U.S. technology sales--to capture their own domestic markets. This appears to have closed such former U.S. markets as Japan, Italy, and Sweden. Several foreign vendors--particularly Germany's Kraftwerk Union, France's Framatome, and Atomic Energy of Canada, Ltd.--have competed aggressively for export sales, offering customers a choice of suppliers and technology. Their sales have reduced the U.S. share of the remaining export market.

The nuclear export market has become highly competitive and technology, economics, and politics may influence a customer's choice of suppliers. Divergence in nonproliferation policies is but one of the many factors.

CHAPTER 3

IMPACT OF U.S. NONPROLIFERATION POLICIES ON THE COMPETITIVENESS OF NUCLEAR EXPORTS COULD NOT BE DETERMINED

The Nuclear Non-Proliferation Act had no apparent influence on the award of five nuclear reactor export sales to foreign suppliers in the 2 years after its passage. Also in the same period, a U.S. supplier succeeded in selling four reactors for export despite the customer's concern over U.S. nonproliferation policies. The depressed market during the period provided only a limited test of the NNPA's impact. Our examination of earlier competitions found that prior U.S. nonproliferation policies did play a part in the failure of U.S. suppliers to win orders in Brazil and Iran during 1975-77; in other competitions during that period, such factors as financing and political considerations were the decisive causes. The NNPA's impact on other nuclear exports, such as components and architect-engineer services, was equally unclear. Industry officials and foreign customers have complained about the NNPA's export restrictions and related export license delays, but there was little evidence that it actually caused lost export sales.

NUCLEAR POWER PLANT ORDERS SINCE NNPA WAS ENACTED

The export market for nuclear reactors was quite depressed in the 2 years after passage of the NNPA. Romania ordered four reactors from AECL, and Argentina ordered one reactor from Kraftwerk Union. All five are to be natural-uranium-fueled, heavy-water reactors. U.S. companies do not produce that type of reactor and did not actively compete for these orders. Accordingly, it appears that the NNPA had no influence on the ability of U.S. companies to compete for these orders.

During the same period, Westinghouse was successful in winning orders for four nuclear reactors in South Korea. U.S. nonproliferation policies were a concern of South Korea, prompting an insistence that contracts contain a cancellation clause in the event export licenses were not issued timely. That concern was eased by introduction of a congressional resolution that would permit a variance to established enrichment ceilings. Subsequently, a law was passed which effectively eliminates those ceilings for countries, such as South Korea, which are party to the Treaty on Non-Proliferation of Nuclear Weapons.

Our observations on these export orders are summarized below. A more detailed discussion is presented in appendix I.

Romania

Romania in November 1978 announced plans to purchase two heavy-water reactors from AECL. In 1979 the plan was expanded by the addition of two reactors. The awards may represent a significant new market for the Canadians; Romania by some reports intends to purchase as many as 12 reactors over the next two decades.

The award of these reactor sales to AECL may be due to the technical and political appeal of the heavy-water reactor for the Romanians and, in the view of one U.S. supplier, Romania was a somewhat less than viable market because of anticipated export license problems.

Argentina

In October 1979, Argentina selected Kraftwerk Union to build its third heavy-water reactor system. AECL competed strongly for the order, offering a system that had a substantial economic advantage over the Kraftwerk system. That advantage, however, was overcome by Germany's excellent record in constructing Argentina's first power reactor and by related factors. Although Argentine officials did not cite nonproliferation policies as a competitive factor, much publicity was given to Canada's requirement for full-scope safeguards as opposed to Germany's requirement for safeguards only on facilities supplied by it.

U.S. companies were not in contention for this reactor order. Argentina's nuclear power program is based on heavy-water, natural-uranium-fueled reactors which U.S. companies do not produce. This choice of reactor design avoids dependence on foreign enrichment services. It also effectively excludes U.S. companies from the Argentine market.

South Korea

In April 1978, shortly after passage of the NNPA, South Korea ordered two nuclear reactors from Westinghouse, and in August 1979 it ordered another two units from Westinghouse. These four reactors represent the only export orders won by any U.S. vendor since the NNPA was passed. Competition for the latter two units was especially intense. Concerns relating to U.S. nonproliferation policies were raised, prompting an insistence that contracts contain a cancellation clause in the event

export licenses were not issued timely. The concerns were somewhat eased by introduction of a congressional resolution that would permit a variance to the enrichment ceiling in the existing agreement for cooperation. South Korea ultimately decided in favor of its traditional supplier--Westinghouse--from whom it had ordered four of its first five reactors. In June 1980, Congress passed a modified version of the resolution, Public Law 96-280, which effectively eliminates enrichment ceilings for countries, such as South Korea, which are party to the Treaty on Non-Proliferation of Nuclear Weapons.

NUCLEAR POWER PLANT ORDERS 1975-77

During 1975-77, Kraftwerk and Framatome won export orders for a total of 10 nuclear reactor systems in four countries--Spain, Iran, Brazil, and South Africa. In the same period, U.S. companies won orders for seven reactors in Spain and one reactor in the Philippines. During that period, U.S. nonproliferation policies were changing in response to India's 1974 nuclear explosion and they included certain features--restrictions on enrichment technology exports and control over reprocessing of U.S.-origin fuel--that became law through the Nuclear Non-Proliferation Act. An examination of the competition for orders won by foreign suppliers in that period provided a further means of assessing whether U.S. nonproliferation policies affected exports.

U.S. nonproliferation policies had no decisive impact on the awards to foreign vendors in Spain and South Africa. U.S. companies tendered formal bids but lost out in Spain because of more favorable financing provided by the Kraftwerk offer. Framatome won the South Africa orders when GE was unable to sustain its consortium arrangement with a European firm--reportedly due to political problems between South Africa and the foreign firm's government.

U.S. nuclear policies did play a part in the failure of U.S. firms to market plants in Brazil and Iran. Brazil turned to West Germany in 1975 because of the controversy over U.S. enrichment service contracts and because of the lure of obtaining complete fuel-cycle capability via exports of German technology. Iranian orders from the United States were stalled pending the conclusion of a U.S.-Iranian bilateral agreement for cooperation; this was delayed at least in part owing to nonproliferation concerns of the U.S. Government.

Our observations on the competition for these export orders are summarized below. A more detailed discussion is presented in appendix I.

Spain

In 1975, and again in late 1977, Spanish electric utilities placed orders for nuclear plants with West Germany's Kraftwerk Union. Those orders, which broke a virtual monopoly on nuclear orders held by the United States, can more accurately be attributed to superior financing packages offered by the Germans than to any nonproliferation policies advocated by the U.S. Government. Nonetheless, U.S. companies seeking business in Spain argue strongly that the U.S. position on proliferation and the policies enacted to sustain that position have eroded the market position of the United States and will affect future U.S. business opportunities.

It may be some time, however, before that hypothesis can be fully tested. Spain is unlikely to award any new plant orders in the near future, and this may afford U.S. nuclear vendors a respite during which U.S. policies and their applications will be clarified.

South Africa

South Africa in mid-1974 advertised for the supply and construction of two nuclear power plant units at Koeburg. Contracts for the units were ultimately awarded in 1976 to a French consortium led by Framatome. GE had initially been designated the successful bidder, but found itself forced to withdraw following the breakup of its consortium arrangement with a European firm. (A similar fate had earlier befallen Westinghouse during the competition, thus removing it from contention.)

GE's problems with its consortium were cited as the immediate cause of its failure to win the South African contracts. Even at that time, however, concern had already surfaced as to whether any U.S. nuclear vendor would be in a position to obtain either U.S. Eximbank financing guarantees or an export license in light of the political and human rights issues surrounding commercial ventures in South Africa.

Iran

The prolonged delay in concluding a mutually acceptable U.S.-Iran bilateral agreement for cooperation precluded any U.S. sales of nuclear units to Iran. Such an agreement is a prerequisite to U.S. nuclear exports. The extended negotiations on the agreement reflected, at least in part, U.S. nonproliferation concerns; the U.S. stance on reprocessing, for example, did not meet with Iranian approval. To the extent that a U.S. reactor vendor had an assured entrance to

the market (and there is some evidence to suggest that such was the case), the nonproliferation issues that stalled the bilateral agreement can be said to have prevented U.S. vendors from selling reactors to Iran. In the meantime, both Kraftwerk Union and Framatome were able to proceed with sales of nuclear units to Iran. However, the new regime in Iran has announced its intention to terminate the nuclear program, and it appears that even the units under construction will not be completed.

Brazil

In 1974 the U.S. Government proposed to offer Brazil enrichment services contracts contingent on the availability of U.S. enrichment capacity. This caused Brazil to become uneasy over the reliability of the United States as an enrichment supplier and, coupled with its interest in building a domestic nuclear industry and acquiring a greater degree of energy independence, opened the door to the Germans and their attractive offer of fuel-cycle services technology.

In 1975 Brazil and West Germany reached agreement for Germany to supply at least two nuclear power plants, with options for six more, as well as the full range of fuel-cycle services, including enrichment and reprocessing technology. That agreement represented a direct loss for U.S. vendors of two plants as well as the de facto closure of the Brazilian market to the United States because the option plants represented the remainder of Brazil's planned nuclear program.

OTHER NUCLEAR EXPORTS

Sales by foreign reactor suppliers may mean the loss of U.S. sales of other power plant materials and services because foreign customers tend to buy architect-engineer services, turbine generators, components, and the initial fuel load from suppliers of the same nationality as the reactor supplier. Most of the suppliers we contacted generally deal directly with the reactor supplier or architect-engineer rather than with the foreign customer. They were unable to identify sales lost as a result of U.S. nonproliferation policies but noted that they were effectively excluded from major sales for projects not won by a U.S. reactor supplier. However, some suppliers of components and nuclear materials have dealt directly with foreign customers and have had to apply for export licenses. They cited delays and other difficulties in obtaining licenses--due to nonproliferation concerns--as lessening the reliability of U.S. suppliers in the eyes of foreign customers. They noted that some customers have sought alternative suppliers and have encouraged domestic development of nuclear industry as steps toward nuclear energy independence.

Architect-engineering services

Other than the reactor vendor, the architect-engineer is most directly involved with the foreign customers (government and/or utility) for a nuclear power plant project. Architect-engineers provide a variety of services, including technical and economical feasibility studies, safety reports, detailed design and specifications, procurement, construction or construction management, quality control, systems operation and maintenance, and personnel training. A contract for architect-engineer services for a nuclear plant unit can amount to as much as $100 million and 1,500 man-years of employment over 6 years. If a U.S. architect-engineer handles the procurement function, U.S. suppliers are likely to be favored for plant equipment not available within the country, especially if the specifications have been written to U.S. standards. Consequently, the selection of a U.S. architect-engineer may have a more favorable impact on the U.S. balance of payments than is indicated by the value of the architect-engineer services alone.

It is difficult to obtain documentary evidence of U.S. architect-engineers having lost contracts for services abroad as a result of U.S. nonproliferation policies. The major nuclear architect-engineer firms pointed to overseas competition for reactor sales in which Westinghouse and GE were unsuccessful; they noted that their firms were thereby excluded from providing major services on such projects. As noted earlier, however, lack of success of U.S. vendors could be attributed to U.S. nonproliferation policies only for Brazil and Iran.

Company officials of the architect-engineer for Brazil's first nuclear power plant, which included a Westinghouse reactor, told us they had expected that both they and Westinghouse would be awarded contracts for at least the next two plants in Brazil. The architect-engineer contracts would have been worth $150 million to $200 million, according to those officials. They could only speculate as to the precise dialog between Brazilian officials on the one hand and Westinghouse and U.S. Government officials on the other. In any case, according to company officials, the Brazilians lost confidence in the United States as a supplier, primarily because of lack of assurances on replacement fuel for the first plant, and ultimately awarded the contracts to the German Kraftwerk Union.

Power plant components and other nuclear materials

To understand the potential impact of U.S. nonproliferation policies on the export of power plant components and other

nuclear materials, certain observations should be made about the market. First, many components have strictly nuclear uses but some are suited for other uses as well. Second, component suppliers may be unaware of the ultimate destination of their products. Purchase of components is generally handled by either the reactor vendor or the architect-engineer and only rarely by the foreign government or utility. In manufacturing the reactor, Westinghouse and GE purchase components from a myriad of suppliers, who may not be concerned whether their components end up in a plant in South Carolina or in South Korea.

