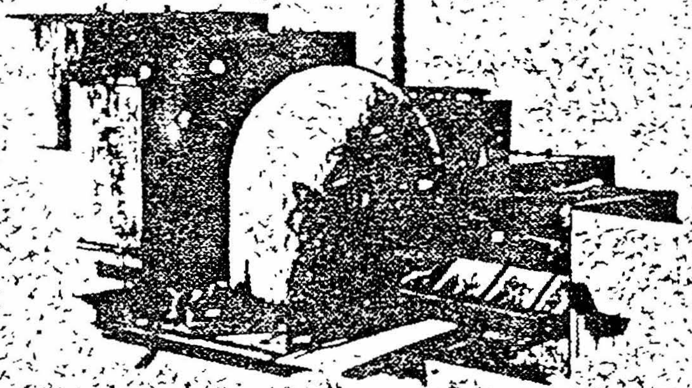
[redacted]

DEFENSE INTELLIGENCE AGENCY

NUCLEAR PROLIFERATION WATCH (U)



(b)(3):10 USC 424

Warning Notice
Sensitive Intelligence Sources and Methods Involved
National Security Information
Unauthorized Disclosure Subject to Criminal Sanctions

TCS 808518/78

(b)(3):50 USC 403-1(i)

~~TOP SECRET~~

NUCLEAR PROLIFERATION WATCH

FOREWORD

Due to the growing concern for the possibility of further proliferation of nuclear weapons and the need to keep high level officials apprised of the situation in this area, the Defense Intelligence Agency has prepared the Nuclear Proliferation Watch. In order to maintain currency, the book is updated quarterly. Changes in previously reported information are indicated by single vertical lines in the margin; new information is indicated by double lines.

The state of nuclear technology has progressed so rapidly in the past few years that a growing number of nations currently have or shortly will have the capability to develop nuclear weapons. When coupled to present and foreseeable political and military instabilities, there is created an increasing concern that these technical capabilities will in fact be translated into military hardware. This report provides a concise assessment and discussion of selected countries' capabilities and intentions to develop nuclear weapons. The fourteen countries discussed in this report are Argentina, Brazil, India, Iran, Israel, Japan, Libya, Pakistan, South Africa, South Korea, Spain, Sweden, Taiwan, and West Germany. The countries were selected because they have either indicated a strong desire to obtain nuclear weapons or because they already have or soon will have the nuclear facilities necessary to produce fissionable material.

Samuel V. Wilson

SAMUEL V. WILSON
Lieutenant General, USA
Director

TCS 608518/76

COUNTRY ASSESSMENTS

INTRODUCTION

INTRODUCTION

~~(C)~~ A wide variance in the nuclear weapons intentions and levels of nuclear technology prevails in the countries discussed in this study. Each Nth country description analyzes these factors to provide a concise assessment of military intention and an earliest date when an initial nuclear device could be available. Accompanying each assessment is a discussion of pertinent facts upon which the assessment is based, a description of relevant nuclear materials and facilities, a map showing these locations, and a chart indicating the known status of existing or planned resources or facilities. A section is also included which considers the likelihood of terrorist acquisition of nuclear weapons.

(U) An appendix provides additional information dealing with various aspects of nuclear proliferation. Its sections include: a description of the nuclear fuel cycle; a table indicating the Nuclear Non-Proliferation Treaty (NPT) status of the selected countries; a discussion of the NPT and its effectiveness; a table of Nth country and supplier relationships; and a glossary of nuclear terms.

(U) Analysis of a country's nuclear facilities provides an important clue to its nuclear weapons intentions. Many factors affect the proliferation potential of a country, not the least important of which is the choice of reactor. The most common types of commercially available reactors are slightly enriched uranium, light water reactors (LWR) pioneered by the U.S. and natural uranium reactors (usually cooled and moderated with heavy water) championed by Canada--the so called CANDU design.

~~(S/NOFORN)~~ Despite the more favorable economics of light water reactors, many Nth countries are selecting natural uranium fueled power reactors for their nuclear programs. They do this for a number of reasons. First, they would not be dependent upon external sources for enrichment services. Second, the CANDU with its on-line refueling is ideally suited for the production of weapons grade plutonium without compromising its power generation function. The favorable economics of LWRs stem from the fact that it can operate for long periods of time without refueling. This mode of operation has the ancillary property of producing high burnup by-product plutonium, presumably unfit for weapons use. Since the LWR must be completely shut down for the refueling period, usually several weeks, covert production of weapons grade (low burnup) plutonium would be easily detectable. [redacted]

(b)(1),1.4 (h)

ARGENTINA

ARGENTINA

~~(S/NOFORN)~~ Assessment. Argentina is determined to establish a self-sufficient nuclear power program which would allow domestic industry to produce nuclear fuel as well as power reactor components. Although Argentina claims to be striving in this direction exclusively for peaceful purposes, there are strong indications that the country is not precluding the development of nuclear weapons. Argentina has achieved the most advanced nuclear program in Latin America, and it might be technically feasible for them to fabricate a nuclear device by 1979. It is unlikely, however, that such capability would actually be attainable before the early 1980s.

~~(S/NOFORN/NOCONTRACT/WNINTEL)~~ Discussion. [redacted] As a result of the coup in March 1976, the Argentina Nuclear Energy Commission (CNEA) has been taken over by Castro Madero, a man described by some Argentine scientists as the one person in the Argentine military who most wants the country to achieve the goal of having a nuclear weapons capability. Since becoming head of CNEA, however, Madero has not shown indications of strongly advocating this position. It appears that he is working to foster greater cooperation and assistance from nuclear supplier countries, and apparently restraining weapons desires until technology has been transferred. Despite this current attitude, the military has been successful in influencing the type of reactors chosen for the country's power program; natural uranium fueled reactors are to be employed. The safeguards agreement covering Argentina's first power reactor was initiated in early 1972 and is in effect until next year (1977). Although the agreement contained an option to renew the safeguards, Argentina strongly resisted any extension. At present, negotiations are underway between Argentina and West Germany, the reactor supplier, concerning new arrangements. By now, this reactor could have produced enough plutonium for several nuclear devices. The plutonium is currently contained in irradiated fuel elements which are being stored for lack of fuel reprocessing facilities. Construction of a fuel reprocessing plant had been started and could have been operational as early as 1978 if the project was given top priority. Because of the country's economic difficulties, however, resources will instead be concentrated on the development of nuclear power, and completion of the reprocessing plant will be delayed for several years beyond 1978.

~~(S/NOFORN~~ (b)(3):50 USC 403-1(i) [redacted] ~~/NOCONTRACT/WNINTEL)~~ Nuclear Materials and Facilities.

a. Uranium Resources - Argentina has large uranium ore reserves which could justify a natural uranium based nuclear power program. This uranium can be fabricated into reactor fuel without the necessity of building an enrichment plant or contracting for such service from another country. By using domestic natural uranium, Argentina has assured itself of having reactor fuel supplies not subject to control by another country.

b. Ore Processing Plant - Several small uranium ore concentration facilities are currently in operation. Additional capacity will be on-line by the end of next year (1977) with further annual increases scheduled through 1981. Canada has also supposedly agreed to supply technology for a uranium milling facility and possibly a refining plant to be located near San Rafael.

c. Fuel Fabrication Plant - The Argentines have fabricated fuel for their research reactors at one of their laboratories and have plans to build a fuel fabrication plant to manufacture power reactor fuel. Originally the facility was to be operational in 1977; however, the project has been delayed and probably will not be completed before 1979. Argentina hopes to obtain West German technology to produce fuel elements for their operating nuclear plant at Atucha and Canadian technology for follow-on stations.

d. Research Reactor - Argentina has a substantial nuclear research program underway which is devoted to applications of radioisotopes in medicine, biology, and agriculture. There are four research reactors in the country. These reactors are located either at research institutes or universities. They are all low-power, enriched uranium fueled reactors, not suitable for the production of plutonium. To demonstrate the technical competency of its scientists, Argentina is currently trying to sell a 10 MW research reactor to Peru.

e. Fuel Reprocessing Plant - Argentina had a laboratory scale fuel reprocessing plant at Ezeiza which had been used to reprocess fuel from the country's research reactors. While this plant is reported to have been dismantled, the experience gained during its operation would have provided technological experience related to the development of a power reactor fuel recovery plant. Prior to cessation of work the Argentines had successfully separated a small amount of plutonium from bars which were irradiated in one of their research reactors. Construction on a larger reprocessing plant is now underway at Ezeiza to further broaden Argentine expertise in this field, and to recover enriched uranium which can be used in new reactor fuel elements. The Argentines had originally sought assistance from the IAEA in acquiring fuel reprocessing technology, however, they decided to withdraw their requests rather than to submit to IAEA safeguards. They now claim to have an agreement with Italy for technical assistance, and are supposedly constructing the new plant from Italian plans. Because of political changes and economic difficulties, progress in building this plant appears to have stagnated.

f. Power Reactor - Argentina's first power reactor, at Atucha, was built by a West German firm and turned over to the Argentine government in June 1974. This 319 MWe reactor is natural uranium fueled and is well suited for the production of plutonium. The Argentines have also negotiated with Canada regarding the purchase of a second nuclear power plant to be located at Embalse. Stringent safeguard requirements insisted upon by Canada, as well as financial difficulties, had kept these discussions from being concluded for months. Only after threats by Canada to halt preliminary construction efforts on the 600 MWe plant was an agreement finally signed. This reactor is now scheduled for operation in 1980. Argentina hopes to purchase a second 600 MWe Canadian unit which would become operational during 1984-85. This third nuclear power plant will probably be built at the Atucha location.

g. Heavy Water Plant - The U.S. provided the heavy water used in the Atucha reactor; Canada will supply the heavy water for the Embalse reactor. This material is under safeguards and as long as it is in the reactors they cannot be used for producing fissionable material for weapons purposes without violating agreements. The Argentines now plan to build their own heavy water plant. A project has reportedly been established to design a 20 metric ton per year pilot plant. Construction is hoped to commence about 1978.

UNCLASSIFIED

6

ARGENTINA

NUCLEAR FUEL CYCLE DEVELOPMENT

	59	61	63	65	67	69	71	73	75	77	79	81	83	85
URANIUM RESOURCES														
ORE PROCESSING PLANT														
FUEL FABRICATION PLANT														
RESEARCH REACTOR														
FUEL REPROCESSING PLANT														
POWER REACTOR														
HEAVY WATER PLANT														

TCS 6085 18/76

UNCLASSIFIED

TCS 608518/76

Page 8 is Denied in Full

(b)(1),1.4 (b)

BRAZIL

BRAZIL

~~(S/NOFORN)~~ Assessment. It appears that Brazil, with currently only a modest nuclear energy program, is attempting to achieve nuclear independence as rapidly as its limited economic and technological base will permit. The Brazilian drive for self-sufficiency in fuel cycle activities seems at this time to be unrelated to weapons proliferation aspirations; however, with the successful completion of high explosives and weapon R&D, as well as unrestricted use of a U.S.-supplied power reactor and a West German-supplied fuel reprocessing facility, Brazil could have a nuclear device as early as 1980.

~~(S/NOFORN/~~[redacted] (b)(3):50 USC 403-1(i) ~~NOCONTRACT/WNINTEL)~~ Discussion. Although Brazil has only one nuclear power plant under construction, the Brazilians have recently negotiated a package deal with West Germany for acquisition of facilities involved in all phases of the nuclear fuel cycle including uranium enrichment. An agreement has been reached between the two countries and also with the IAEA whereby all details of the bilateral agreement will be subject to control by the international agency. Joint Brazilian and West German companies have been established thus far for producing nuclear fuel and for manufacturing reactor components. [redacted] (b)(1),1.4 (b) technology. In order to obtain a nuclear weapons capability in the near agreements; [redacted] (b)(1),1.4 (h) In that case, they would undoubtedly follow the same path.