Identifying the universe of suppliers that might be affected by U.S. nonproliferation policies was difficult because of the market's nature. With the assistance of industry trade associations and reactor vendors and by examining export license application lists, we identified and interviewed officials of companies that have supplied components and other nuclear materials for power plants overseas. These companies generally did not have data, or declined to make it available, on the potential export market for their products.

Because these companies generally do not deal directly with foreign customers, they were unable to identify specific sales which may have been lost as a result of U.S. nonproliferation policies. They noted, however, that to the extent a reactor vendor, such as Westinghouse or GE, was unsuccessful in obtaining an order overseas for nonproliferation or other reasons, they were thereby excluded from supplying components for the system. Moreover, if U.S. architect-engineers were excluded from markets, their U.S. equipment suppliers would be excluded. Company officials could only speculate as to the reasons why a U.S. reactor vendor had lost a particular sale. Information they provided was secondhand or hearsay, and they directed us to reactor vendors and architect-engineers who had dealt directly with foreign customers.

In short, the export market for components and other nuclear materials is basically tied to the number of reactor exports won by U.S. vendors; a decline in reactor exports will cause a subsequent decline in orders for components. Because of the long time lapse between a plant order and actual completion, some components may not be exported until several years after the reactor is sold.

In some cases, U.S. suppliers may benefit from sales won by foreign reactor vendors--Framatome, Kraftwerk Union, and especially AECL. In such cases, a U.S. supplier would deal directly with the foreign customer and would be required to apply for a nuclear export license if the items to be supplied

were on the Nuclear Regulatory Commission controlled list. If delays or other difficulties occurred before such a license was issued, the reliability of the U.S. supplier would likely be diminished in the eyes of the foreign customer.

Although lost U.S. export sales of components and other nuclear materials were nearly impossible to document, actual or potential licensing delays and other difficulties may be inimical to the interests of U.S. suppliers. This is illustrated by the development of foreign zirconium suppliers.

Zirconium is a specialized metal used for the containment of uranium fuel and for the structural components of nuclear reactors. It has been supplied principally by one supplier in the United States and to a lesser extent by suppliers in France and Japan. The U.S. supplier stated that, due to delays in receiving an export license for sales to France, the French intended to expand indigenous production even though it would be less economical than importing zirconium from the United States. The same supplier was unable to obtain a license in one instance to export zirconium tubing to West Germany; the tubing was apparently to be sold to Argentina. Since the administration's policy regarding such third-country transfers was "unclear" according to company officials, U.S. licensing officials delayed action on the application. The Germans told the U.S. supplier that they would begin to buy one-third of their zirconium from the French, whose facilities, although not large enough to compete economically with the U.S. supplier, would be expanded. Plans to expand zirconium production were also announced by Japan in 1977. Although there is no documentary evidence that this was a direct result of U.S. nonproliferation policies, the desire for independence of supply is a reasonable explanation of such actions. To the extent that further delays in licensing occur bringing into question the reliability of the U.S. supplier, third-country customers can be expected to turn increasingly to the French and Japanese for zirconium as they become more competitive.

January 1979 estimates by the U.S. supplier indicate its share of free-world zirconium sponge production decreased from about 85 percent in 1977 (7,000,000 of 8,250,000 lbs.) to about 74 percent in 1978 (6,000,000 of 8,100,000 lbs.) and to an estimated 61 percent in 1979 (5,000,000 of 8,250,000 lbs.). If the U.S. supplier had maintained its 1977 share of the free-world market, its zirconium sponge production would have been greater by 885,000 pounds in 1978 and 2 million pounds in 1979. This indicates that production lost to French and Japanese suppliers in 1978 and 1979 was valued at about $28.8 million at end-of-year prices.

Royalties and license fees

U.S. companies generally benefit most from direct sales, but they may also benefit through licensing agreements and royalties from licensee sales. Westinghouse, for example, has 10 licensing agreements for plants and fuels in 8 countries. It noted that, although its primary effort is in direct selling, it may be asked to explore the industrial base of a particular country to determine what can be produced locally. In highly industrialized countries, such as France, where the "sell direct" option is not open, Westinghouse has sought a licensee in order to derive some income out of an otherwise closed market. Westinghouse receives an initial fee from the licensee and an additional fee when the licensee makes a sale. Consequently, when Westinghouse's French licensee, Framatome, wins out over a U.S. reactor vendor in a third country, Westinghouse does benefit to the extent of royalty income received as well as through the sale of such components as zirconium tubing and reactor coolant pumps.

There is some evidence that foreign competitors can get along without U.S. licenses. Kraftwerk Union terminated its licensing agreement with Westinghouse in 1969. Consequently, restrictions under the NNPA, such as prior U.S. approval of a recipient country's export of materials or equipment produced from exported U.S. technology, could make U.S. licenses less desirable, thus leading to termination of agreements and subsequent loss of royalties and fees.

Advanced technology

A number of countries are proceeding toward commercial development of advanced nuclear technology, such as breeder reactors and the fuel-reprocessing facilities to sustain them. They view breeder reactors as a future means of increased energy independence. U.S. companies in the past were encouraged to pursue this advanced technology; however, the present ban on its commercial application for nonproliferation reasons has caused the United States to lag behind other countries. This could hurt the ability of U.S. companies to participate in future nuclear markets.

CONCLUSIONS

We did not identify any nuclear export sales lost to foreign competitors as a result of the Nuclear Non-Proliferation Act. U.S. companies have continued to participate in the nuclear export market and have sold four nuclear power reactors. However, the nuclear market has been depressed, providing only a limited test of the NNPA's impact on competitiveness.

It must be recognized that export restrictions stemming from the NNPA have led potential foreign customers to perceive the United States as a less than reliable supplier and that prior nonproliferation policies did play a part in U.S. companies' failures to win reactor export orders during 1975-77. Therefore, based on our analysis of available data, we have concluded that no valid basis exists at this time for making a determination as to the impact of the NNPA on the competitiveness of U.S. nuclear exports. However, it is clear that U.S. companies are at some disadvantage because importers perceive that implementation of the NNPA may result in delayed export licenses for nuclear plants, fuel, and components.

AGENCY COMMENTS AND OUR EVALUATION

The State Department agreed with our conclusion that the impact of the Nuclear Non-Proliferation Act on the competitiveness of nuclear exports could not be specifically determined. It did not "wish to imply, however, that nuclear nonproliferation policies had no impact on nuclear exports." State also suggested that any follow-on study should focus more on the growing component export market. (See app. II.)

The Department of Energy and the Export-Import Bank of the United States did not disagree with our conclusions. Energy provided updated nuclear forecasts, and the Bank did suggest alternate analysis methodology that might be useful to a study of this nature. (See apps. III and V.)

A Westinghouse representative also reviewed a draft of this report and did not disagree with our conclusions. His observation that U.S. companies are at some disadvantage because importers perceive that the NNPA may result in delayed export licenses is recognized in our conclusion.

The Department of Commerce said that the report appears to understate the impact the NNPA may have on possible exports to countries which have not satisfied the Act's nonproliferation criteria, such as Argentina, Pakistan, India, and Chile. (See app. IV.) In particular, Commerce asserted that Argentina chose a type of reactor not available from U.S. vendors in an effort to avoid problems in obtaining enriched fuel, reflecting Argentine uncertainty regarding U.S. policy. It asserted that some major export sales lost prior to passage of the NNPA, such as the Brazilian and Iranian sales, were lost primarily because of then-existing or evolving U.S. nonproliferation policies, which were codified in the NNPA.

Commerce suggested we revise the report to conclude that (1) export sales have been lost primarily because of nonproliferation policies and the NNPA, (2) there will be a continuing adverse effect on U.S. export orders unless NNPA principles are adopted by non-U.S. suppliers, and (3) many future export orders are likely to be lost because customer countries do not meet the test of U.S. policies.

In our opinion, information available to us did not enable us to draw such definite conclusions as suggested by Commerce. The export sales lost in Brazil, Iran, and Argentina which Commerce attributed primarily to nonproliferation policies and the NNPA were placed in a different perspective according to our information, as follows.

--Brazil turned to West Germany for reactors and enrichment technology primarily because the United States would not provide firm contracts in 1974 for enrichment services for fuel reloads, an issue not related to nonproliferation.

--Iran purchased reactors from West Germany and France as part of a national plan that allocated specific shares of planned reactors to those countries. These purchases were negotiated on a sole-source basis. Iran also allocated to U.S. suppliers a share of the planned reactors, but because of failure to negotiate a bilateral agreement--a problem attributed to nonproliferation policies--Iran did not proceed with purchases of these reactors.

--Argentina's first nuclear power plant, ordered from West Germany in 1968, has a heavy-water, natural-uranium-fueled reactor. The second plant, ordered from Canada in 1974, has the same type reactor, as does the third ordered from Kraftwerk in October 1979. Further, according to industry reports, Argentina plans to build three more plants of the same type by 1997, with increasing shares of Argentine content. Thus, it seems clear that Argentina is committed to this type of reactor. In addition, if Argentina had entertained ideas of switching to light-water technology for its 1979 purchase, it need not have been concerned about possible confrontation with U.S. policy, as there were alternate sources for both light-water reactors and the enriched uranium needed to fuel them.

We met with Commerce officials to discuss their comments, and they stated that they adhere to the view that the sales were lost primarily because of nonproliferation policies. Their criteria for attributing lost sales to nonproliferation policies, however, differed from ours. They attribute lost sales to such policies if the policies prevent U.S. companies from competing, apparently assuming that U.S. companies would win the sales if they competed. Since U.S. companies could not compete for those sales, we believe the impact of the policies could not be determined. Commerce officials did not offer evidence to support their position and, after reviewing our evaluation of their comments, said nothing to suggest that we have not treated their comments fairly.

Commerce also commented that "The report does not focus adequately on the effects of the NNPA on the perceived unreliability of the United States as a supplier * * *." It stated that the NNPA requires negotiation or renegotiation of agreements for cooperation before implementing major exports and noted that only seven agreements were initialed in the 2 years after passage of the Act. Commerce suggested that the report be revised in several places to identify the lack of international adherence to nonproliferation policy as a factor in detering U.S. exports. We agree that the lack of international adherence to U.S. nonproliferation policy has the potential to deter U.S. exports and believe this is adequately recognized in the report. (See pp. 1 and 5, ch. 3, and app. I.)

Finally, Commerce noted that the report would benefit from an expansion of its scope in the form of

--a country-by-country review by agencies responsible for implementing the NNPA;

--a determination of whether U.S. nuclear technology transfers to foreign subsidiaries or licensees may be partly the result of nonproliferation policies; and

--greater weight given to comments and assessments by U.S. industry.

Commerce concluded that if the United States is unsuccessful in achieving the NNPA's goal of international restraint, the cost in lost export sales will not have been justified.

We believe the scope of the report is consistent with congressional intent that we determine whether, as a result of the Act, any nation appeared to have, or had in fact, placed an order for civilian nuclear material or equipment with a nation

other than the United States. Information available to us indicates that U.S. nuclear technology transfers have been underway for over 30 years, substantially predating international nonproliferation efforts. Further, much of the report is based on information and assessments provided by members of the U.S. nuclear industry.

CHAPTER 4

U.S. PROSPECTS IN A DECLINING NUCLEAR EXPORT MARKET

Forecasts of future world nuclear power plant capacity have indicated progressively lower growth rates since 1973. By one recent estimate, world capacity in 1985, excluding Communist areas, will amount to only 40 percent of the capacity forecast in 1973, and estimates for later years declined even more. Prospects for U.S. nuclear power exports have also suffered because foreign suppliers have captured their home markets and compete vigorously for the remaining exports. Export projects expected to be completed by 1995 which are open to U.S. competition will be in the range of 26,000 to 53,000 MWE. Although U.S. companies continue to view exports as very important, the present status of nuclear energy programs has led some to question the viability of the nuclear industry worldwide.

DECLINING WORLD MARKET FOR NUCLEAR POWER PLANTS

As recently as 1975, the outlook for worldwide production of nuclear power plants was for vigorous growth and the nuclear power industry held promise as a significant industrial sector. Since that time, many countries have seriously reassessed their nuclear plans and substantially reduced their growth; these forecasts have reflected this trend progressively since 1973. A May 1979 Energy Information Administration (EIA) report estimated world nuclear power capacity, excluding Communist areas, would reach a level of 216,000 to 247,000 MWE by 1985, or about 40 percent of the capacity forecasted in 1973. Similarly, recent capacity estimates for 1990 and 2000 were only 30 percent and 22 percent, respectively, of the 1973 forecasts.

An August 1979 report by Pan Heuristics 1/ for the U.S. Government demonstrated the radical decline in estimates of world nuclear power growth, as shown in the following table.

1/ Rowen, Henry and Wohlstetter, Albert. U.S. Non-Proliferation Strategy Reformulated. Final report by Pan Heuristics for the Council on Environmental Quality, Department of Energy, and National Security Council, Aug. 29, 1979.

Cumulative Free World Countries
Nuclear Power Growth Estimates

Date of forecast	1975	1977	1985	1990	2000
	(GWe capacity) (note a)				
Aug. 1973	95	192	580	1,144	2,910
Dec. 1975 (note b)	-	105 to 110	479 to 530	875 to 1,004	2,005 to 2,480
Dec. 1977	-	88	278 to 368	504 to 700	1,000 to 1,800
Oct. 1978 (note c)	-	-	245 to 274	373 to 462	850 to 1,200
Jan. 1979 (note d)	-	-	200	300	480 to 870
May 1979 (note c)	-	-	216 to 247	305 to 376	550 to 750

a/ Gigawatt electric capacity = 1,000 Megawatts.
b/ OECD/NEA and IAEA, Uranium Resources, Production and Demand.
c/ Chronology of U.S. and WOCA Nuclear Power Forecasts, EIA, May 7, 1979 and June 15, 1979.
d/ Pan Heuristics, Jan. 1979.

Other forecasts have not been so pessimistic. The International Nuclear Fuel Cycle Evaluation, a 2-year technical and analytic study conducted by representatives from 66 countries, forecast substantially greater nuclear power growth. Its February 1980 forecast coincided with the October 1978 estimates in the table and forecast even greater growth for later years--1,300 to 2,150 GWe by 2010, and 1,800 to 3,900 GWe by 2025.

The Department of Energy, in commenting on a draft of this report (see app. III), provided its July 1980 forecast of world nuclear power growth. That forecast reflects further shrinkage in nuclear power growth.

To determine the potential export market, we examined program data in more detail because the table data includes capacity already in place, under construction, and on order and also includes data on the U.S. nuclear program. A September

1979 EIA report 1/ focused on 32 foreign countries that constitute the free-world export market. These countries had 214 nuclear power plants operating or under construction at the end of 1978, representing generating capacity of about 127,000 MWe. Our analysis of EIA data showed that, to achieve forecasted generating capacities, these countries must construct additional plants with capacities of

--2,300 to 9,700 MWe by 1985,
--37,300 to 77,600 MWe by 1990, and
--104,400 to 166,600 MWe by 1995.

These capacity estimates represent a conservative approximation of the free world export market. Certain Communist country markets and countries not included in the 32 reported by EIA may eventually present market opportunities.

EXPORT PROSPECTS FOR U.S. NUCLEAR POWER SUPPLIERS

The prospects for U.S. nuclear power exports have also suffered because the larger country programs are served exclusively by indigenous suppliers, foreign competition is vigorous for remaining exports, and many customers are likely to demand increasing local participation. In the present market it is difficult to forecast with confidence the extent of export business that U.S. nuclear suppliers may capture--recent forecasts have been quite pessimistic. Our analysis of EIA reports indicated that export projects expected to be completed by 1995 which are open to U.S. competition will be in the range of 26,600 to 53,200 MWe capacity as shown on the next page.

Foreign suppliers, particularly Kraftwerk Union, Framatome, and AECL, can be expected to compete strongly for this market. In addition, certain of the more significant countries in this market--Italy, Spain, South Korea--have pushed hard for increasing local participation in nuclear projects. Both of these factors will restrict the share of U.S. companies in this market.

This estimate represents a radical decline from an April 1976 Energy Research and Development Administration report, which indicated that U.S. exports to countries not producing nuclear power plants would amount to 150,000 MWe capacity between 1980-90.

1/ Chronology of U.S. and WOCA Nuclear Power Forecasts. EIA, May 7, 1979, revised Sept. 30, 1979.

Potential Exports Open to U.S. Competition

Country/Groups	MWe	
	Low estimate	High estimate
Australia/New Zealand	-	1,000
Austria/Switzerland	1,900	3,000
Benelux/Denmark	3,300	4,700
Greece/Turkey	600	1,800
Italy	4,600	8,600
Spain/Portugal	2,500	6,900
India	1,200	1,600
South Korea	7,400	11,600
Iran	-	1,200
Mexico	1,300	2,800
Pakistan	600	1,800
Philippines	-	1,200
South Africa	1,600	3,400
Taiwan	1,600	3,600
Total	26,600	53,200

The Department of Energy, in commenting on a draft of this report (see app. III), provided an updated table of potential export orders open to U.S. competition. The table extended the forecast period to the year 2000 and added several new countries as prospective customers, leading to a higher range of 50,750 to 93,060 MWe capacity to be ordered. The increase was attributed primarily to the 5-year addition to the timeframe. Energy expressed the view that seven countries in the updated table could achieve nuclear self-sufficiency relatively soon, thereby reducing the potential export market to a range of 22,850 to 43,360 MWe. It suggested that a more refined assessment of export market potential would require closer inspection of

1. the degree of indigenous industrial infrastructure in all nations with devoted or potential capabilities in nuclear manufacturing;

2. the traditional economic and industrial cooperation between neighboring states or unions, such as the Dutch or Belgian adoption of technologies and services provided by EURATOM allies; and

3. a nation's tradition or inclination to adopt certain nuclear reactor technologies uncommon to U.S. vendor designs and services, such as the heavy-water reactor program being pursued by Argentina.

We believe that Energy's updated table and analysis are consistent with, and reinforce, our analysis. We agree that analysis of potential U.S. exports could be refined to a greater degree, but our intent was to establish an order-of-magnitude estimate rather than a definitive statement.

Others in the industry have also become more pessimistic about U.S. nuclear export prospects. A 1977 Westinghouse study forecast an export market of 61 plants, with total capacity of 55,000 MWe, for the 5 years ending 1982. It estimated that U.S. companies, with appropriate Government support, could capture 75 percent of the market. A March 1979 Westinghouse study estimated that the potential export market for the ensuing 2 years would be as many as 30 nuclear plants, with total capacity up to 29,000 MWe. It maintained that U.S. suppliers, with appropriate Government support could capture 60 to 70 percent of the market but stated that the prospects for realization were poor at that time. According to Westinghouse, appropriate Government support includes competitive export financing, moderation in environmental and human rights policies, adoption of nonproliferation policies that are no more restrictive than those agreed to by other supplier nations, and streamlining of export license procedures.

POTENTIAL ECONOMIC IMPACT OF EXPORT SALES

By one 1977 estimate, the U.S. share of the export market during 1978-82 could amount to $17 billion and generate 500,000 man-years of employment. This level of exports would substantially improve utilization of the industry's production capacity.

More recent studies were not so optimistic. Some questioned the viability of the nuclear industry worldwide and went so far as to suggest that, barring substantial political and economical changes in the next 5 years, several suppliers may be severely strained to maintain reactor manufacturing operations.

We attempted to obtain information to make a comprehensive objective evaluation of the importance of exports to nuclear companies in terms of contributions to employment, use of facilities, overhead, research and development, and profits. However, detailed information was not available from the individual companies or other sources we contacted, so we had to settle for information at a more superficial level.

Difficulty of assessing significance of exports to the nuclear industry

The term "nuclear industry" is a rather elusive concept, in that it does not represent a discrete number of companies devoted to producing materials and components for nuclear power plants. Rather, the industry largely consists of subordinate segments of diversified companies. For example, the nuclear activities of the dominant company, Westinghouse, represent only about 8 percent of its business. General Electric, Combustion Engineering, and Babcock & Wilcox are also diversified. For competitive reasons, these companies tend to be guarded in releasing information about their nuclear activities, to the point that the significance of those activities cannot be discerned by analysis of public financial reports.

The ambiguous nature of the nuclear industry carries over into the Government's commercial reporting activities. The Census Bureau compiles annual statistical data on industry orders and shipments based on confidential company reports. However, the data reported for the nuclear industry covers only equipment, parts, materials, and services that are specifically designed for nuclear applications. Under this system, general-use materials and parts, which comprise a major portion of a nuclear power plant, would be reported under industry sectors other than "Atomic Energy Products and Services." For example, in 1978 the Census Bureau reported total shipments of atomic energy products in 1977 of $1.7 billion, including exports of $231 million; 1976 data reported $1.5 billion in shipments, including $238 million in exports. Considering that a typical nuclear power plant costs more than $1 billion and U.S. companies had more than 90 plants in various stages of construction at the end of 1977, the Census sector on the atomic energy industry obviously represents a small part of total nuclear power plant costs.

With the constraints on information dealing with business activities, it was not possible to carry out a detailed objective analysis of the significance of exports to the U.S. nuclear industry. Indeed, we could find no current independent studies of this matter, and our contacts with economic consultants indicated it would require substantial time and expense to carry out such a study. We did obtain some studies, primarily from Westinghouse, that estimate some of the economic implications as seen by industry.

Data in the Westinghouse studies--man-years, value, employment dispersal--and the related projections of economic significance of exports, should be regarded as broad estimates rather than a precise definition of the economic impact. We attempted to evaluate the Westinghouse methodology and support for these studies. We learned, however, that the information was not developed from cost accounting records but from a series of estimates made by officials responsible for engineering, procurement, finance, and management. Accordingly, we could not verify the estimates.

Nuclear power plant exports

Nuclear power plants rank among the largest export transactions in world commerce. A 900 MWe plant may easily exceed a $1 billion price and take upwards of 7 years to complete. A 1977 Westinghouse study estimated the export value and related U.S. employment that would stem from turnkey contracts for nuclear plants of varying size as shown in the following table.

Turnkey Value and Nuclear Power Plant Exports
Effect on Employment

	600 MWe plant		900 MWe plant		1150 MWe plant	
	Man-years	Value (000 omitted)	Man-years	Value (000 omitted)	Man-years	Value (000 omitted)
U.S. equipment supply	8,055	$196,500	9,840	$240,000	11,890	$290,000
U.S. project and architect-engineering management	2,255	55,000	2,870	70,000	3,690	90,000
Construction of buildings and installation of equipment (part done by U.S. manpower)	3,280	80,000	3,690	90,000	4,100	100,000
Construction equipment	900	22,000	1,025	25,000	1,230	30,000
Total	14,490	$353,500	17,425	$425,000	20,910	$510,000

This study suggested that indirect employment in communities where components are manufactured and designed would approximately equal direct employment. It concluded that a nuclear plant export would therefore provide 30,000 to 40,000 man-years of employment, depending on project size and scope. It also stated that this employment would be geographically dispersed, including 174 cities in 31 states.

Westinghouse estimated that 500,000 man-years of employment could be generated by nuclear power plant export sales during 1978-82. This estimate assumed that the Government would provide sufficient support, as discussed earlier, for U.S. companies to capture 75 percent of the projected $17.2 billion export market. It was based on an export market of 61 plants with total capacity of 55,000 MWe in 32 countries, with due recognition to foreign participation; export content of projects ranged from 2 to 70 percent.

Westinghouse views

Westinghouse concluded that nuclear energy would play a substantial role in filling future world energy needs. It views the current industry depression as a lengthy but temporary interruption. Its analysis indicates that this depression has resulted in substantial unused manufacturing capacity and that world nuclear suppliers are "scrambling" for whatever export business becomes available.