~~(S/NOFORN/NOCONTRACT/WNINTEL)~~ Nuclear Materials and Facilities.

a. Uranium Resources - Since 1970 the Brazilian government has significantly increased budget allocations for exploration efforts. Ten areas of the country are under intensive investigation. It has been estimated that the most promising uranium deposits may contain 7,600 metric tons of recoverable uranium. Although new reserves have reportedly been discovered, it is feared by Brazilian energy officials that they will not reach their goal of being self-sufficient by the mid-1980's. To help exploit their new deposit, located at Pocos de Caldas, the Brazilians will be receiving French assistance under the provisions of a contract signed in August 1976.

b. Ore Processing Plant - Uranium from the Pocos de Caldas deposit is processed in an ore concentration plant located near the mine. The plant is estimated to produce 190 metric tons of uranium annually. The French contract also calls for the construction of another uranium treatment plant which is to be operational in 1979. The uranium processed by these plants will be fabricated into fuel for the West German-supplied power reactors.

c. Fuel Fabrication Plant - The agreement with West Germany includes the construction of a fuel element fabrication plant, and the transfer of the technology, engineering, and operational expertise associated with it. In July 1976 a joint Brazilian - West German company was established which will construct the plant in Sepetiba, near Rio de Janeiro. The plant is scheduled to be operational at the end of 1978 with an initial capacity of 100 metric tons per year of fuel. This fuel will be used to reload the Angra I reactor (see para f. below). An expansion of the plant's capacity will ultimately enable fuel to be fabricated for the Angra 2 and 3 reactors.

d. Research Reactor - Three research reactors are in operation in Brazil. They are fueled with enriched uranium provided by the U.S. and are not suitable for the production of plutonium for a weapons program.

e. Uranium Enrichment Plant - A uranium enrichment plant utilizing an aerodynamic process developed in West Germany (the Becker nozzle process) is to be built in Brazil as part of the overall Brazilian-West German agreement. The process has been pursued in the FRG only to the pilot plant stage and the Brazilian plant will be the first attempt to demonstrate its viability on a larger scale. The process is still in its experimental phase and may not be able to meet Brazilian requirements for enriched uranium power reactor fuel. It is highly unlikely that this facility will be operational in any case before 1980. The Brazilians themselves may have some doubts about the ultimate success of this project, and have been discussing enrichment assistance with France. France has one national enrichment plant operational and is currently leading a multi-national effort to build a second facility. Both of these plants use the gaseous diffusion method of uranium enrichment, an already proven technology. While the French have reportedly offered to build a gaseous diffusion plant in Brazil, the high cost has prevented Brazilian acceptance. Brazil could guarantee a future supply of enriched uranium by accepting a French proposal to join other countries and participate in the multi-national consortium now planning a second jointly owned plant. Thus far Brazil has indicated reluctance to join the group, apparently still seeking a domestic capability.

f. Power Reactor - Brazil has one nuclear power plant, Angra I, presently under construction. It is a 600 MWe plant being built by Westinghouse. The plant will most likely not be completed before 1978. The West German package agreement calls for Germany to sell Brazil at least four 1,200 MWe nuclear power plants with an option for an additional four. Financing arrangements for the first two, Angra 2 and 3, have been completed. These plants are to be operational in 1983 and 1984, respectively. Purchase of additional plants is expected during 1977 or 1978.

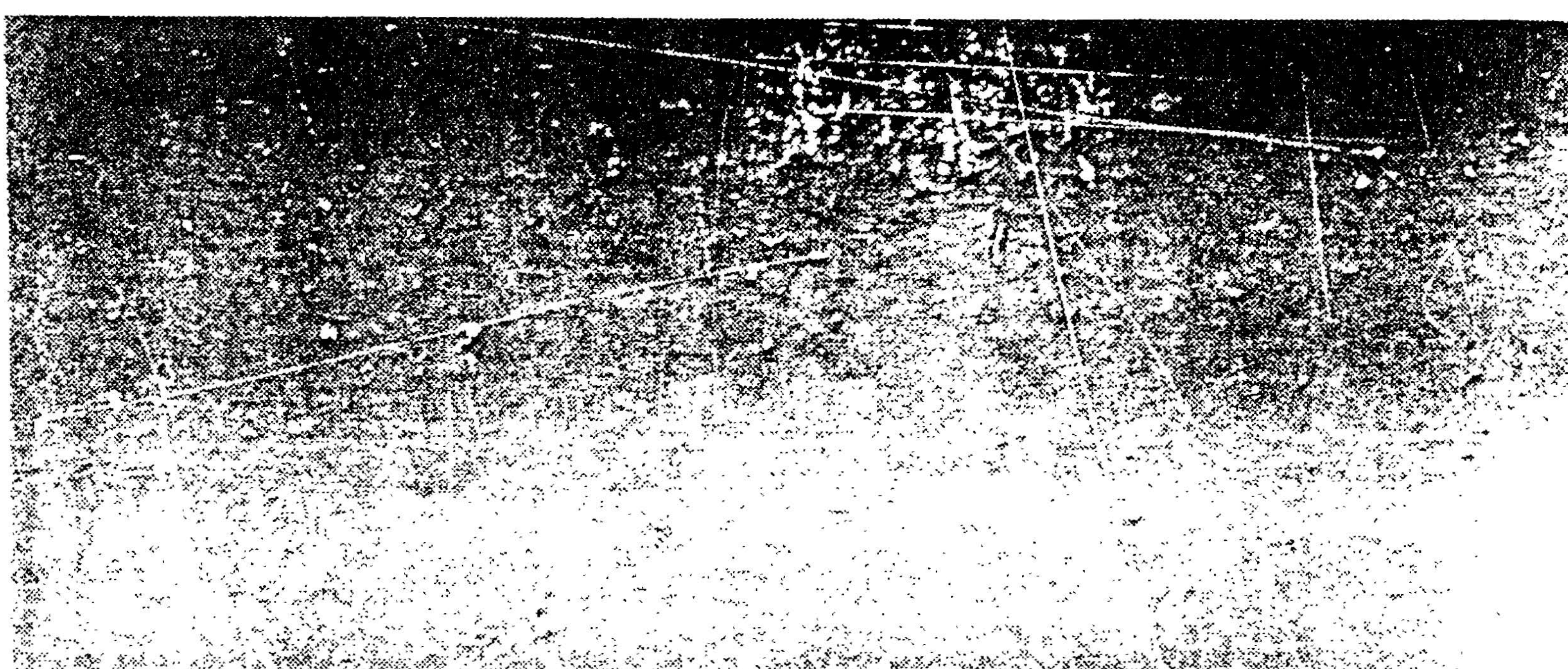
g. Fuel Reprocessing Plant - West German assistance will be provided to Brazil for the construction of a pilot reprocessing plant. It is possible that this plant could be operating by the time irradiated fuel is being discharged from the U.S.-supplied power reactor.

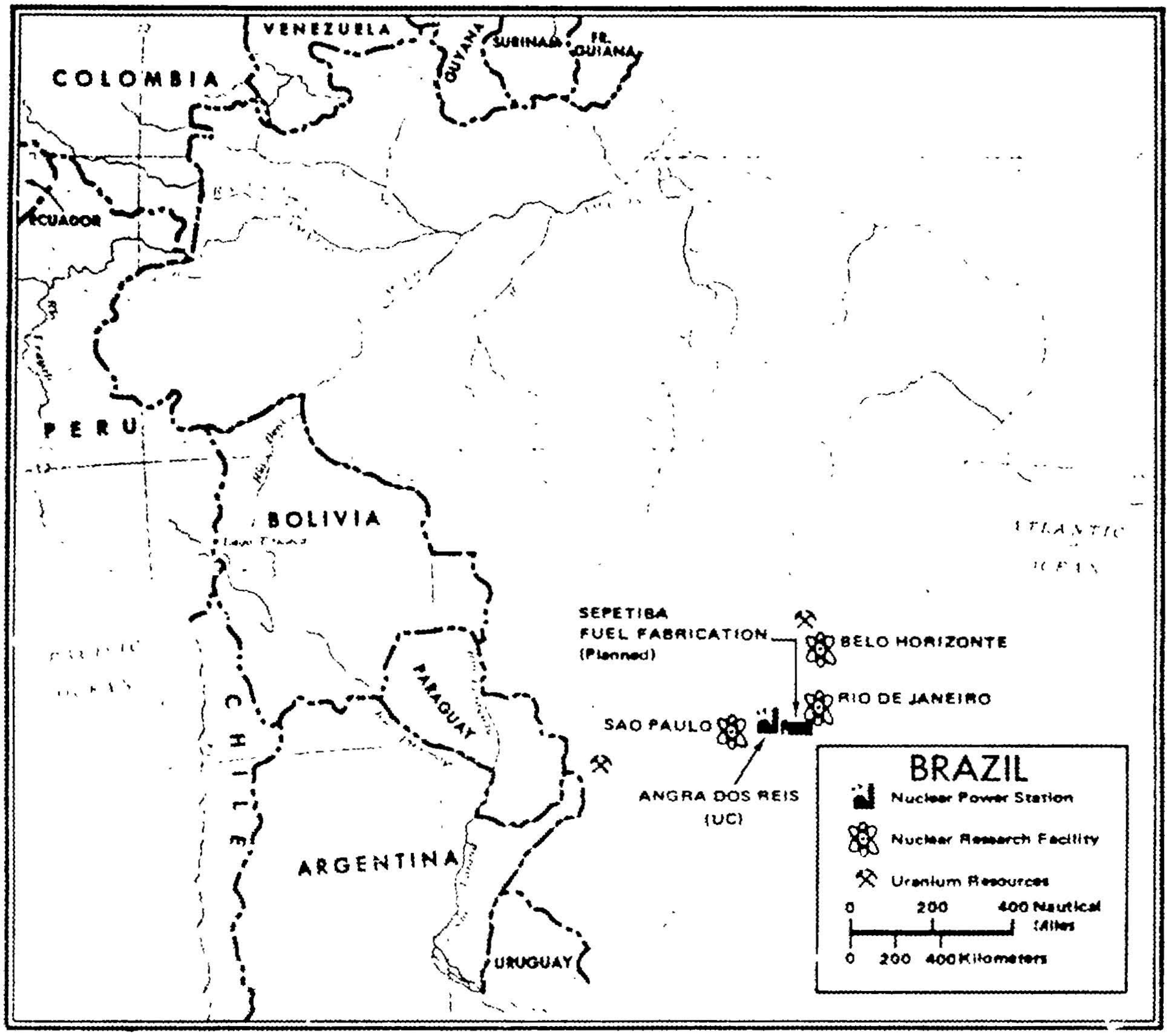
h. Thorium Resources - Thorium is currently produced in Brazil as a by-product of rare earths extraction from monazite beach sand deposits. The reserves of thorium obtained in this manner are estimated at about 1,300 metric tons. Possible additional reserves are estimated to be as high as 60,000 metric tons. Although thorium is not currently in wide use on a global scale, gas-cooled thermal breeder reactors that operate on a uranium/thorium fuel cycle could be attractive to Brazil.