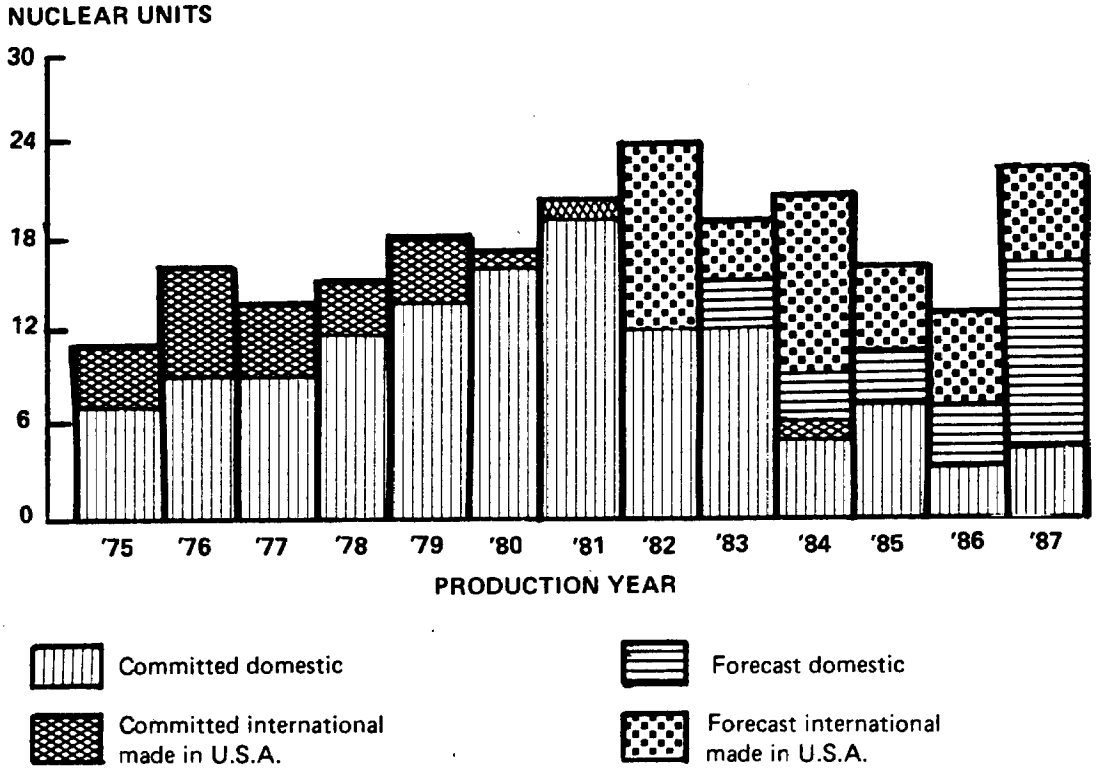
A Westinghouse analysis provided to us in January 1979 indicated that the four U.S. power reactor suppliers had an order backlog (units to be in operation in 1980 or later) equivalent to about 4.5 years of capacity (assuming a standard reactor size of 1,000 MWe). The following table shows the estimated capacity and backlog of U.S. and foreign suppliers.

Country	Unit capacity per year	Backlog	
		Total MWe	Years of capacity
France	7	31,800	4.5
West Germany	7	27,400	3.9
Canada	5	11,100	2.2
Sweden	2	3,700	1.8
Japan	6	5,600	.9
United States	30	133,600	4.5
Total	57	213,200	

With the long leadtime for reactor orders and the paucity of orders in recent years backlog work could shrink rapidly. The U.S. backlog is already stretched out so that production will reach only 20 units a year, or two-thirds capacity, during one of the next 8 years, as shown in the following graph.

Westinghouse believes that a favorable U.S. export policy--one that featured policies and practices comparable with those of other supplier nations--could help U.S. companies to obtain a 75 percent share of the market in countries not having their own suppliers. It believes that this could significantly improve the use of U.S. nuclear industry capacity.

UNITED STATES NUCLEAR INDUSTRY
UTILIZATION OF CAPACITY



General Electric views

The prospects for the nuclear power industry have become so discouraging that the issue of industry viability has been openly discussed in industry forums. A GE representative stated in an October 1978 speech 1/ that a dispassionate assessment would conclude that the power reactor supplier industry as structured at that time was not economically viable. His criteria was that a business must either produce a competitive return on investment or offer prospects of satisfactory future returns. He stated that the reactor supplier industry shows poorly against such criteria, noting that three of the four U.S. suppliers reported losses in 1977 and that two, in almost 20 years of operation, had never reported sustained periods of commercial nuclear profits. He stated that future prospects were also poor, due to reduced electrical growth and other factors. In his view, the industry breakeven level was around 15 reactor units a year and a Department of Energy forecasted level of 13 units a year or less would inevitably require structural change in the industry. He said that GE was adjusting to lower production levels and was committed to supporting its reactors as well as to competing for future business. Finally, he reiterated GE's belief that nuclear energy is vital to the United States and that ultimately the electric utilities and the public would accept it for its economic and social benefits.

Nuclear industry literature

A number of articles in the past few years have discussed the bleak outlook for the nuclear industry in general and for certain companies in particular.

A November 1979 report prepared for the International Consultative Group on Nuclear Energy (a panel of experts from some 15 countries) 2/ discussed the viability of the world nuclear industry. The report concluded that, unless substantial political and economic changes occur in the early 1980s to stimulate new orders, a number of reactor suppliers--GE, Babcock & Wilcox, Kraftwerk Union, AECL, and ASEA-Atom--may

---

1/ Camp, P.W. "Nuclear Industry Viability From the GE Perspective," Speech delivered at the American Nuclear Society Executive Conference, Phoenix, Ariz., Oct. 17, 1978.

2/ Lonnroth, Mans and Walker, William. The Viability of the Civil Nuclear Industry. The Rockefeller Foundation/The Royal Institute of International Affairs, Nov. 1979.

be severely strained to maintain reactor manufacturing operations, and that, if changes still have not occurred by the mid-1980s, Combustion Engineering and Westinghouse could face similar difficulties. The report's conclusions stemmed from a determination that reactor vendors are faced with substantial overcapacity in the 1980s and have few avenues for coping with this. The report noted that installed reactor manufacturing capacity in seven major western countries is 50,000 to 60,000 MWe a year, while recent forecasts have predicted an order rate of 35,000 to 50,000 MWe a year in the 1980s compared with an average annual order rate of 25,000 MWe during the 1970s.

The report claimed that an order rate of 14,000 to 25,000 MWe is a more probable outcome, leading to the excess capacity determination; this ordering rate was based on several factors including

--lower electricity growth rates;

--increasing pessimism about the world's economy;

--further oil price hikes that may lead to inflation, recession, and a worse climate for nuclear investment; and

--political and economic constraints which dim the prospects for nuclear orders in several developed countries.

A November 1, 1979, Engineering News Record article 1/ made a similar assessment of the domestic nuclear business. It asserted that nuclear power is in deep trouble and that the nuclear power business hangs by a thread. The article stated that nuclear safety, waste disposal, and regulatory uncertainty are the key issues confronting the industry and that Presidential action is needed to resolve them. It noted the substantial shrinkage in nuclear power forecasts for both domestic and foreign markets. It also observed that electric utilities had begun to question earlier decisions on nuclear power, noting that 67 plants in the United States were deferred or canceled during September 1978 through August 1979. Further, it noted that some 30 of the 78 plants actively under construction were less than 25 percent complete and that one utility was studying the possibility of converting two such units to coal power.

1/"A-power option losing steam as jobs dwindle," pp. 32 and 33.

COUNTRY CASE STUDIES OF NUCLEAR POWER PLANT EXPORT SALES

During 1975-79, U.S. foreign competitors--Kraftwerk Union, Framatome, and Atomic Energy of Canada Limited--received export orders for 15 nuclear power plants. In some cases, these orders were hotly contested by U.S. vendors; in others, there was no formal bid competition but U.S. companies did, to varying degrees, seek an entrance into the market. If evolving U.S. nonproliferation policies, culminating in the 1978 NNPA, have indeed hurt the ability of U.S. companies to compete for export orders, then an examination of the 15 "lost" sales--plants purchased by Spain, South Africa, Iran, Brazil, Romania, and Argentina--provides at least one basis for assessing the validity of such a claim.

Since passage of the NNPA, U.S. companies have competed for and won four nuclear power plant sales--all to South Korea. Examination of those sales provides another perspective on the competitive impact of U.S. nonproliferation policies.

SPAIN

In 1975, and again in late 1977, Spanish electric utilities placed orders for nuclear plants with Kraftwerk Union. Those orders, which broke a virtual monopoly on nuclear orders held by the United States, can more accurately be attributed to superior financing packages offered by the Germans than to nonproliferation policies advocated by the U.S. Government. Nonetheless, U.S. companies seeking to do business in Spain argue strongly that the U.S. position on proliferation and the policies enacted to sustain that position have eroded the market position of the United States and will affect future U.S. business opportunities.

It may be some time, however, before that hypothesis can be fully tested. Spain is unlikely to award any new plant orders in the near future, and this may afford U.S. nuclear vendors a respite during which U.S. policies and their applications will be clarified.

Spain's energy program

The Spanish Energy Plan approved by the Cortes (Parliament) in August 1979 confirms a basic commitment made in the 1960s to commercial nuclear power. At that time, Spain began constructing its first generation of three nuclear power plants, all of which became operational between 1968-72. In the flush of enthusiasm with nuclear power that followed, Spain

contracted for seven additional units (all now under construction) and by 1977 had made tentative commitments for as many as eight more plants. As late as 1975, when other countries had already recognized the implications of the 1973 energy crisis, Spain's plans still called for large-scale energy growth and an installed nuclear plant capacity of 22,700 MWe by 1985.

Belated awareness of the economic downturn, growing public concern and opposition to nuclear power, and the change in government following Generalissimo Franco's death in 1975 all led to an interim hold in the nuclear program. Authorizations for all plants beyond the 10 in operation or under construction were deferred pending resolution of the energy plan.

That plan, drawn up in 1977, scales down the ambitious nuclear program put forward in 1974, but does affirm nuclear power as a source of energy Spain cannot afford to forego. Nuclear power is projected to increase from roughly 7 percent of electric generation in 1977 to approximately 37 percent by 1987. This would require at least three units more than the current 10, yielding a total nuclear generating capacity of 10,500 MWe by 1987.

Although the energy plan has been much debated--and nuclear power is a sensitive element--some observers believe that Spain must exercise the nuclear option. The plan also stressed greater independence through developing indigenous technology and diversifying fuel supply sources.

How nuclear market functions

Spain's electric utilities, most privately owned, have played a dominant role in the ordering of nuclear power plants. Their autonomous functioning during the Franco era, however, has given way to a closer working relationship with the government, and the new energy plan is likely to reinforce the central role of government in planning for national nuclear power needs.

The utilities have, however, held a deciding voice in the bidding and award of nuclear plant orders to date. Generally, a utility must obtain a site authorization from the government before an actual contract can be signed. In many cases, bid negotiations have been well advanced before such authorization has been granted. The utility conducts the bidding and selects the specific reactor supplier and engineering firms. In this bid process, the utilities have used architect-engineers in a consultant role, particularly for the earlier plants. U.S.

architect-engineer companies have generally fulfilled that function and provided expertise in the preparation and evaluation of bids.

U.S. architect-engineer firms have established informal partnerships with Spanish engineering companies. This has been a virtual prerequisite for getting nuclear work in Spain, a reflection of Spanish insistence on increasing the percent of local goods and services in nuclear plants. There is no legally mandated percent of local content, but the Ministry of Industry monitors local participation.

The plant competitions

U.S. nuclear vendors enjoyed a near monopoly during the first decade of Spanish plant construction. Two of Spain's first three plants went to U.S. companies; the third, a French gas-cooled reactor, is already outmoded. The second generation of seven nuclear plants were all awarded to either Westinghouse or General Electric.

Bids for the third generation of units were issued and awards made during the mid-1970s. None of these units received a construction permit prior to the resolution of the energy plan; some in fact were never granted preliminary authorization and have been shelved indefinitely.

During this period, Kraftwerk Union broke into the market with an order for the Trillo plant in 1975, followed 2 years later with the award of the Regodola plant. In both cases, U.S. vendors competed actively but could not match the financing terms offered by the German supplier. In the case of the Regodola plant, some U.S. suppliers also believed that recently announced U.S. nonproliferation policies did nothing to advance the cause of U.S. companies in Spain.

Trillo

Negotiations leading to the award of the 1,000 MWe Trillo plant took place during the first half of 1975. A utility consortium composed of Union Electrica and two smaller utilities received initial offers from four vendors, and by June 1975 the competition had been narrowed to Westinghouse and Kraftwerk Union. In late July, Westinghouse learned that the Trillo unit had been awarded to Kraftwerk.

The loss of the Trillo contract can be directly attributed to the superior financing terms offered by the West Germans, which the U.S. Export-Import Bank was unable to match. The Kraftwerk offer, with a reported contract value of 900 million deutchmarks, contained a financing proposal covering (1) a loan of 90 percent of the German content at a fixed rate of 9 percent, (2) a loan of 10 percent of the German value to be applied to Spanish goods and services, and (3) the capitalization of interest during construction.

In contrast, the U.S. Export-Import Bank in mid-July offered a standard financing package with provision for a loan to cover 45 percent of the U.S. content at 8 percent interest, a guarantee for an additional 30 percent, and a 10 percent cash downpayment. This package was based on an estimated total U.S. export value for goods and services of $192,328,000. The proposal excluded any local-cost financing and also attached several conditions to the loan that the Spanish utility consortium reportedly found difficult to accept.

In reviewing the circumstances of the award to Kraftwerk Union, Westinghouse concluded that financing constituted the sole reason for the loss. According to Westinghouse, the bid negotiations demonstrated that its offer was technically preferred by the utilities and commercially acceptable, but these factors were not sufficient to outweigh the strength of the German financing package.

Regodola

The Germans successfully reentered the Spanish market in 1977 with the capture of an order to construct the 1,000 MWe Regodola nuclear power plant. 1/ Once again, German financing proved to be the decisive factor, but there was also the suggestion that U.S. nonproliferation policies announced in April 1977 may have further weakened the Westinghouse position.

The utilities sponsoring Regodola--collectively referred to as the Asociacion Central Nuclear de Regodola--issued bid specifications in the fall of 1976. By August 1977, competition had been narrowed to Westinghouse and Kraftwerk Union.

1/ Following the award of Trillo to Kraftwerk Union, Westinghouse received letters of intent for three units--Vandellos 2 and Escatron units 1 and 2. The Germans did not actively compete for these plants, but Westinghouse received stiff competition from the French Framatome.

Westinghouse had already recognized that financing would again be critical and attempted to work with the Asociacion in preparing and submitting the necessary loan application to Eximbank.

The financing of local Spanish goods and services and the financial data required by both Eximbank and U.S. commercial banks proved to be the major stumbling blocks. According to Westinghouse, the Regodola consortium automatically assumed availability of terms from Eximbank similar to those provided for two earlier U.S. orders. 1/ The key issue concerned the ability of Westinghouse to arrange a sufficient commercial loan to cover up to $200 million worth of local peseta costs. Germany was reportedly offering a direct credit of 85 percent of German content, local cost financing equivalent to 15 percent, and capitalization of interest during construction.

Both Eximbank and the commercial banks, however, required financial data sufficient to adjudge the group's financial status and projections. Such data was never forthcoming from the Asociacion, which resented the request as an intrusion into its affairs. The Germans made no such request. As a result, Eximbank could not issue even a preliminary loan commitment nor did Westinghouse succeed in arranging a U.S. commercial loan. In November 1977, Westinghouse was notified informally that Regodola had been awarded to Kraftwerk Union.

According to Westinghouse, the Asociacion also advised it that the German Government's support of its nuclear industry in obtaining export business--and the U.S. administration's failure to do so--was an added factor in the selection of Kraftwerk Union. This was coupled with a reported uneasiness among Spanish utility and government officials concerning the granting of U.S. export licenses for reactors and fuel reloads.

The Regodola plant itself is not considered to be an active project and has been classed among those third-generation nuclear plants awaiting construction permits. During the reconsideration of Spain's energy needs, however,

---

1/ In July 1976, Eximbank issued a preliminary commitment for the Vandellos 2 plant authorizing a direct credit and loan guarantee covering 82.8 percent of the U.S. plant value. Eximbank's August 1977 offer for Escatron 1 raised that direct credit and loan guarantee portion to 90 percent.

it was tacitly recognized that the Regodola utilities were neither large enough nor financially secure enough to support a nuclear facility.

The future market

There is a general consensus among U.S. firms operating in Spain--and among some Spanish firms as well--that U.S. nonproliferation policies could seriously affect U.S. future competitiveness in the Spanish nuclear market. U.S. prospects will also be influenced by a number of other factors, among them the market itself, the existence of incentives for Spain to buy European products, and aggressive marketing by European vendors.

Spain's energy plan was approved in August 1979, but Spain is not likely to be in the market for new plants for the next few years. The plan provided for construction of three or four of eight plants in the third generation of orders. In September 1979, the Spanish Government approved the start of construction on Trillo and the two Valdecaballeros units awarded to General Electric.

Once Spain does reenter the market--possibly in the early 1980s--the Europeans should continue to pose a strong competitive threat.

Spain's anticipated entrance into the European Economic Community will support the chances of Framatome and Kraftwerk Union; both France and Germany have already been accused by U.S. companies of using the Community membership carrot as a trade lever. Likewise, the added expectation of Spain's inclusion in the European Atomic Energy Community may reinforce Europe as an alternate to the United States as a commercial nuclear source.

U.S. suppliers have had the competitive advantages of accumulated experience in Spain, an effective working relationship with Spanish engineering firms, and a technological edge in plant design and construction. The Germans, however, now have a reference plant in Trillo, and both Kraftwerk Union and Framatome can be expected to press hard for future export orders, supported by their governments and respective loan institutions.

In this competitive environment, financing and assured fuel supplies are expected to be decisive in the award of future plants. Financing proved to be the crucial factor in the award of Trillo and Regodola to Kraftwerk Union, and there is no reason to doubt that Spanish utilities will in the future

expect U.S. financing to be commensurate with that offered by the Europeans. The key may well be the ability of U.S. vendors to obtain financing for Spanish goods and services. As the percent of local content increases--and this is a goal actively pursued by Spain--the financing of that content will represent an increasingly significant aspect of a nuclear vendor's bid.

Spain, which perceives nuclear power as a means to greater energy independence, attaches a corresponding importance to the availability of adequate and dependable sources of fuel over the life of a reactor. The NNPA, with its program of renegotiation of what Spain regarded as a binding bilateral agreement, demands for full-scope safeguards, and stipulated export cutoff dates if those conditions were not met shook Spain's faith in the credibility of U.S. nuclear suppliers. Even prior to the NNPA, Spanish utilities sought, albeit unsuccessfully, to insert export guarantee clauses in contracts with U.S. nuclear vendors.

Future access to the Spanish nuclear market may depend on the ability of the U.S. administration to dispel Spain's uneasiness and sense of the current unpredictability of U.S. policies.

SOUTH AFRICA

South Africa in mid-1974 advertised for the supply and construction of two nuclear power plant units. Contracts were ultimately awarded to a French consortium led by Framatome in 1976, although General Electric had initially been designated the successful bidder. GE, however, was forced to withdraw following the breakup of its consortium arrangement with a European firm.

GE's problems in keeping its consortium alive were cited as the immediate cause of the loss of the South African units to a French competitor. Even at that time, however, concern had already surfaced as to whether any U.S. nuclear vendor would be in a position to obtain either Eximbank financing guarantees or an export license in light of the political and human rights issues surrounding commercial ventures in South Africa.

Bid competition

South Africa's state-owned Electricity Supply Commission issued bids in 1974 for the turnkey supply and construction of two 925 MWe nuclear plants at Koeburg. Kraftwerk Union, Framatome, GE, and Westinghouse constituted the major competitors.

Both GE and Westinghouse foresaw the need to associate with foreign firms, not only to satisfy the turnkey dictates of the tender but, more importantly, to ensure a foreign source of financing. The latter consideration stemmed from concern over the potential availability of Eximbank financing guarantees in the context of the growing concern with human rights. Consequently, Westinghouse established a joint venture with a British firm which would supply the turbine-generator island. GE joined forces with a Dutch firm for the civil contracting work and a Swiss firm for the supply of boilers.

Westinghouse ran into trouble shortly before the bid due date in October 1974. Its British associate abruptly withdrew from the partnership, forcing Westinghouse to submit an incomplete bid. Although granted additional time to prepare a properly responsive bid, Westinghouse did not survive the first bid evaluation round and was dropped from the competition in early 1975.

GE did achieve initial success as the first choice of the Commission but encountered the same problem as Westinghouse. GE's Dutch partner withdrew from the competition, citing its inability to obtain government financing because of political and human rights issues. GE, unable to find another partner, also dropped out, and Framatome picked up the contracts for Koeburg. According to a State Department official, South Africa was less than eager to wait for GE to find another partner; France was even then viewed as a country possessing more stable, predictable export policies.

The loss of the two nuclear units to the French was immediately attributable to the failure of U.S. suppliers to maintain viable consortia. It is also true, however, that nuclear plant sales to South Africa might well have encountered difficulties from an export licensing as well as financing guarantees standpoint. At the time of the award, there was considerable debate within the U.S. Government as to the propriety of aiding South Africa in the construction of nuclear power plants, both in the context of nuclear proliferation and the issue of human rights. It was during the course of congressional hearings on the licensing and financial guarantees for such a sale that the award to GE fell through.1/

1/ Eximbank had issued a preliminary commitment to provide a loan guarantee for 90 percent of the U.S. costs, estimated at $227 million.

IRAN

The prolonged delay in the conclusion of a mutually acceptable U.S.-Iran bilateral agreement for cooperation precluded any U.S. sales. Such an agreement is a legal prerequisite to U.S. exports of nuclear technology and materials. The extended negotiations on the agreement reflected, at least in part, U.S. nonproliferation concerns; the U.S. stance on reprocessing did not meet with Iranian approval. To the extent that a U.S. reactor vendor had an assured entrance to the market (and there is some evidence to suggest that such was the case), the nonproliferation issues that stalled the bilateral agreement can be said to have prevented U.S. reactor sales to Iran. In the meantime, both Kraftwerk Union and Framatome were able to sell nuclear units to Iran.

Iranian market

In the mid-1970s, Iran embarked on an ambitious nuclear program that called for construction, by the 1990s, of about 20 reactors with total installed capacity of 23,000 MWe. In pursuit of that objective, Iran in 1974 ordered two reactors each from Framatome and Kraftwerk Union and by 1977 had made at least tentative commitments for four additional units from Kraftwerk Union.

These sales represented part of what was reportedly an Iranian commitment of specified megawatt allocations to West Germany and France. According to one U.S. nuclear vendor, Germany was to have received plant orders for 7,000 MWe and France was programed for 5,000 MWe. The United States was slated for an even greater share; according to Westinghouse, Iran planned to purchase six to eight nuclear power plants from the United States, for a total allocation of up to 10,000 MWe capacity.

Although Westinghouse in particular mounted an extensive sales effort in Iran, no U.S. reactors were sold owing to the protracted negotiations between the two countries on the necessary bilateral agreement. Those negotiations, which did ultimately result in the initialing of an agreement in August 1978, took so long principally because of the concurrent evolution of U.S. nonproliferation policies. From 1975 on, the U.S. Government was involved in formulating, submitting, and awaiting the enactment of nonproliferation legislation which was passed in March 1978. It was only after that date that the Iranian negotiations had a firm basis on which to proceed.

A primary sticking point during the negotiations did prove to be the U.S. Government's position on reprocessing. Iran, in line with a number of other countries, objected to the concept of undefined U.S. control over the future disposition of Iranian spent fuel; it wanted to retain the reprocessing option and also wanted clarification as to the specific procedures and policies the United States would follow.