BRAZIL

NUCLEAR FUEL CYCLE DEVELOPMENT

	59		61		63		65		67		69		71		73		75		77		79		81		83		8
URANIUM RESOURCES																											
ORE PROCESSING PLANT																											
FUEL FABRICATION PLANT																											
RESEARCH REACTOR																											
FUEL REPROCESSING PLANT																											
URANIUM ENRICHMENT PLANT																											
POWER REACTOR																											
THORIUM RESOURCES																											




VENEZUELA
GUYANA
SURINAM
FR. GUIANA
COLOMBIA
ECUADOR
PERU
BOLIVIA
PARAGUAY
CHILE
ARGENTINA
URUGUAY
SEPETIBA
FUEL FABRICATION
(Planned)
BELO HORIZONTE
RIO DE JANEIRO
SAO PAULO
ANGRA DOS REIS
(UC)
BRAZIL
Nuclear Power Station
Nuclear Research Facility
Uranium Resources
0 200 400 Nautical Miles
0 200 400 Kilometers

CI BR 1-6/74

INDIA

INDIA

~~(S/NOFORN)~~ Assessment. On 18 May 1974, India became the sixth nation to detonate a nuclear device. While we do not know if a decision to initiate a weapons program has been made, we believe that India will opt for a nuclear weapons program with the intention of keeping it small and covert; however, pressures for an overt program are likely to prove irresistible as the program gains momentum. By 1985, India could produce a total of nearly 2700 kilograms of unsafeguarded plutonium, sufficient for 500 nominal yield nuclear weapons.

~~(S/NOFORN)~~ Discussion. An active nuclear energy program over the last decade has enabled India to have all of the essential materials and facilities for production of nuclear weapons. Using a Canadian supplied research reactor, the Indians could have stockpiled plutonium for some 10-15 nuclear weapons. A major nuclear weapons program, which does not violate safeguard agreements, however, is dependent upon the successful completion of the indigenously built power reactors at Kalpakkam and Narora. The first of these is scheduled for completion in 1978 and the last in 1982. Each of these reactors will be capable of producing about 140 kilograms of plutonium per year. By 1985, India could produce a total of nearly 2700 kilograms of safeguard free plutonium, sufficient for nearly 500 nominal yield weapons. The announced purpose of the Indian test was a peaceful nuclear explosion experiment for which they have advanced several possible uses. Although there have been numerous reports of a second test, there is no hard evidence of preparations for such an event. The Indians have held lengthy discussions with the Canadians about resumption of aid necessary for the completion of the Rajasthan II reactor. The aid was terminated in May 1974 because Canada felt India violated the bilateral agreement on the Canadian-supplied CIRUS research reactor. Canada, however, announced in May 1976 that they would not resume the nuclear aid. Several devices for contingency weaponization will probably be covertly fabricated over the next several years. India will probably begin a weapon program with the intention of keeping it small and covert; however, pressures for an overt program are likely to prove irresistible as the program gains momentum. India lacks a long range weapon delivery system and currently relies on Canberra bombers. India has a modest space program; however, it will be 1985 before they develop a long range missile.

~~(S/NOFORN)~~ Nuclear Materials and Facilities.

a. Uranium Resources - Reserves are estimated to be about 30,000 metric tons of uranium oxide.

b. Ore Processing Plant - Uranium Corporation of India, Ltd, operates a facility capable of concentrating 200 metric tons of ore per year.

c. Fuel Fabrication Plant - The Nuclear Fuel Complex (NFC) at Hyderabad has the capability to fabricate both natural uranium and slightly enriched uranium fuel elements for use in heavy water and light water power reactors respectively. A fuel fabrication plant for research reactor fuel was constructed at the Bhabha Atomic Research Center (BARC) in 1958.

d. Research Reactor - Although four research reactors are located at BARC, only CIRUS, the 40 MWt, natural uranium fueled, heavy water moderated, Canadian built reactor is a plutonium producer. It can produce about 10 kilograms of plutonium annually. A 100 MWt research reactor, similar to CIRUS and designated R-5, is under construction at BARC. When completed in 1979, it will be able to produce 25 kilograms of plutonium per year.

e. Fuel Reprocessing Plant - A fuel reprocessing facility with 0.35 metric tons per day capacity was constructed at BARC in 1964 to reprocess research reactor fuel. A fuel reprocessing plant for power reactor fuel was recently completed at Tarapur and another facility for reprocessing power reactor and fast breeder reactor fuel is under construction at Kalpakkam. Both facilities will have a capacity of 0.5 metric tons per day.

f. Light Water Power Reactor - Two American built light water reactors using slightly enriched uranium are in operation at Tarapur. The U.S. has a 30-year contract to supply enriched fuel for these reactors.

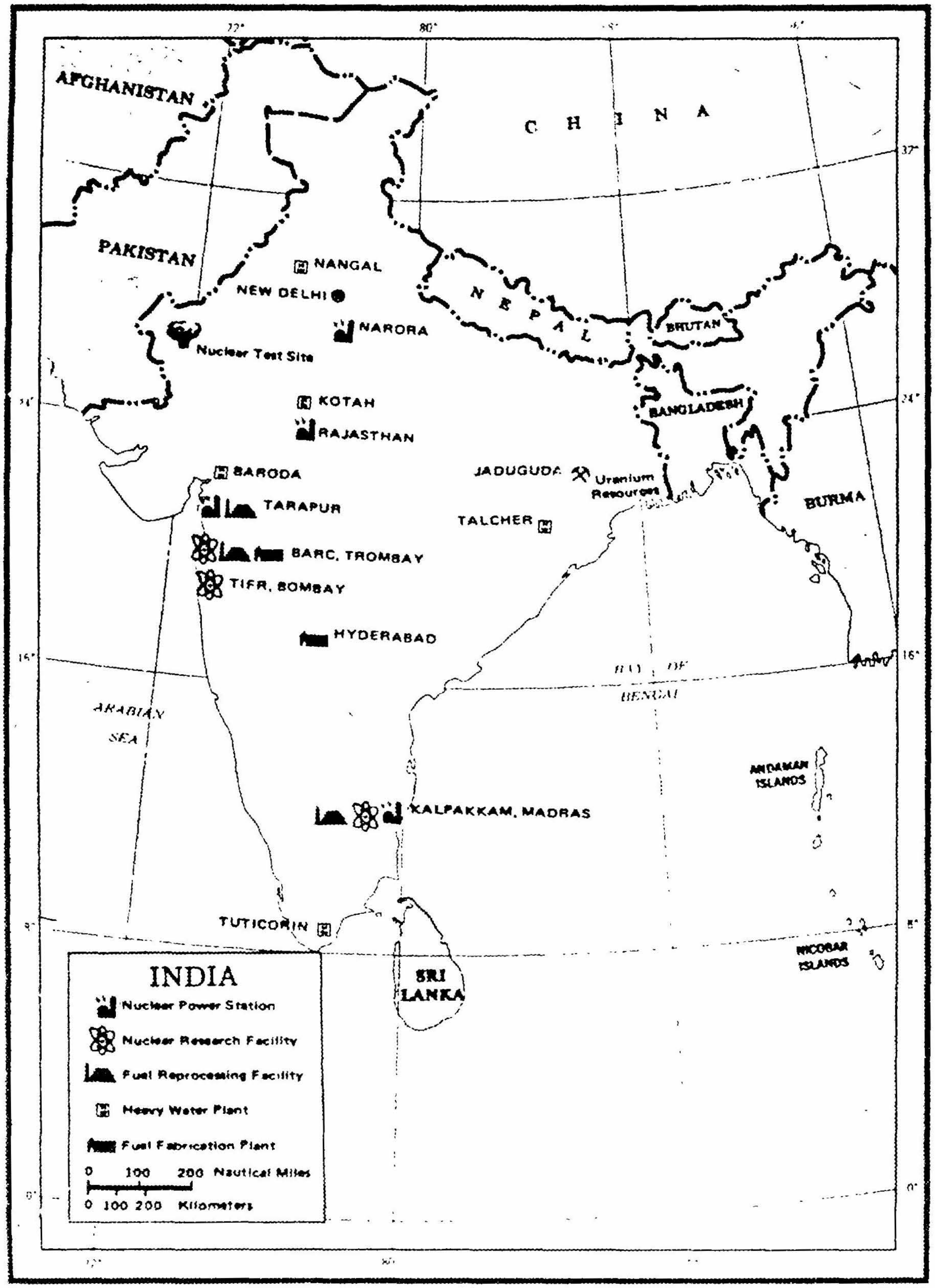
g. CANDU Power Reactor - Two natural uranium fueled heavy water moderated power reactors have been constructed at Rajasthan with Canadian assistance. Both reactors are under safeguards. The first of the two Canadian reactors is operational. Completion of the second reactor, however, has been delayed by withdrawal of Canadian assistance following the detonation of the nuclear device in May 1974. Originally scheduled for operation in 1972, completion will be delayed until at least 1977. The Indians are building four copies of the Canadian reactors at Kalpakkam and Narora. Since they are being indigenously constructed, they will be safeguard free.

h. Breeder Reactor - A 15 MWe fast breeder test reactor is under construction with French assistance at Kalpakkam. It is expected to be completed in 1978 and will be capable of producing 13 kilograms of plutonium per year.

i. Heavy Water Plant - India has a small heavy water production plant in operation and four large production plants under construction. When completed in 1977 these plants will supply nearly 300 metric tons of heavy water per year. To ensure a sufficient supply of heavy water for the start-up of the Rajasthan II reactor, India will have to purchase heavy water from foreign sources in 1976 and 1977. Funds have been set aside to purchase 230 metric tons of heavy water from the USSR.

j. Nuclear Device - The device that was exploded underground in the Rajasthan Desert on 18 May 1974 had a yield of about 15 kilotons. Placed about 100 meters underground, the device created a crater about 150 meters wide and about 15 meters deep. Although fissures occurred in the crater, apparently the detonation released no radioactivity to the atmosphere.

~~(S/NOFORN)~~ Cooperative Agreements. India has cooperative agreements with 17 countries in the field of atomic energy. These countries include possible proliferators such as Argentina, Brazil, Spain, Egypt, and the United Arab Emirates.



CI IN 1-6/74

TCS 609518/76

Page 19 is Denied in Full

(b)(1),1.4 (b)

IRAN

IRAN

~~(S/NOFORN)~~ Assessment. The Shah of Iran is attempting to establish a very ambitious nuclear power program with a goal of 22,000 MWe installed by 1990. By achieving an indigenous nuclear fuel cycle, unlikely before the mid-1980s, Teheran would also have the option of developing a nuclear weapons program. It is conceivable that a fuel reprocessing facility could be constructed by the time Iran's first power reactor is complete. If the necessary high explosives and weapons R&D is also accomplished during this period, Iran could be in a position to fabricate a nuclear device by the mid-1980s.

~~(S~~ (b)(3):50 USC 403-1(i) ~~NOFORN)~~ Discussion. During recent years, Iran has conducted extensive negotiations with virtually all of the major nuclear supplier nations. An agreement with France reportedly involves the entire range of technologies within the nuclear fuel cycle, although the provision of a fuel reprocessing capability will probably not occur within the next few years. Concurrent with the establishment of a nuclear research and power generation base, Iran is forging ahead in other technological areas that could set the framework for achieving a nuclear weapons option. Of particular interest is the assistance Iran is seeking from a Swedish firm to establish a high explosive development laboratory near Teheran, including the provision of a computer program which - although it has a wide range of applications - has been used to conduct implosive research in the U.S. nuclear weapons development program. Furthermore, it is interesting to note that a high-speed camera which would be capable of photographing detonation phenomena has been ordered by the Atomic Energy Organization of Iran. Although this piece of equipment is ostensibly slated for use in Iran's controlled thermonuclear research project, it would be ideally suited for nuclear weapon related studies.

~~(S/NOFORN)~~ Nuclear Materials and Facilities.

a. Uranium Resources - To compensate for a lack of domestic uranium reserves, Iran is negotiating with South Africa for the purchase of large amounts of uranium oxide. South Africa has extensive reserves and could become the primary source of uranium concentrate for Iran's planned nuclear power program. Australia has also made a bid to become a stable and reliable supplier of minerals to Iran, presumably including uranium, a chief Australian resource.

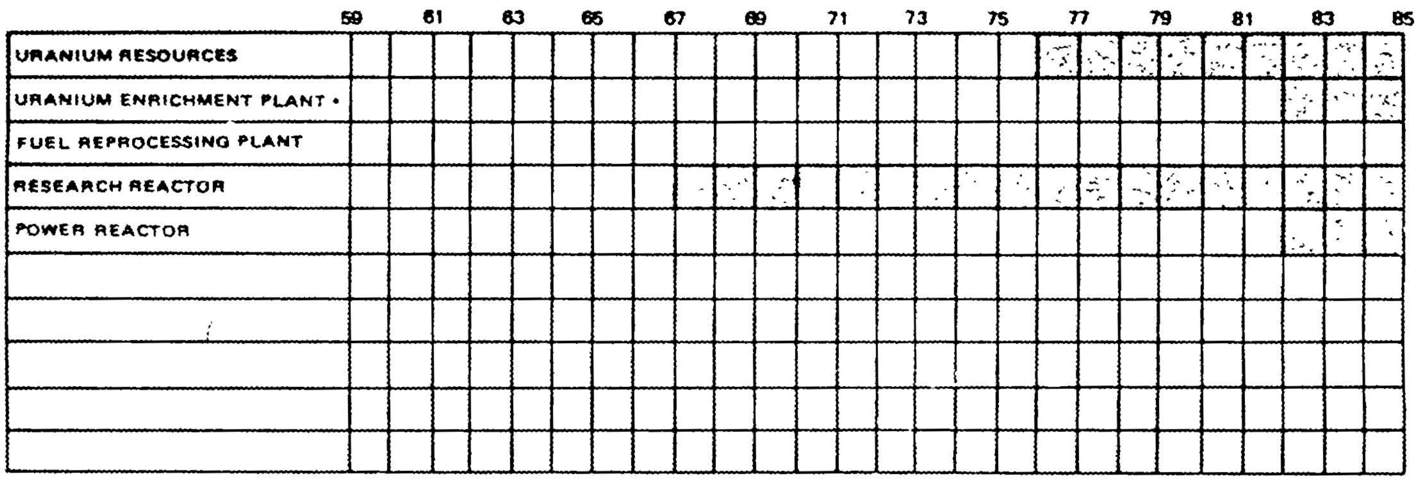
b. Uranium Enrichment Plant - Iran has invested in France's enrichment endeavors and is studying the possibility of joining private U.S. companies in a similar project. It is also possible that Iran will reach an agreement with South Africa for part ownership in that country's planned enrichment plant.

c. Fuel Reprocessing Plant - Iran has been discussing the acquisition of a reprocessing plant with the U.S., France, and possibly West Germany. The U.S. has agreed to permit the multinational reprocessing of U.S.-origin nuclear fuel in Iran, but is seeking to prevent establishment of a national facility. In early 1975, Iran reached an agreement with France for construction of a research center which would include a small reprocessing facility to be operational by 1980.

d. Research Reactor - Iran has a U.S. supplied research reactor which has been operational since 1967 at a Teheran research center; however, it is unsuitable for the production of plutonium. In addition, in early 1975, an agreement was reached with the French for building a research center near Esfahan and supplying two of three reactors the center will eventually house. Iran hopes to have at least one of these reactors operational by 1980.

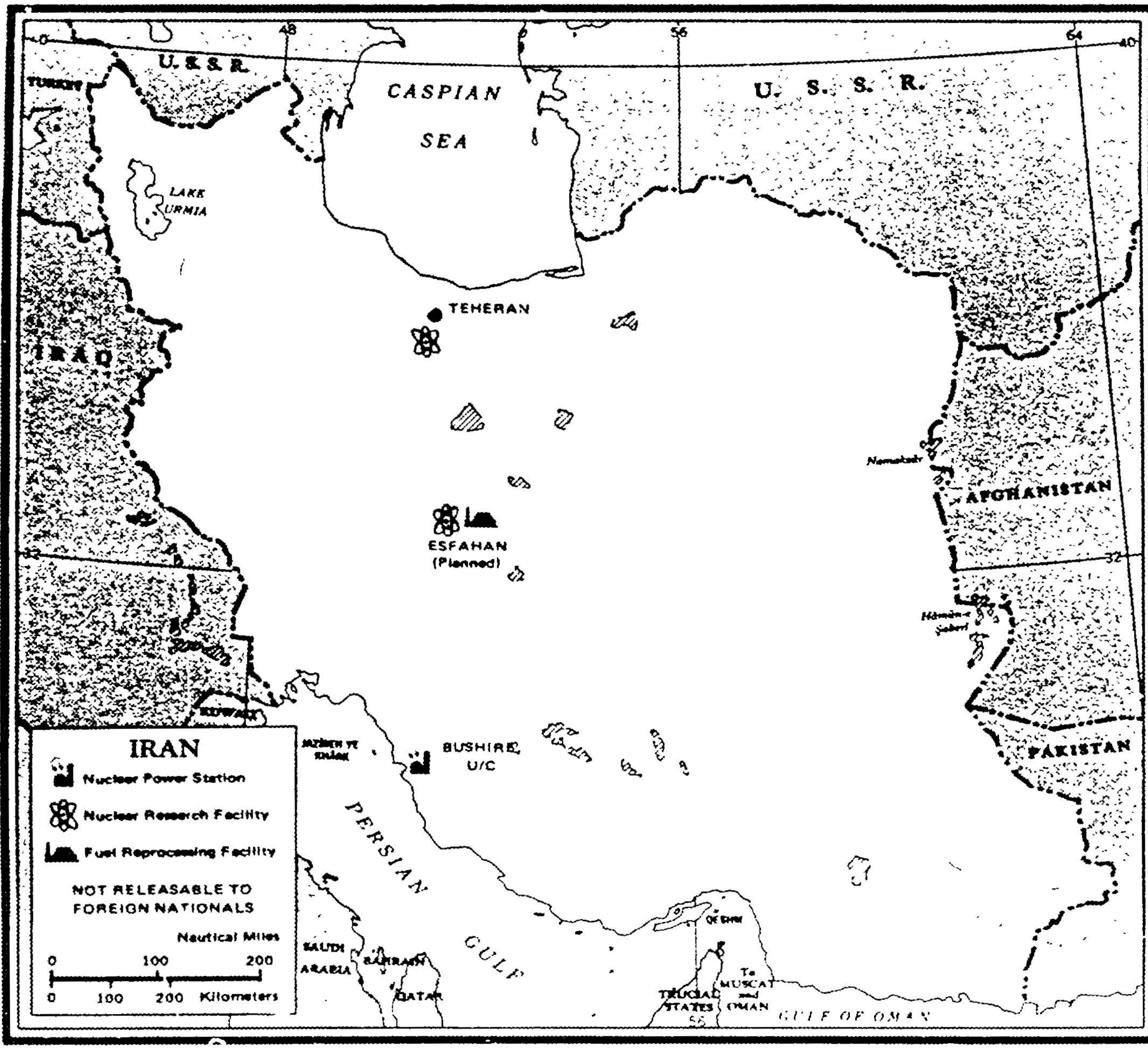
e. Power Reactor - Iran has signed contracts with both West Germany and France for the construction of two power reactors each. The German 1300 MWe reactors are now under construction near Bushire on the Persian Gulf. The first of these probably will not be completed before 1982. A site for the French 900 MWe reactors has yet to be selected. Discussions have also been held with the U.S. for the purchase of as many as eight power reactors.

IRAN
NUCLEAR FUEL CYCLE DEVELOPMENT



*CONSORTIUM ARRANGEMENT--PLANT WILL NOT BE LOCATED IN IRAN.

CI-IR-1-6/74



SECRET

TCS 805618/76

ISRAEL

Page 24-29 is
Denied in Full

(b)(1),1.4 (c)

(b)(1),1.4 (c)

(b)(1),1.4 (c)

(b)(1),1.4 (c)

(b)(1),1.4 (c)

(b)(1),1.4 (c)

JAPAN

JAPAN

~~(S/NOFORN)~~ Assessment. Japan is capable of developing a nuclear device within one or two years of a decision to do so; however, we do not believe that this decision has been made. The Director of Central Intelligence, the Central Intelligence Agency, the Department of State, and the Assistant Chief of Staff for Intelligence, Department of the Army believe that Japan would not embark on a program of nuclear weapons development in the absence of a major adverse shift in great power relationships which presented Japan with a clear-cut threat to its security. The Defense Intelligence Agency, Director of Naval Intelligence, Department of the Navy and the Assistant Chief of Staff, Intelligence, Department of the Air Force see a strong chance that Japan's leaders will conclude that they must have nuclear weapons if they are to achieve their national objectives in the developing Asian power balance. Such a decision could come in the early 1980s.

~~(S/NOFORN)~~ Discussion. Japan's expanding nuclear research and power reactor development programs have ranked it among the world leaders in the nuclear industry. Limited uranium resources and no enrichment capability forces Japan to rely upon foreign countries to support what will be the second largest nuclear power program in the world by 1985. While a nuclear weapons program is not known to exist, the Japanese research and power programs will enable them to rapidly exercise this option should they so desire. A Japanese weapons program, however, must overcome several obstacles. The country has only limited uranium resources. While they have been active in foreign exploration for additional resources, current supplies would not support a major weapons program. All but one of Japan's power reactors are light water reactors that use slightly enriched uranium fuel. Because Japan does not yet have an enrichment capability, it must rely on foreign nations for its fuel supply. Should Japan overtly opt for a weapons program, it faces the distinct possibility that these countries (currently the U.S. and France) will terminate their fuel supply and thus shut down Japan's power program. Since all of Japan's nuclear facilities are under safeguard agreements, they would have to abrogate these agreements in order to obtain the large quantity of plutonium sufficient to meet military requirements.

~~(S/NOFORN)~~ Nuclear Materials and Facilities.

a. Uranium Resources - Japan's domestic uranium ores are estimated to be only 15,000 metric tons. Japan has done extensive ore prospecting in numerous foreign countries and has entered into several joint development programs overseas in order to secure the needed uranium.

b. Ore Processing Plant - A pilot facility with a capacity of 50 metric tons of ore per day is operated by the Power Reactor and Nuclear Fuel Development Corporation (PNC).

c. Fuel Fabrication Plant - A fuel fabrication research laboratory was founded in 1956 at Tokai Mura. A company to fabricate boiling water reactor fuel elements was established in 1966 and one to fabricate pressurized water reactor fuel elements was established in 1968.

d. Research Reactor - Of the more than a dozen Japanese research reactors, only the indigenously constructed JRR-3 at Tokai Mura is capable of producing plutonium. If operated at design power, it can produce about two kilograms of plutonium annually.

e. Fuel Reprocessing Plant - A 210 metric ton per year fuel reprocessing plant is under construction with French assistance at Tokai Mura. The plant is scheduled for completion in 1978. The Japanese are considering building a large 1500 metric tons per year plant by 1985 so that they can satisfy their reprocessing needs. Japan is negotiating with the U.K. and France for reprocessing services to satisfy their requirements until a second plant is completed.

f. Uranium Enrichment Plant - Since almost all of Japan's power reactors require slightly enriched uranium fuel, PNC is attempting to develop its own gas centrifuge enrichment method. The Japanese goal is to build a pilot plant by 1980 and a commercial plant by 1985. An initial cascade of 180 separators was tested in October 1974.

g. Power Reactor - The Japanese estimate that by 1985 49,000 megawatts of electricity will be generated by nuclear power. Their first power reactor was a British gas-cooled design while their remaining reactors are light water designs. Six of the twelve operational reactors have been built entirely by the Japanese.

h. Breeder Reactor - An experimental fast breeder reactor, JOYO, is under construction at Tokai Mura. This 100 MWt reactor is scheduled for completion in 1977 and will be capable of producing about eight kilograms of plutonium annually. A 300 MWe prototype fast breeder reactor, MONJU, was originally scheduled for completion in 1978 and could have produced 100 kilograms of plutonium annually. Funding problems have postponed construction of this reactor.