Iran's nuclear program has now ground to a halt. With the deposition of the Shah in late 1978 and the decision on the part of the present regime to table nuclear plant construction, Kraftwerk Union and Framatome are not likely to complete the first four units, let alone see firm contracts for any additional units.

BRAZIL

In 1975, Brazil and West Germany reached agreement on Germany's supplying at least two nuclear power plants, with options for six more plants, and the full gamut of fuel-cycle services, including enrichment and reprocessing technology. That agreement represented a direct loss for U.S. vendors of two plants as well as the de facto closure of the Brazilian market to the United States, as the option plants would complete Brazil's planned nuclear program.

The U.S. Government's 1974 handling of enrichment services contracts, as well as its policy against export of enrichment technology, had a direct impact on Brazil's purchase of German reactors, according to Westinghouse. Brazil's resultant uneasiness over the reliability of the United States as an enrichment supplier, coupled with Brazil's interest in building a domestic nuclear industry and acquiring a greater degree of energy independence, opened the door to the Germans and their attractive offer of full fuel-cycle services technology.

Brazilian market

Brazil contracted with Westinghouse in 1972 for the construction of its first nuclear plant and by 1973 had plans for installation of nine nuclear power plants by 1990. Westinghouse presented the Brazilians with a proposed nuclear program in mid-1974, which anticipated Westinghouse involvement in the development of local industry as well as the supply of nuclear plants. The proposal advocated a phased development approach; Westinghouse would establish a nuclear engineering company in Brazil, license fuel fabrication and nuclear plant equipment technology, and provide managerial assistance in

the development of a heavy components facility. According to Westinghouse, these plans corresponded with Brazil's emphasis on expanding local content in nuclear plants and encouraging growth of indigenous engineering and design capability. At the same time, the fuel-fabricating technology would represent the first stage in Brazil's acquisition of nuclear fuel-cycle technology.

U.S. enrichment actions

At the time Westinghouse was pursuing reactor sales in Brazil, the U.S. Government was encountering problems in the allocation of enrichment services contracts. The Atomic Energy Commission in 1973 had revised its enrichment contract procedures to require customers to conclude long-term contracts a minimum of 8 years in advance of initial delivery. A transition period was set with a deadline of June 30, 1974, for the placement of contracts to cover enriched fuel deliveries during July 1978 through June 1982.

As of the June 30, 1974, deadline, customers had requested fuel contracts in excess of existing capacity. Barred by its regulations from making firm contracts above capacity, the Commission in early August 1974 indicated that a number of customers, including Brazil, would be offered "conditional" contracts. Despite assurances from then-President Nixon that the United States would fulfill these fuel contracts, Brazil viewed with concern this signal that the United States might be less than a secure, guaranteed source of enriched uranium.

Foreign competition

Brazil's anxiety over fuel supplies surfaced in its discussions with Westinghouse in the summer of 1974; about the same time, Westinghouse learned it would face stiff competition from Kraftwerk Union. Westinghouse later reported that by October the Germans had prepared a general nuclear program for Brazil encompassing not only construction of nuclear plants but also support in developing fuel technology and in building a domestic engineering and components manufacturing capability. In addition, the Germans offered a pilot fuel fabrication plant, reprocessing capability, and Brazilian participation in an enrichment plant. 1/

1/ The French were also reported to have made an offer covering fuel enrichment and reprocessing, but they were not considered serious competitors because of Framatome's licensee status.

A number of factors contributed to the competitiveness of the German proposal. Westinghouse believed the offer of an enrichment plant, albeit incorporating an as yet unproved technology, 1/ constituted a highly attractive inducement for Brazil. Brazil's emphasis on acquiring indigenous enrichment capability had been given weight and urgency as a result of U.S. actions on enrichment contracts. The willingness of the Germans to provide the capability to reprocess spent fuel further enhanced the deal in the eyes of the Brazilians. Furthermore, the Germans presented their offer on a government-to-government basis, dealing directly with the Minister of Mines and Energy.

By early 1975, Westinghouse hopes of obtaining nuclear business in Brazil were receding. Westinghouse could not, in line with U.S. Government policy, match the German enrichment and reprocessing offer, and in April an official U.S. Government statement ruled out any linkage of U.S. reactor sales with the provision of enrichment technology for the present or near future. (The statement followed an apparent attempt by a U.S. engineering firm to explore the possibility of constructing an enrichment facility in Brazil, which had engendered some confusion during the final German-Brazilian negotiations.)

Brazil and West Germany subsequently concluded a nuclear agreement on June 27, 1975, amid protests by the U.S. Government on the proliferation consequences of transferring sensitive technology. 2/ The Brazilian-German accord covered construction of up to eight 1,200 MWe reactors and enrichment and reprocessing facilities, with an estimated cost of as much as $10 billion over a 15-year period. At the end of 1978, two of the units (Angra 2 and 3) were under contract, amid reports that the remainder of the program was facing delays and cost escalations. By mid-1979, estimated costs were alleged to have risen to between $20 billion and $30 billion.

It is Westinghouse's view that, until the Atomic Energy Commission in 1974 made enrichment contracts conditional, Brazil did not press for other elements of the fuel cycle.

1/ The Germans offered an enrichment facility using the "nozzle" enrichment process.

2/ In 1977, the German Government announced that it had suspended the grant of any further permits for the export of reprocessing technologies; the Brazilian agreement, however, would still be honored.

Brazil's subsequent concern over secure fuel sources represented a turning point in the Westinghouse negotiations and led to Brazil's interest in acquiring full fuel-cycle technology, a technology not available from the Americans.

ROMANIA

Romania in 1978 announced plans to purchase two CANDU heavy water reactors from Atomic Energy of Canada Limited. This plan was expanded to four reactors in 1979. The CANDU awards may represent a significant new market for the Canadians, as Romania by some reports intends to purchase as many as 12 CANDUs over the next two decades.

The award of these reactor sales to AECL may be a function of the technical and political appeal of the heavy-water reactor for the Romanians and, in the view of one U.S. supplier, Romania was a somewhat less than viable market because of anticipated export license problems.

Romanian market

The Romanian purchase of two 600 MWe CANDUs, reportedly valued at 800 million Canadian dollars each, represents the first such order since Romania's 1975 contract with the Soviet reactor vendor Atomenergoexport for a 440 MWe light-water reactor. According to one press report, work on that plant has still not been started and the unit may never be built. There has also been speculation that Romania's subsequent choice of the heavy-water reactor may represent a move toward greater independence in its nuclear plant program. The shift away from the light-water reactor had the effect of excluding both Russian and American vendors. Romania's interest in the CANDU reportedly dated from 1974.

In the early 1970s, Westinghouse became peripherally involved in the Romanian nuclear program, but only as a potential supplier of containment vessel technology. Romania was seeking a containment vessel for its Russian-manufactured plant and was very interested in the Westinghouse-designed ice-condensor containment vessel. Westinghouse eventually concluded that it was not interested in the business and preferred to license a Finnish firm for the technology rather than engage directly in marketing the vessel. Further, Westinghouse was uncertain as to the prevailing U.S. Government attitude toward nuclear marketing activities in Communist countries.

Westinghouse does not perceive the CANDU sales as "lost" to the United States, but rather as a reflection of its own decision not to pursue Romanian business because of the real questionability of being able to obtain a U.S. export license.

Eximbank, in commenting on a draft of this report (see app. V), questioned whether Romania is committed to heavy rather than light-water technology and suggested that it may be a more promising market than described, one that could have been influenced by the NNPA. We found the nuclear export market to be a very elusive target, particularly when we were counseled not to contact major potential customers. However, the Russian light-water reactor purchased by Romania has developed very slowly--at zero percent construction at the end of 1979--according to industry reports. On the other hand, there has been much publicity for Romania's plans to exploit technology transfers from AECL. Romania may ultimately build as many as 16 CANDU reactors, with the Romanian content steadily increasing. Further, as noted earlier in this report, Westinghouse did not regard Romania as a viable market.

ARGENTINA

In October 1979, Argentina selected Kraftwerk Union to build its third heavy-water reactor system. AECL of Canada competed strongly for the order, offering a system that had a substantial economic advantage over the Kraftwerk system. That advantage, however, was overcome by Germany's excellent record in constructing Argentina's first power reactor and by related factors. Although nonproliferation policies were not cited by Argentine officials as a competitive factor, much publicity was given to Canada's requirement for full-scope safeguards as opposed to Germany's requirement for safeguards only on facilities supplied by it.

U.S. companies were not in contention for this reactor order. Argentina's nuclear power program is based on heavy-water, natural-uranium-fueled reactors which U.S. companies do not produce. This choice of reactor design avoids dependence on foreign enrichment services. It also effectively excludes U.S. companies from the Argentine market.

Nuclear energy program

Argentina has the most active and most advanced nuclear energy program in Latin America. Its goal is to establish an integrated, self-sufficient nuclear energy industry with full fuel-cycle capability. Argentina, which has an abundance of

uranium, has focused its program on the heavy-water, natural-uranium-fueled reactor; this choice of reactor design permits it to avoid dependence on other countries for uranium enrichment services.

Argentina has three domestically built research reactors. It has one German built, natural-uranium-fueled power reactor in operation, another under construction by AECL, and a third was recently ordered from Kraftwerk. Three additional nuclear power plants are expected to be constructed by 1997. Argentina also has a small heavy-water plant in operation and recently ordered a large heavy-water plant from a Swiss firm. In addition, it plans eventually to build a plutonium reprocessing plant to process spent fuel.

Argentina has stated that its nuclear program is guided by the principle that all nuclear work will be directed toward peaceful uses of nuclear energy. While much of Argentina's nuclear facilities are presently covered by international safeguard controls, Argentina has not signed the Treaty on Non-Proliferation of Nuclear weapons and views safeguards as potentially restricting its nuclear program.

Nuclear plant competition

In October 1979, Argentina announced that Kraftwerk Union had been selected to build that country's third nuclear power plant, a 698 MWe heavy-water reactor system. At the same time, the Swiss company, Sulzer Bros. Ltd., was selected to supply a 200-ton per year heavy-water production plant. The awards followed intense competition between the successful companies and Canadian suppliers. U.S. companies were never in real contention because Argentina is committed to heavy-water reactors, which U.S. companies do not produce. U.S. suppliers did not bid on the heavy-water plant either, but the U.S. Government reportedly did offer to sell heavy water to Argentina.

Competition for the reactor order involved a number of factors, including construction and operating costs and the technical capabilities and experience of the competitors. Although nonproliferation policies were not cited as a factor by Argentine officials, such policies figured prominently in news accounts of the competition.

Economically, the Canadian offer was most attractive. Over 30 years of operation, the estimated cost of generating electricity for the Kraftwerk plant was 18.9 percent ($383 million) more expensive than for the Canadian plant. Canada also

had the advantage of a national program based on heavy-water reactors and much more experience in building them.

Kraftwerk's decisive advantage stemmed from Germany's record in constructing Argentina's first power reactor, which was completed at the contract price and has an excellent operating record. In addition, the new plant will be at the same location, thus permitting savings in operations support. In contrast, the Canadian plant now under construction in Argentina is 2 years behind schedule and its costs have risen from $320 million to $1 billion.

Canada, according to news reports, insisted that Argentina accept the equivalent of Non-Proliferation Treaty safeguards on all aspects of its nuclear program as a condition of sale. Argentina reportedly did not request that Canada change its safeguards policy. Although specific safeguards agreements relative to the sale were not made public, Germany's past practice has been to require safeguards only on the facilities supplied, rather than full-scope safeguards on all of the customer's nuclear facilities.

SOUTH KOREA

In April 1978, shortly after passage of the NNPA, South Korea ordered two nuclear reactors from Westinghouse, and in August 1979 it ordered another two units. These four reactors represent the only export orders won by any U.S. vendor since the NNPA was passed. Although the competition for the latter two units was especially intense and concerns over U.S. nonproliferation policies were raised, South Korea ultimately decided in favor of its traditional supplier--Westinghouse, from whom four of the country's first five reactors had been ordered.