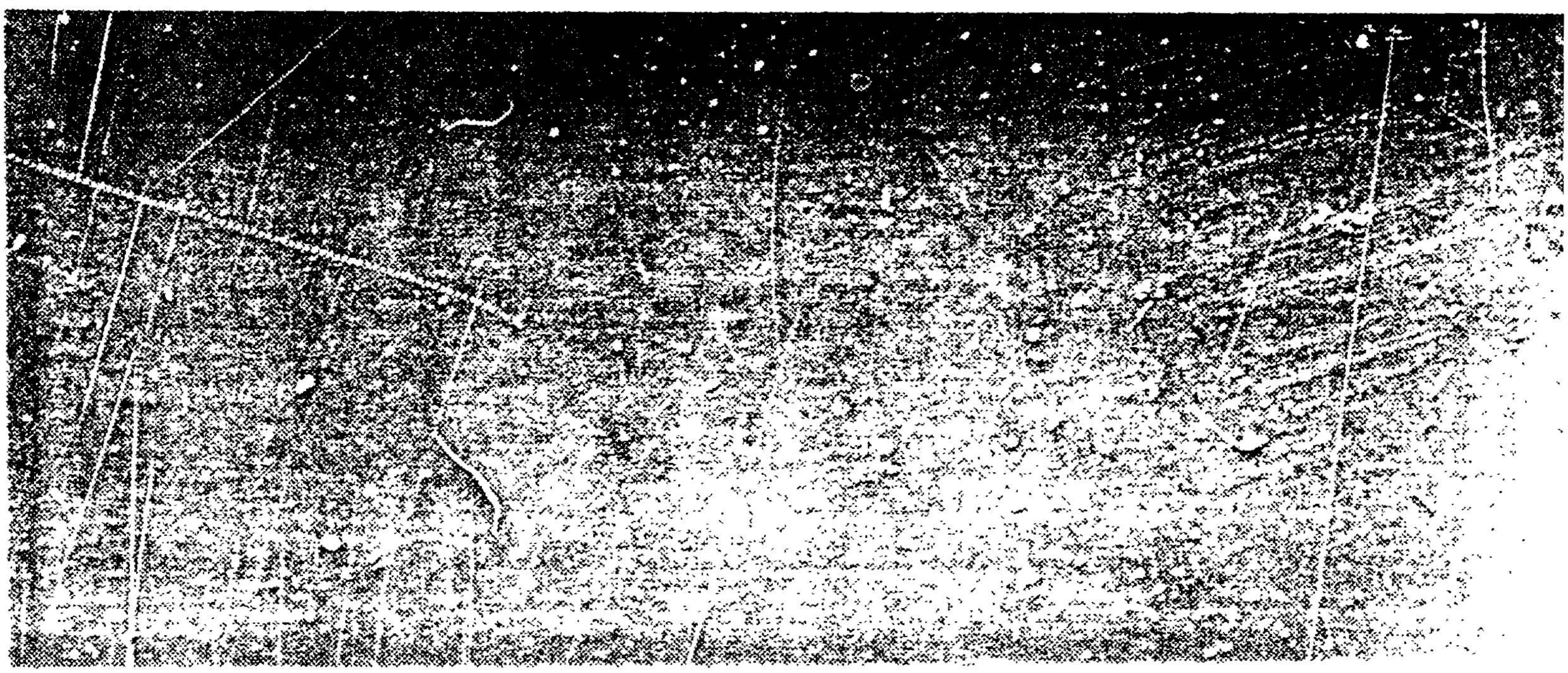
i. Advanced Thermal Reactor - A heavy water moderated, light water cooled, advanced thermal reactor, FUGEN, is being indigenously constructed at Tsuruga. Scheduled for operation in 1977, it can produce about 50 kilograms of plutonium annually. Since it is scheduled to use slightly enriched U.S. fuel, the reactor products will be safeguarded.

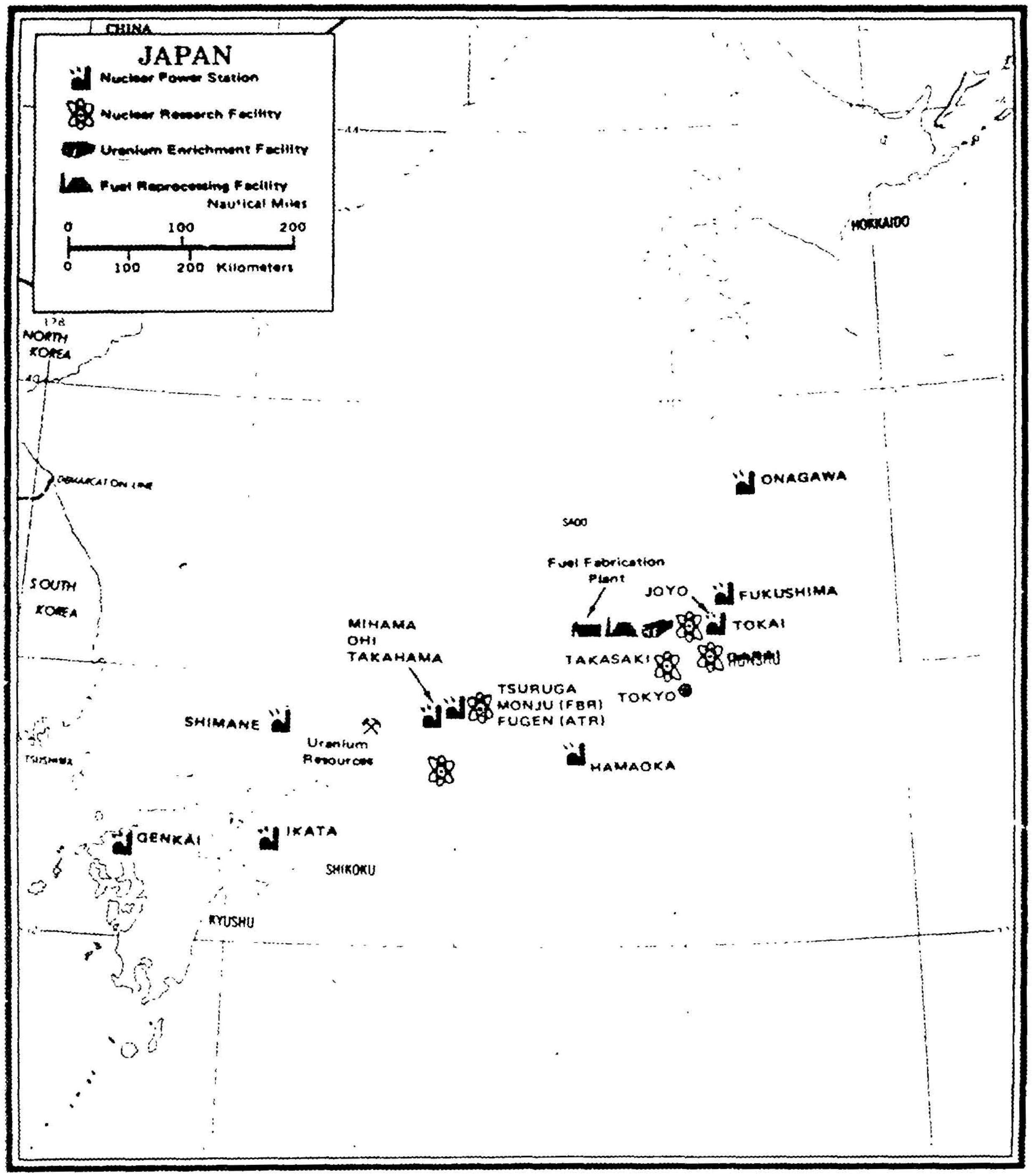
(U) Cooperative Agreements. Japan has cooperative agreements with 22 countries including the U.S., USSR, Pakistan, Argentina, and France.

JAPAN

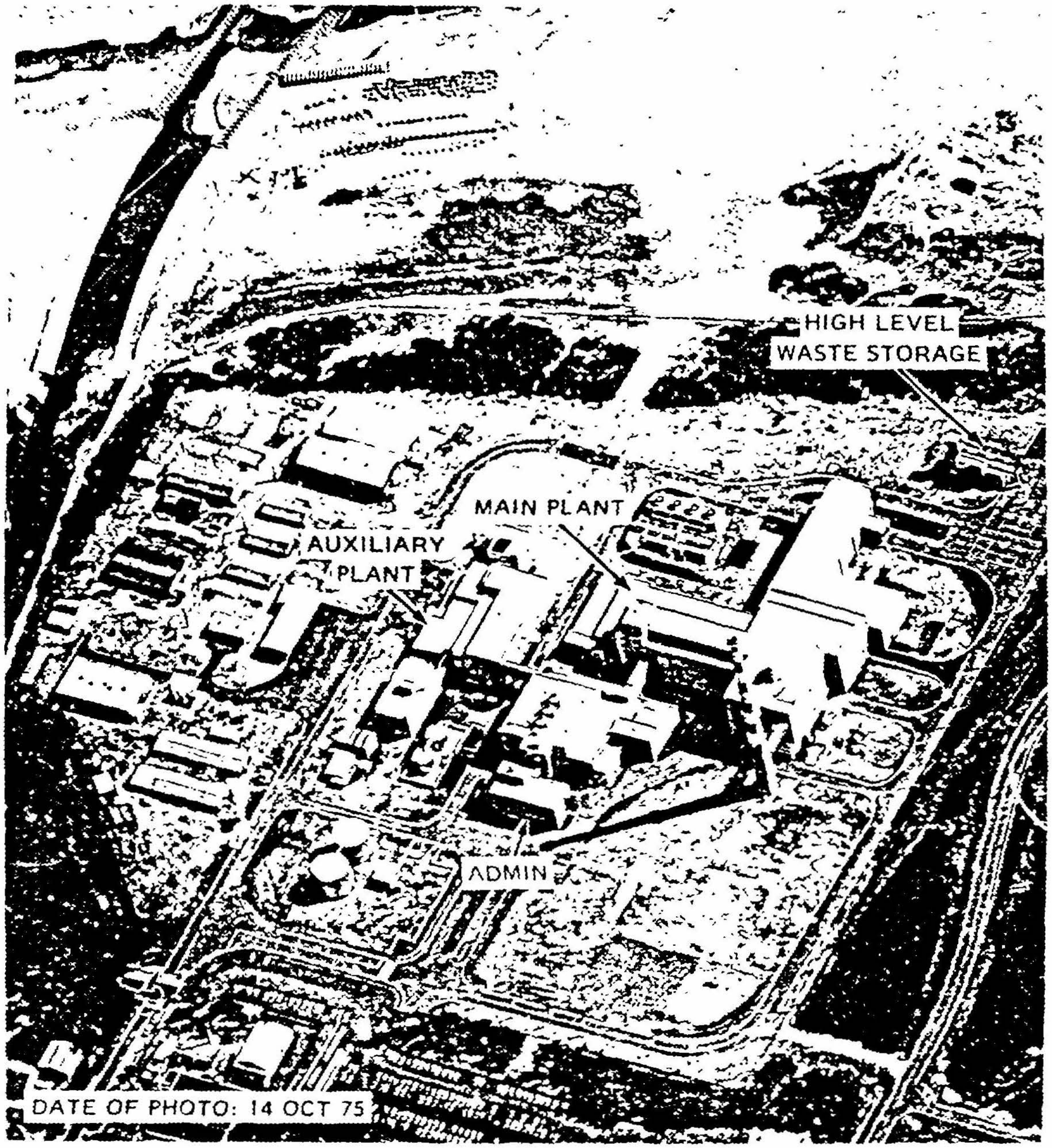
NUCLEAR FUEL CYCLE DEVELOPMENT

	59		61		63		65		67		69		71		73		75		77		79		81		83		85
URANIUM RESOURCES																											
ORE PROCESSING PLANT																											
FUEL FABRICATION PLANT																											
RESEARCH REACTOR																											
FUEL REPROCESSING PLANT																											
URANIUM ENRICHMENT PLANT																											
POWER REACTOR																											
BREEDER REACTOR																											
ADVANCED THERMAL REACTOR																											