Nuclear energy program

South Korea, lacking its own natural energy resources, has relied heavily on oil imports to sustain its rapid growth needs. Having concluded that nuclear energy was both a desirable and feasible means of gaining a greater degree of energy independence, the Government of Korea has undertaken an extremely ambitious program to develop nuclear energy capability. Long-range plans call for as many as 44 reactors by the year 2000 to produce over 60 percent of total electrical generating capacity. To date, the South Koreans have purchased seven reactors--six from Westinghouse and one from Canada. To achieve its long-range goals, the South Korean Government intends to purchase about two reactors a year. Consequently, the market is extremely attractive to reactor vendors worldwide.

Bid competition

South Korea has enjoyed a close relationship with the United States and has relied heavily on it for most aspects of its nuclear power program. According to U.S. Government officials, while there has in the past been a bias on the part of the South Koreans toward U.S. technology, especially that of Westinghouse, there is nonetheless a significant and growing interest in certain parts of the Korean Government in diversifying supply sources.

Negotiations leading to the April 1978 reactor award were already nearing completion when the NNPA was passed in March of that year. The South Koreans were concerned by issues raised and requirements set forth in the Act. They requested that a clause be included in the final contract to the effect that it would be canceled if export licenses were not issued in a timely manner by the U.S. Government.

Negotiations for an additional two nuclear reactors--ultimately awarded to Westinghouse in August 1979--were quite intense. In addition to considerations of technology, price, and financing, U.S. nonproliferation policy was of much concern to South Korean Government officials.

The primary concern with respect to the NNPA was its program to renegotiate agreements such as the U.S.-Korean agreement for cooperation, which took on special significance due to the agreement's enrichment ceiling. The Koreans wanted fuel supply assurances, and the enrichment services associated with the additional two reactors would have exceeded that ceiling. That condition would require renegotiation of the agreement, and the Koreans were hesitant to renegotiate before they had seen the type of agreements that Japan and various European countries would renegotiate with the United States. South Korea, seeking over the long-term to enter the export market with respect to its developing nuclear industry, did not wish to take any action which would make it less competitive than Japan or the European countries.

While South Korea was thus concerned with U.S. nonproliferation policies, French and German companies sought entrance into the potentially lucrative Korean market. The South Koreans realized, according to a U.S. Embassy official, that it was a buyers market, and they sought to take advantage of it.

The enrichment ceiling problem was eased by introduction of a Joint Senate Resolution that would provide flexibility of up to 10 percent in the limit on enrichment services contained in bilateral agreements. Nonetheless, as in the case of the reactors contracted for in April 1978, the South Koreans succeeded in having a cancellation clause included in the contract. In June 1980, Congress passed a modified version of the resolution, Public Law 96-280, which effectively eliminates enrichment ceilings for countries, such as South Korea, which are party to the Treaty on Non-Proliferation of Nuclear Weapons.

DEPARTMENT OF STATE
Comptroller
Washington, D.C. 20520

July 16, 1980

Mr. J. Kenneth Fasick
Director
International Division
U.S. General Accounting Office
Washington, D.C.

Dear Mr. Fasick:

I am replying to your letter June 17, 1980, which forwarded copies of the draft report: "U.S. Nuclear Non-Proliferation Policy: Impact On Exports And Nuclear Industry Can Not Be Determined."

The enclosed comments on this report were prepared by the Deputy Assistant Secretary for the Bureau of Oceans and International Environmental and Scientific Affairs.

We appreciate having had the opportunity to review and comment on the draft report. If I may be of further assistance, I trust you will let me know.

Sincerely,

Roger B. Feldman

Enclosure:
As stated

ASSISTANT SECRETARY OF STATE
OCEANS AND INTERNATIONAL ENVIRONMENTAL AND SCIENTIFIC AFFAIRS
WASHINGTON, D.C. 20520

July 16, 1980

Mr. J. K. Fasick
Director
International Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Fasick:

I am replying to your letter of June 17, 1980, with which you forwarded for our review and comment a copy of the draft report entitled "U.S. Nuclear Non-Proliferation Policy: Impact on Exports and Nuclear Industry Can Not be Determined".

We agree with the basic conclusion of the study that the impact of the Nuclear Non-Proliferation Act on the competitiveness of nuclear exports could not be specifically determined. This is due largely both to the limited number of nuclear reactor orders placed in the export market since the passage of the Act and to the difficulty of evaluating the interrelationships of the various factors leading to the selection of a supplier.

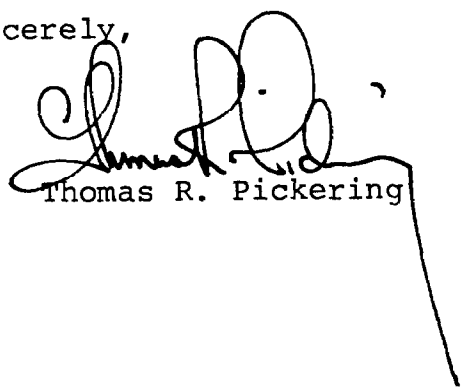
We would not wish to imply, however, that nuclear nonproliferation policies have had no impact on nuclear exports. Not all potential importers of nuclear items have agreed to safeguards required by the U.S. NNPA, and, therefore, some U.S. sales have had to be forgone. Moreover, as noted in our January 1980 report to the Congress pursuant to Section 601 of the Act, a number of countries continue to be concerned about U.S. reliability of supply and of what they perceive as U.S. attempts to change conditions of supply unilaterally. This can, of course, have some impact on U.S. export potential, and we are continuing to work to resolve such concerns where they may exist.

In addition, with the reduction in the number of orders being placed for new reactors, the sale of enrichment services and components is becoming an increasingly important part of the export market. Even for reactors built by other suppliers some portion of the enrichment services and/or replacement

parts and components market may be open to U.S. suppliers. While the report reviews the enrichment services market, it barely touches upon the impact of the NNPA on the component market. We believe that if the GAO undertakes any follow-on study in this area, that this aspect should be looked into as well.

Our detailed comments relating to specific sections of the draft report are enclosed.

Sincerely,



Thomas R. Pickering

Enclosure:
As stated.

Comments on Draft GAO Report
"U.S. Nuclear Non-Proliferation Policy:
Impact on Exports And Nuclear Industry Can Not Be Determined"

Page vii, sixth line - It would be clearer if the word "future" were inserted before enrichment services contracts to show that existing contracts were not affected.

Page 3, sentence beginning on sixth line from bottom - the Act also requires U.S. approval over reprocessing.

Page 5, fifth line under section "Non-Proliferation policies since 1974" - The United States also attempted unsuccessfully to obtain agreement on a requirement for "full-scope" safeguards.

Page 6, last paragraph - Under present policies U.S. exports are conditioned upon right of veto on reprocessing as well as retransfers. Neither U.S. non-proliferation policies nor the NNPA prohibit the export of breeder technology.

Page 11, second full paragraph - Westinghouse also sold the SENA reactor (located in France) to a joint Franco-Belgian consortium during this period.

Pag 12, second paragraph, second sentence - The U.S. did not place all foreign contracts on conditional status in 1974; instead, most new contracts were entered into on a conditional basis.

Page 14, second tic re environmental concerns - The Executive Order does not require preparation of an environmental impact statement for export of nuclear reactors but instead requires the concise review of the environmental issues involved.

Page 19, second paragraph in section on France - Framatome does not need DOE approval to export Westinghouse technology; instead they must obtain Westinghouse approval for transfers to those countries which are not generally authorized under 10 CFR 810 to receive light water reactor technology; Westinghouse must in turn obtain DOE approval.

Page 26, first full paragraph - A joint resolution was introduced in both the House and the Senate in mid-1979 which would have permitted export of enrichment services up to ten percent in excess of the ceilings contained in Agreement for Cooperation. Action on this resolution was not completed prior to the Korean decision on units 7 and 8 but came much later. The final resolution (Public Law 96-280) essentially eliminates the ceiling for countries which are party to the NPT.

Page 27, last sentence - same comment as for page 26.

Page 70, last paragraph - should probably read "With the deposition ....".

Page 82, last two paragraphs - As noted in the comment relating to page 26, the joint resolution providing up to ten percent flexibility was not passed. Instead, it was replaced with a resolution, which has since become law, which effectively eliminates the ceiling for NPT parties. Since Korea is an NPT party, this eliminates the ceiling problem for Korea.

GAO note: Page numbers refer to the draft report. In general, we have made the suggested clarifications and revisions. The change suggested for page 11 was not made, however, because it conflicted with information from Westinghouse and other sources.

Department of Energy
Washington, D.C. 20461

JUL 22 1980

Mr. J. Dexter Peach
Energy and Minerals Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Peach:

We have reviewed the draft report "U.S. Nuclear Non-Proliferation Policy: Impact on Exports and Nuclear Industry Cannot be Determined," and wish to commend you and your staff for this useful analysis of a very difficult topic. We would also like to offer the following information with regard to the most current foreign nuclear forecasts prepared by the Energy Information Administration (EIA). Because the draft report cites EIA forecasts from May and September 1979 in the preparation of analysis in Chapter 4, "U.S. Prospects in A Declining Nuclear Export Market," we have transmitted for your consideration two tables of the most current data and some suggested technical assessments for enhancing the basic analysis of these data.

Table 1 represents the most current EIA nuclear forecasts through the year 2000 for both the U.S. and foreign non-Communist nations. These forecasts are detailed in the EIA Annual Report to Congress 1979, scheduled for publication by the end of this month. As seen in the Table 1, total non-Communist nuclear generating capacity may now range between 203-237 gigawatts (GWe) in 1985 and 450-600 GWe in 2000. You may wish to include these new forecasts in the Table on page 42 of the draft. (See p. 33.)

Table 2 updates through the year 2000 the information on potential orders which you previously summarized through 1995 in the table on page 45 of the draft. Please note that Iran has been deleted from the previous forecast but that several new countries have entered as prospective nuclear power candidates. These ranges greatly increase the order potential from the 1995 estimates previously cited, primarily because the time horizon to 2000 exceeds the normal planning leadtimes for nuclear reactor projects (10-15 years). Under such leadtime assumptions, many of the potential reactor orders thus represented may be justified by electricity demand growth after 1995 and, by the same token, may not necessarily be limited by financial constraints, environmental and/or siting restrictions, or political circumstances which characterize the near term (and thus the 1995 forecasts) in many countries. (See p. 35.)

On the other hand, we believe that this range of potential orders, 50,750 MWe to 93,060 MWe should be represented as the total potential export market over approximately the next 10 years, i.e., from 1981-1990. Further, a more rigorous treatment of individual countries in this group such as Belgium, Italy, Spain, Switzerland, South Africa, South Korea, and Taiwan, could further reduce this potential export market due to the existence of nuclear industrial infrastructures in these nations.

With a practical assumption that these seven nations could achieve total nuclear self-sufficiency by the end of the next phase of reactor orders, the potential export market for the U.S. might then be reduced to between 22,850 MWe and 43,360 MWe for the years 1981-1990. An additional consideration, the type of reactor technology favored by individual nations (heavy water reactors in Argentina for example) would reduce this potential market even further.

Regardless of the data you choose to adopt, we would recommend that a closer inspection be made of the following factors:

1) the degree of indigenous industrial infrastructure in all nations with devoted or potential capabilities in nuclear manufacturing;

2) the traditional economic and industrial cooperation between neighboring states or unions, such as the Dutch or Belgian adoption of technologies and services produced by Euratom allies; and,

3) a nation's tradition or inclination to adopt certain nuclear reactor technologies uncommon to U.S. vendor designs and services, such as the heavy water reactor program being pursued by Argentina.

A more detailed review of these factors may enhance and refine your assessment of the actual export market potential which could exist for the U.S. in the future. Without these qualifications, we believe that you may overstate this potential.

We appreciate the opportunity to comment on this draft report and trust you will consider our comments in preparing the final report.

Sincerely,

Jack E. Hobbs
Controller

Enclosures

Table 1

Nuclear Power Forecasts
For The
World Outside Centrally Planned Economic Areas (WOCA)
(Gigawatts Electric Installed
Capacity At Year-End)

	1985	1990	1995	2000
United States	89-109	121-139	137-160	160-200
Non-U.S. WOCA	117-128	165-200	228-280	290-400
Total	203-237	286-339	365-440	450-600

Source: Nuclear Energy Analysis Division, Office of Applied Analysis, Energy Information Administration, and scheduled for publication in the Annual Report to Congress - 1979, July 1980.