CHINA
JAPAN
Nuclear Power Station
Nuclear Research Facility
Uranium Enrichment Facility
Fuel Reprocessing Facility
Nautical Miles
0 100 200
0 100 200 Kilometers
NORTH KOREA
DEMARCATION LINE
SOUTH KOREA
HOKKAIDO
ONAGAWA
SADO
Fuel Fabrication Plant
JOYO
FUKUSHIMA
TOKAI
TAKASAKI
HONSHU
TOKYO
MIHAMA
OHI
TAKAHAMA
TSURUGA
MONJU (FBR)
FUGEN (ATR)
SHIMANE
Uranium Resources
HAMAOKA
GENKAI
IKATA
SHIKOKU
KYUSHU

CIJA 1-6/74



NUCLEAR FUEL REPROCESSING PLANT TOKAI MURA, JAPAN

LIBYA

LIBYA

(b)(1),1.4 (c)

[redacted]

Libyan officials have reportedly claimed that Libya has agreed to finance the construction of the reprocessing plant that Pakistan is buying from France in return for Pakistan's help in developing Libya's nuclear energy program.

Libya has signed a "declaration of interest" on nuclear cooperation with France. The agreement reportedly includes the training of technicians, uranium exploration, and construction of a 600 MWe nuclear power plant in Libya. The timetable for the construction of the power plant, if it has been established at all, is not known.

Libya has also reached an agreement with the Soviet Union for the construction of a nuclear research center. Provisions of the agreement would give the Soviets full control of the nuclear facilities and materials while minimizing third country participation. In the past the Soviets have maintained that they would never offer such assistance if there was any indication that Libya would use the facility for anything but peaceful purposes.

Most recent reports state that the LAEC has under consideration a curriculum for a nuclear sciences graduate study program to be established in Libya by the Soviet Union. The curriculum includes the study of nuclear weapons and the various aspects of the production and use of virtually all types of fissionable materials suitable for nuclear weapons. This is inconsistent with the above stated Soviet attitude. It is likely that weapons information has been included only upon Libyan demands, although it is probable that the studies on this subject will cover only information which is available in open literature.

~~(C)~~ Nuclear Materials and Facilities.

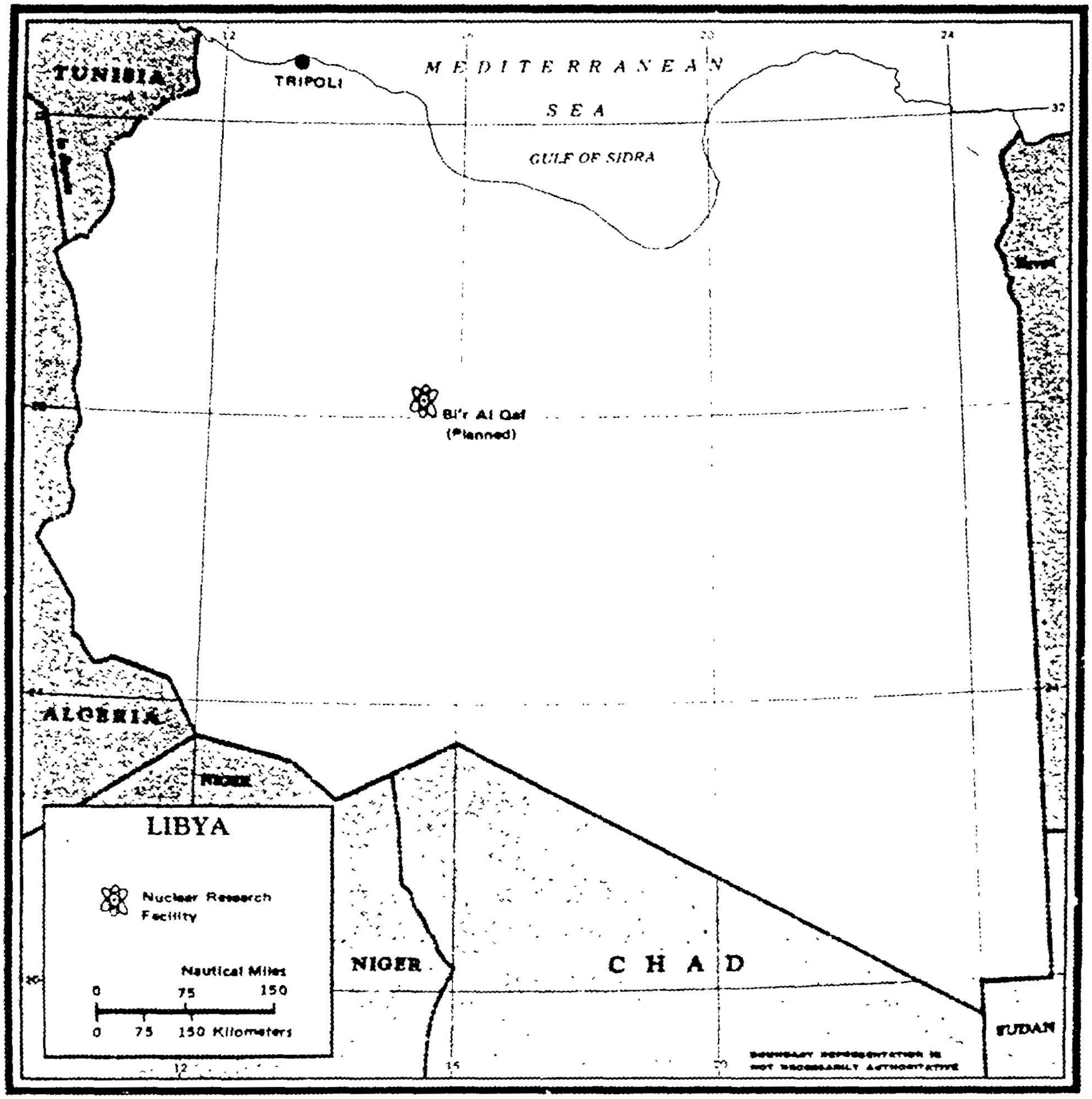
a. Uranium Resources - Libya is not known to possess significant uranium reserves; however, it has recently been reported that the Soviets have discovered deposits in the southern part of the country. The extent of these deposits has not yet been determined, but could be influencing the Soviets to seek control over Libya's nuclear resources.

b. Research Reactor - Plans for the nuclear research center to be built by the Soviets and scheduled to be completed in 1979 have been variously reported to include one or two training-research-radioisotope production reactors in the 2-10 MWt range and fueled with 80% enriched uranium. At this power and level of enrichment, the reactor(s) would not be capable of producing significant quantities of plutonium.

LIBYA

NUCLEAR FUEL CYCLE DEVELOPMENT

	59	61	63	65	67	69	71	73	75	77	79	81	83	85
RESEARCH REACTOR														
POWER REACTOR														



CI LY 1 6.74

UNCLASSIFIED

PAKISTAN

PAKISTAN

~~(S/NOFORN~~ [redacted] ~~NOCONTRACT/WNINTEL)~~ Assessment. Prime Minister Bhutto was motivated by India's detonation of a nuclear device in May 1974 to pave the way for Pakistan to achieve a similar capability. Apparently to implement an effort toward achieving this goal, a technical group has been established within the Pakistan Atomic Energy Commission. The group has thus far been studying the properties of various explosives and has unsuccessfully tested triggering circuits. Additionally, in March 1976 France agreed to sell Pakistan a fuel reprocessing plant which is scheduled to become operational in 1980. If Pakistan decides to abrogate safeguards agreements, a nuclear device could be developed within a year after plutonium becomes available from the reprocessing plant.

~~(S/NOFORN~~ [redacted] ~~NOCONTRACT/WNINTEL)~~ Discussion. Although plans for an extensive nuclear power program existed at the time of the Indian nuclear test in May 1974, Pakistan had only one major reactor and two nuclear research facilities. [redacted] in four years. Bhutto stated publicly in late 1974 that Pakistan would explode a nuclear device if denied the help it sought in strengthening its conventional military capabilities. The U.S. decision in February 1975 to end its embargo on the sale of conventional arms to Pakistan and India may have reduced Pakistan's motivation to develop nuclear weapons, but we believe that it did not remove it. Pakistan has been trying to establish an independent nuclear program by negotiating for a heavy water plant from West Germany, and a fuel fabrication plant from Canada or Italy. Acquisition of these facilities, together with the French reprocessing plant and an already operational Canadian-built natural uranium power reactor would indeed give Pakistan the type of nuclear independence it seeks. The reprocessing plant, which will provide Pakistan with a source of plutonium will be subject to stringent safeguards which include a 20-year prohibition against replication of the technology, and apply not only to the reprocessing facility itself, but also to any fissionable material supplied in connection with the facility or processed by it. Although the Pakistanis would prefer to develop a weapons option independently, they realize their technological shortcomings and have been strengthening ties with the PRC. [redacted]

[redacted] It is doubtful that the PRC would actually provide Pakistan with weapons technology, however, this reporting indicates Bhutto's intentions have not changed since 1974.

~~(S/NOFORN/~~[redacted]~~NOCONTRACT/WNINTEL)~~ Nuclear Materials and Facilities.

a. Uranium Resources - The Pakistanis have been actively exploring for uranium for a number of years and claim to have located deposits which can support their domestic requirements for the foreseeable future. The deposits are scattered throughout the country and data on the extent of reserves is still being compiled.

b. Power Reactor - Pakistan has a Canadian-supplied, natural uranium fueled, 137 MWe CANDU type nuclear reactor, known as the KANUPP. This reactor has been operational since late 1972 and by now irradiated fuel elements being stored in the facility's cooling ponds could contain as much as 200 kg of plutonium. Although the reactor is operated under safeguards, the Canadian-Pakistani agreement does not contain any specific prohibition against use of reactor produced materials for peaceful nuclear explosives. At present, the Canadians are attempting to renegotiate the safeguards conditions; however, thus far these have been rejected. If Pakistan follows through with its reprocessing plans without agreeing to more restrictive safeguards on the KANUPP, Canada is prepared to phase out all nuclear cooperation.

Pakistan is still undecided on the type of reactor to be employed in its next station at Chasma Barrage, but plans to order a 600 MW unit by the end of this year. Discussions have been held with both the Canadians and the French for the reactor which is to be operational about 1981. The present Pakistani long-range power program envisages 24 nuclear power plants by the end of the century. The first six will probably be located at Chasma.

c. Fuel Fabrication Plant - The Pakistanis presently have a laboratory-scale fuel fabrication operation underway at the Pakistan Institute of Nuclear Science and Technology (PINSTECH) and hope to eventually use domestic uranium as fuel for their natural uranium reactor. This uranium is to be fabricated into fuel elements in a plant the Pakistanis have been trying to purchase from Canada. Although a contract has been signed and IAEA safeguards agreed to by Pakistan, Canada is delaying completion of the sale until Pakistan's position on peaceful nuclear explosions is fully established. Because the Pakistanis consider the safeguards too restrictive, they are reportedly now seeking to buy the plant from Italy.

d. Research Reactor - A 5 MWt U.S.-supplied reactor began operation in 1965 and is used for training purposes. It is not suitable for the production of plutonium.

e. Fuel Reprocessing Plant - In March 1976, the Pakistanis signed a trilateral agreement with France and the IAEA covering safeguards on a fuel reprocessing plant Pakistan is to buy from France. During early September, however, the French government formed a new committee to study the export of their nuclear technology. President Giscard has been reported as having a strong desire to halt nuclear proliferation and the new committee could provide him with the basis for cancellation of the reprocessing plant sale. An additional problem confronting Pakistan is the financing of the plant.

(b)(1),1.4 (b)

[redacted]

If the sale transaction is eventually completed, the facility would be of pilot-plant capacity; i.e., 100 metric tons of fuel per year. It is currently planned to be operational in 1980. This size plant could handle the equivalent of from two to three cores from Pakistan's KANUPP reactor per year; each core could have up to 100 kg of contained plutonium, assuming normal operation of the reactor.

f. Heavy Water Plant - The Pakistanis require a supply of make-up heavy water to compensate for losses sustained in the normal operation of their natural uranium power reactor. If they decide to use light water reactors for future nuclear power stations, the amount of make-up for the single reactor could easily be supplied by the U.S. or Canada. Instead of importing this water, however, the Pakistanis have signed a contract with a West German firm for a safeguarded 11 metric ton per year plant.

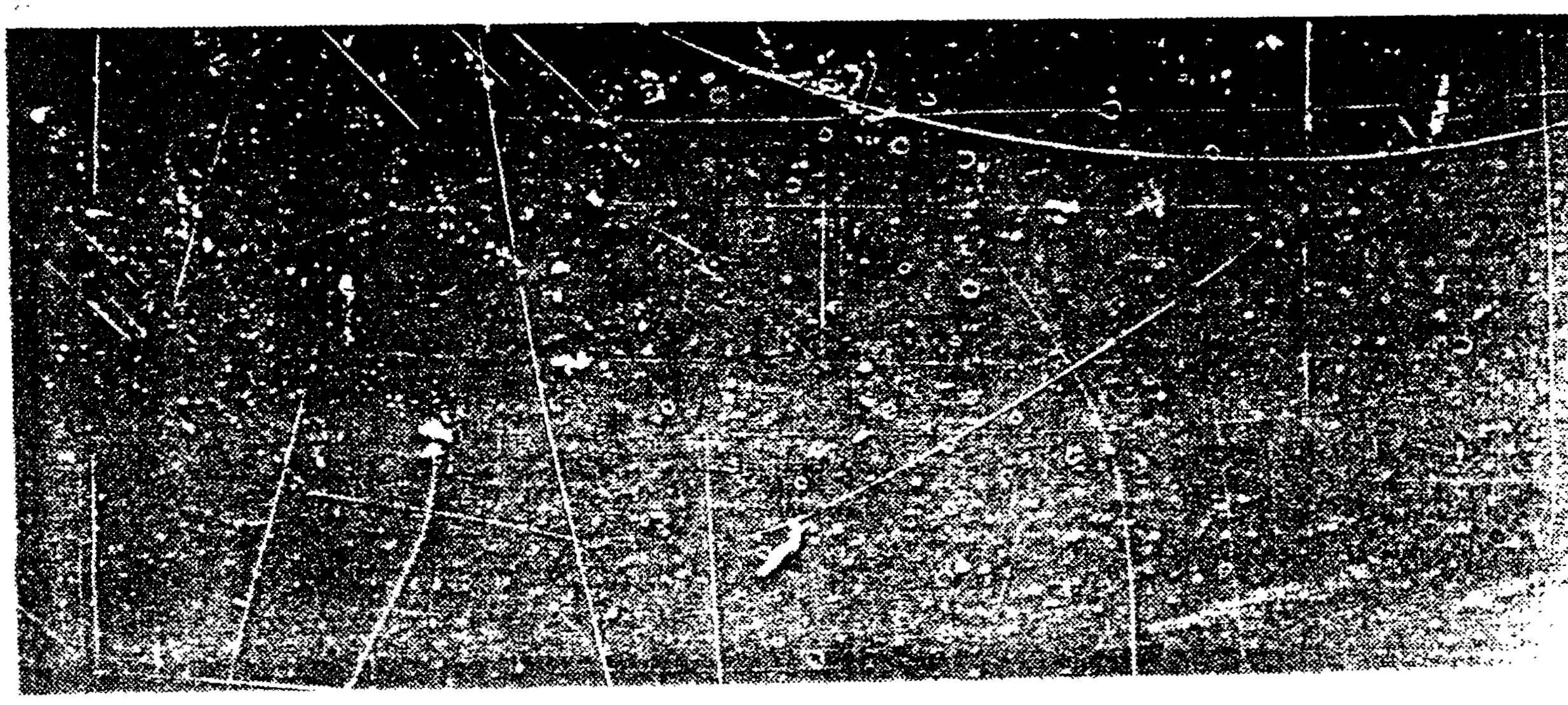
PAKISTAN

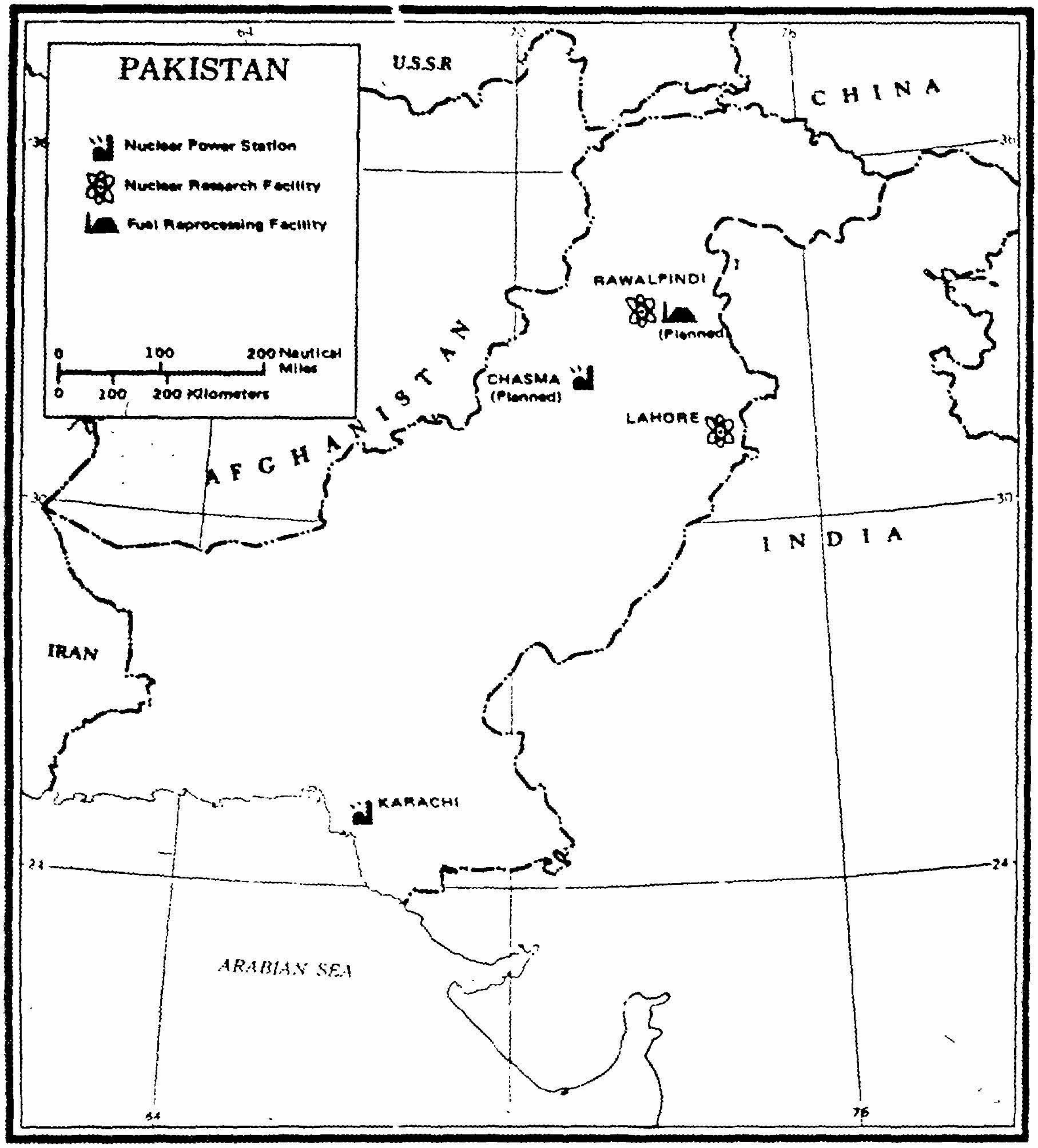
NUCLEAR FUEL CYCLE DEVELOPMENT

	59		61		63		65		67		69		71		73		75		77		79		81		83	
URANIUM RESOURCES																									
POWER REACTOR																									
FUEL FABRICATION PLANT																									
RESEARCH REACTOR																									
FUEL REPROCESSING PLANT																									
HEAVY WATER PLANT																									

UNCLASSIFIED

TCS 6085 18/76





CI PK-1-8/74

Page 45 is Denied in Full

(b)(1),1.4 (b)

SOUTH AFRICA

SOUTH AFRICA

~~(S/NOFORN)~~ Assessment. There are no indications that South Africa is currently pursuing a nuclear weapons program. The only likely military threat to South Africa would come from its African neighbors, and its military capability is so much greater than theirs that it has no military need for nuclear weapons in the foreseeable future. If South Africa did, however, perceive a serious threat to its security which could not be handled with conventional means, the government might attempt to develop a nuclear option using enriched uranium as the fissile material. Following this route, the country could develop a nuclear device sometime in the 1976-78 period.

~~(S/NOFORN)~~ Discussion. Although South Africa will have no power reactors until the 1980s, an indigenously built plant for the separation of uranium isotopes was reportedly completed in late 1975, however, it probably has not yet begun regular operation. Severe health problems have occurred as a result of UF_6 leaks. These leaks, due to the corrosion of plastic vacuum pump valve seats, have apparently caused the illness of several employees, two of which have died.

The South Africans claim that this uranium enrichment plant is strictly for the production of low enrichment reactor grade uranium. If, however, the design of the plant enables it to produce highly enriched material, enough of this material could be available for a nuclear device as early as this year (1976). If the plant would first have to be modified before highly enriched material could be produced, an additional year or two would probably be required. Although there is no evidence of high explosive and weapon research and development underway in South Africa, such activities could be taking place and, indeed, could have been already completed without our knowledge.

~~(C/NOFORN)~~ Nuclear Materials and Facilities.

a. Uranium Resources - South Africa possesses about 300,000 metric tons of uranium oxide, an amount surpassed only by the U.S. and Canada. In addition, a South African governmental corporation is a member of a consortium active in a large scale mining effort underway in South-West Africa. This effort involves exploitation of a deposit which may be the world's largest, possibly containing 250,000 metric tons of uranium oxide.

b. Ore Processing Plant - The reserves of uranium in both South Africa and South-West Africa are low grade. In South Africa, economic recovery of the uranium is achieved by producing the material as a by-product of gold mining operations. In South-West Africa, the ore will be strip mined to keep the project economically viable. A large ore concentration plant is now under construction to process the ore from the South-West African deposit.

c. Fuel Fabrication Plant - According to officials of the Electric Supply Commission (ESCOM), South Africa's national utility company, a fuel fabrication plant will be built using U.S. technology by about 1985.

d. Uranium Enrichment Plant - South Africa has independently built a uranium enrichment pilot plant at Valindaba employing what it claims is an entirely new technology unrelated to the gaseous diffusion, gas centrifuge, or jet nozzle processes in use or under development elsewhere in the world. We believe that this process is an aerodynamic one, perhaps a variation of the jet nozzle technique being developed in West Germany or the vortex tube which has received relatively little attention. It is estimated that the pilot plant will have a capacity to produce roughly 70-85 metric tons of reactor grade fuel per year when fully operational. During mid-1973, the South African government approved the funding of "preparatory work" on a full-scale plant utilizing the same process. The ultimate capacity of this plant has not as yet been decided by South Africa; however, it will probably be an order of magnitude larger than that of the pilot plant. The completion date is planned for the mid-1980s.