Table 2

Potential Exports Open to U.S. Competition
(Estimated Nuclear Generating Capacity For 2000
Less Capacity Operating on Under Construction)

Countries	Low Estimate (MWe)	High Estimate (MWe)
OECD		
Australia	1,000	2,000
Belgium	2,000	4,000
Denmark	950	1,900
Greece	1,800	2,400
Ireland	1,200	3,000
Italy	4,200	9,400
Netherlands	900	1,800
New Zealand	-	600
Portugal	1,200	1,800
Spain	5,000	7,000
Switzerland	-	1,000
Turkey	1,000	1,600
Non-OECD		
Argentina	3,600	4,800
Chile	600	1,200
Egypt	600	1,800
India	1,640	2,840
Israel	960	1,920
Malaysia	-	600
Mexico	2,800	4,300
Pakistan	1,200	2,400
Philippines	600	1,800
South Africa	2,800	5,800
South Korea	8,100	12,100
Taiwan	5,800	9,800
Thailand	-	1,800
Venezuela	600	1,200
Yugoslavia	2,200	4,200
	50,750	93,060

UNITED STATES DEPARTMENT OF COMMERCE
Office of Inspector General
Washington, D.C. 20230

July 24, 1980

Mr. Henry Eschwege
Director, Community and Economic
Development Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Eschwege:

This is in reply to your letter of June 17, 1980 requesting comments on the draft report entitled "U. S. Nuclear Non-Proliferation Policy: Impact on Exports and Nuclear Industry Can Not Be Determined".

We have reviewed the enclosed comments of the International Trade Administration and believe they are responsive to the matters discussed in the report.

Sincerely,

Mary P. Bass
Inspector General

Enclosure

UNITED STATES DEPARTMENT OF COMMERCE
The Under Secretary for International Trade
Washington, D.C. 20230

18 JUL 1980

Mr. Henry Eschwege
Director
U.S. General Accounting Office
Washington, DC 20548

Dear Mr. Eschwege:

This is in response to your letter of June 17, 1980 to the Secretary asking for the comments of the Department of Commerce on the draft report to Congress entitled "U.S. Nuclear Non-Proliferation Policy: Impact on Exports and Nuclear Industry Cannot Be Determined."

Enclosed are our comments. Thank you for the opportunity to review the report.

Sincerely,

Donald A. Furtado
Deputy Under Secretary

Enclosure

COMMENTS OF THE DEPARTMENT OF COMMERCE ON THE REPORT BY THE GENERAL ACCOUNTING OFFICE: "U.S. Nuclear Non-Proliferation Policy: Impact on Exports and Nuclear Industry Cannot Be Determined"

The report contains a useful compendium of developments in the nuclear export area during the past years. Some of its conclusions may be unintentionally misleading, however.

For example, the first paragraph of the Cover Summary states that "GAO could not identify any export sales lost as a result of the Act, but did find indications that non-proliferation policies can influence export sales." By focusing only on the Nuclear Non-Proliferation Act (NNPA) rather than the policies codified in the NNPA, the conclusion may be technically accurate, but nevertheless misleading.

Most major export sales of the 1970's were lost prior to passage of the NNPA. Nevertheless, some, such as the Brazilian and Iranian sales, were lost primarily because of then-existing or evolving U.S. non-proliferation policies which were formally codified in the NNPA.

The referenced conclusion and other portions of the report also fail to emphasize that it is often difficult to identify one single factor as the sole or decisive factor causing the loss of an export sale. The report correctly concludes that the growing competitiveness of foreign suppliers, more generous financing on the part of the governments, and a shrinking market are important reasons for the loss of U.S. nuclear exports. The report also cites environmental impact statements, human rights policies, political trade restrictions, the Foreign Corrupt Practices Act, and anti-boycott statutes as factors which can affect an export sale. The existence of such reasons and export disincentives does not lessen the impact of the NNPA on export sales, however; it merely increases the factors which must be considered by a potential buyer of U.S. nuclear exports. The more factors the potential buyer must consider, the less likely it is that one single factor will be identified as the cause of a lost export sale. In such a highly competitive field as nuclear exports, each additional negative factor increases the cumulative impact on the potential U.S. sale.

The report appears to understate the impact which non-proliferation policies of the NNPA may have on possible nuclear exports to such countries as Argentina, Pakistan, India and Chile. These countries have not yet satisified the NNPA's non-proliferation criteria, but are among the few markets available outside the Soviet bloc to non-indigenous suppliers.

As an example, U.S. firms cannot be encouraged to bid on Pakistan's invitation to European engineering consultants for the design of a 600 megawatt nuclear power plant at Chasma although the Pakistanis acknowledge U.S. superiority in this

field. Another example is Combustion Engineering's difficulty in receiving U.S Government approval to export $60 million in pressure vessels and componentry for an Argentine reactor. The report notes that Argentina elected to build a reactor that is not available from U.S. vendors and concludes that the NNPA apparently did not influence the ability of U.S. vendors to compete. Actually, it is our understanding that Argentina chose this type of reactor in an effort to avoid problems in obtaining enriched fuel, reflecting Argentine uncertainty regarding U.S. policy. The United States hopes that Argentina will be persuaded ultimately to make commitments which will satisfy the policy set forth in the NNPA, but this does not mitigate the intervening negative effect of the policy on U.S. nuclear exports. The same comment applies to Pakistan, India, Chile and other countries which have not yet satisfied the NNPA's non-proliferation criteria.

As in the case of Combustion Engineering's opportunity for supplying part of Argentina's reactor, U.S. policy affects not only entire nuclear facilities and fuel supplies but also portions thereof. Complementary orders for dual use equipment such as computers and other instrumentation are unlikely to be approved for U.S. export.

The report does not focus adequately on the effects of the NNPA on the perceived unreliability of the United States as a supplier, although the NNPA was intended to alleviate this problem. The NNPA requires negotiation of agreements for cooperation before implementing major exports, and in particular re-negotiation of old agreements. Two years after the passage of the NNPA, only seven agreements have been initialed. In addition, the institution of the International Nuclear Fuel Cycle Evaluation (INFCE) probably has contributed to two years of uncertainty as to what the U.S. policy eventually will be. The INFCE was desirable in ascertaining technical aspects of global nuclear aspirations and intentions, but it appears to have created for some the impression of possible changes in U.S. nuclear policy shortly after codification of that policy in the NNPA.

With these comments in mind, we suggest the following revisions:

1. Revise the last sentence of the first paragraph of the cover summary to read:

   "GAO could not identify any export sales lost solely as a result of the Act, but did identify sales preceding the Act which were lost primarily as a result of non-proliferation policy codified in the Act. In addition, GAO did find indications that non-proliferation policy can influence export sales."

2. The first paragraphs of Chapter 3 should be revised to read:

"The impact of the Nuclear Non-Proliferation Act on the competitiveness of U.S. nuclear exports, in the narrowest sense, could not be determined; in the broader sense, the Act has an adverse impact on U.S. nuclear exports. The depressed market in the two years after the March 1978 passage of the Act provided only a limited test of the Act's impact. In that period, one U.S. supplier succeeded in selling four reactors for export in spite of the customer's concern over U.S. non-proliferation policies. The Act had little apparent influence on the award of five nuclear reactor orders to foreign suppliers. However, in at least one of these orders, the country concerned chose from a non-U.S. vendor a type of reactor that is not dependent on enriched fuel in order to avoid confrontation with the U.S. policy.

"Our examination of earlier competitions found that U.S. non-proliferation policies preceding the Act did play a part in the failure of U.S. suppliers to win orders in Brazil and Iran during the period 1975-1977. Although in other orders during that period factors such as financing and political considerations were decisive in the loss of contracts to other suppliers, the U.S. non-proliferation policy was an additional deterrent to reactor exports. These earlier policies were codified in the Act, and there will be a continuing adverse effect on U.S. export orders unless the principles of the Act are adopted by non-U.S. suppliers. Many orders that will develop in the future are likely to be lost to U.S. industry because the countries do not meet the test of the U.S. policies. Possible exports to such countries as Argentina, Pakistan, India and Chile--which are among the few markets available outside the Soviet bloc to non-indigenous suppliers--are unlikely to be authorized for this reason. The policies set forth in the NNPA impact equally on other nuclear exports, such as components and architectural or engineering services."

3. The final section of Chapter 3, the first two sentences of Chapter 4, the Cover Summary and the Digest all should be revised to identify the lack of international adherence to non-proliferation policy as a factor in deterring U.S. exports.

The report would benefit from an expansion of its scope. For example, country-by-country reviews by U.S. entities having a responsibility for implementation of the NNPA, the Arms Control and Disarmament Agency, and the Department of State's Office of Non-Proliferation and Export Policy, would be useful. A determination should be made regarding the extent to which the transfer of U.S. nuclear technology to foreign subsidiaries or licensee may be partly the result of U.S. non-proliferation

policies. Greater weight also should be given to the comments and assessments made by U.S. industry.

The above comments are not intended to reflect on the merits of the non-proliferation principles set forth in the NNPA. We would be better off if all international suppliers of nuclear equipment and services adhered to those principles. However, if the United States is unsuccessful in achieving the NNPA's goal of international restraint, the cost in lost export sales will not have been justified.

EXPORT-IMPORT BANK OF THE UNITED STATES
WASHINGTON, D.C. 20571

July 15, 1980

FIRST VICE PRESIDENT
AND
VICE CHAIRMAN

CABLE ADDRESS "EXIMBANK"
TELEX 89-461

Mr. J. K. Fasick
Director, International Division
United States General Accounting Office
Washington, D.C. 20548

Dear Mr. Fasick:

Thank you for the opportunity to review your draft report entitled, "U.S. Nuclear Non-Proliferation Policy: Impact on Exports and Nuclear Industry Can Not Be Determined." Our comments are detailed below.

Regarding the one issue that directly involves Eximbank policies, the report discusses in several places concern on the part of U.S. nuclear vendors as to whether they could obtain Eximbank financing in 1976 for sales to South Africa. These references to the possibility of Eximbank financing are incorrect in that, at that time, Eximbank was authorized only to extend guarantees of private financing--not direct loans--in support of export sales to South Africa. The Bank's latitude in this area was limited even further with the passage of Public Law 95-630 in November 1978.

For many years, Eximbank has been concerned with the issue of "additionality"; that is, what would have happened to specific export transactions had the Bank's financial support not been available. This is a difficult but important type of analysis, and we believe it might usefully have been a part of your study.

In the case of your analysis, the question that warrants examination is: "How many additional nuclear export orders might have been placed with U.S. suppliers in the absence of the Nuclear Non-Proliferation Act of 1978?" U.S. nuclear suppliers should be well-prepared to address this type of query, and their responses could be verified by discussions with applicable potential purchasers.

Our last comment has to do with the strength of your argument that the NNPA had no apparent influence on the purchase of four nuclear reactors by Romania from Canada. Missing from your discussion

of Romania's decision to purchase the heavy water reactors is any evidence that Romania is irrevocably committed to heavy rather than light water technology, as Argentina seems to be. If Romania is not so committed, then it might have been a more promising U.S. market than you describe, one that could have been influenced by the NNPA. As you pointed out, Romania ordered a light water reactor from the Soviet Union in 1975, so it would not appear that light water technology has been completely eliminated from the Romanian nuclear program.

If you have any questions regarding these comments, please let us know.

Sincerely yours,

H.K. Allen

(006040)

* U.S. GOVERNMENT PRINTING OFFICE : 1980- 620-386/278

AN EQUAL OPPORTUNITY EMPLOYER

UNITED STATES
GENERAL ACCOUNTING OFFICE
WASHINGTON, D.C. 20548

OFFICIAL BUSINESS
PENALTY FOR PRIVATE USE,$300

POSTAGE AND FEES PAID
U. S. GENERAL ACCOUNTING OFFICE

THIRD CLASS