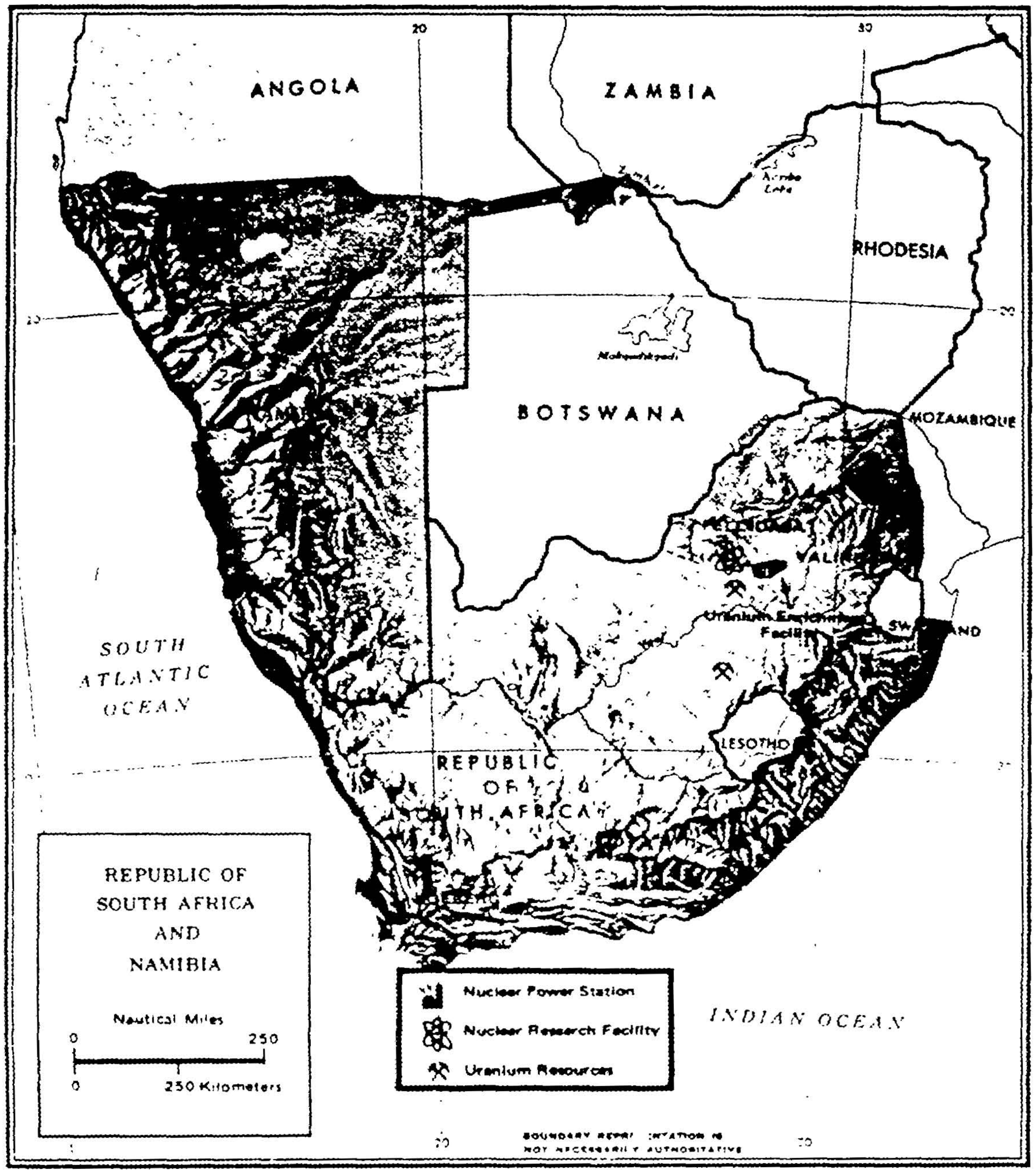
e. Research Reactor - South Africa has only one research reactor which reached criticality in 1965. The reactor is a 20 MWt unit, fueled with highly enriched uranium, and not suitable for plutonium production.

f. Power Reactor - A contract for South Africa's first nuclear power station has been awarded to a French consortium. The dual reactor station is to be built at Koeberg near Cape Town. The first 922 MWe unit is scheduled for operation in November 1982, with the second unit to follow one year later. Although a U.S.-Swiss-Dutch consortium had for some time been considered the front-runner in the competition for this contract, the proposed sale fell victim to intense political opposition within the consortium member nations.

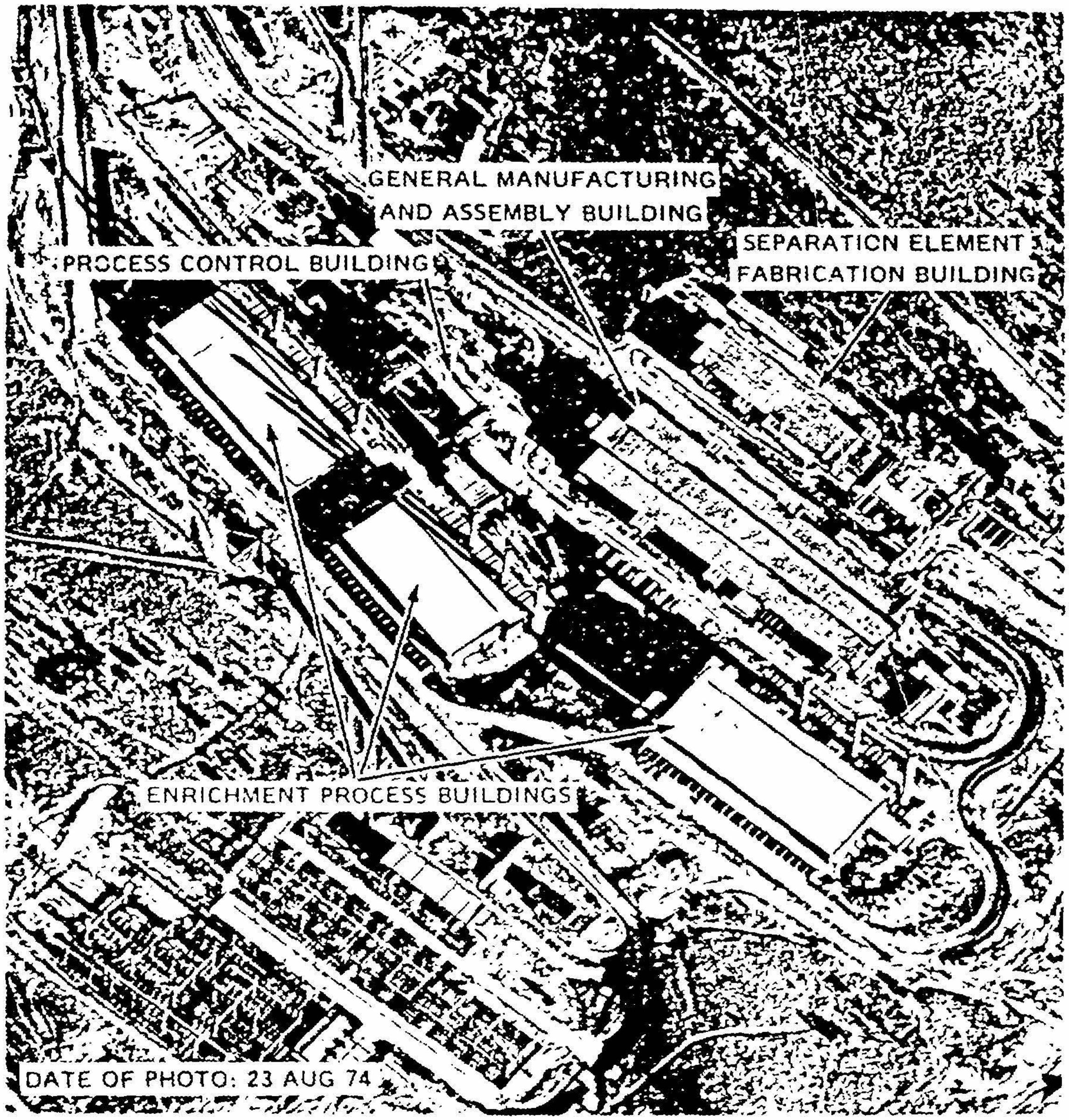
SOUTH AFRICA

NUCLEAR FUEL CYCLE DEVELOPMENT

	59	61	63	65	67	69	71	73	75	77	79	81	83	85
URANIUM RESOURCES														
ORE PROCESSING PLANT														
URANIUM ENRICHMENT PLANT														
RESEARCH REACTOR														
POWER REACTOR														
FUEL FABRICATION PLANT														


ANGOLA
ZAMBIA
RHODESIA
BOTSWANA
MOZAMBIQUE
LESOTHO
REPUBLIC OF SOUTH AFRICA
SOUTH ATLANTIC OCEAN
INDIAN OCEAN
REPUBLIC OF SOUTH AFRICA AND NAMIBIA
Nautical Miles
0
250
0
250 Kilometers
Nuclear Power Station
Nuclear Research Facility
Uranium Resources
20
30

CLSE 1 9/76



VALINDABA URANIUM ENRICHMENT PILOT PLANT

SOUTH KOREA

(b)(3):50 USC 403-1(i)

SOUTH KOREA

~~(S/NOFORN/~~ [redacted] (b)(3):50 USC 403-1(i) ~~WNINTEL)~~ Assessment. At the direction of President Park, the Republic of Korea (ROK) has established a nuclear weapons development program and has recently initiated an ambitious power program. However, the country lacks most of the facilities necessary for a weapons program, and it is unlikely that South Korea will have the materials for a nuclear device until the 1980s.

(TS [redacted] ~~NOFORN/~~ [redacted] (b)(3):50 USC 403-1 (i) ~~NOCONTRACT/WNINTEL)~~ Discussion. South Korea's nuclear research efforts began in 1959 with the establishment of the Korean Atomic Energy Research Institute (KAERI) at Seoul. Little significant work was accomplished during the 1960s. Since 1970, however, the South Koreans have initiated an ambitious power program, negotiated for natural uranium fueled reactors, and have actively attempted to obtain an indigenous reprocessing capability. President Park reportedly directed Korean scientists to secretly develop a nuclear weapon by 1980. South Korea ratified the NPT in 1975; however, clandestine reporting indicates Seoul eventually plans to circumvent the safeguards and violate the non-proliferation agreements. They reportedly ratified the treaty merely to ensure that they will get whatever facilities they feel necessary to support their program. The government has attempted to lure Korean scientists working abroad back to Korea to serve in their research and weapons programs. South Korea lacks most of the facilities necessary for a weapons program, although the South Koreans have recently attempted to obtain them. A natural uranium fueled research reactor similar to the CIRUS reactor in India was unsuccessfully sought from the Canadians. The Koreans have also attempted to purchase a fuel reprocessing plant from France. A recent contract for a Canadian natural uranium fueled CANDU power reactor was secured only after South Korea agreed to cancel indefinitely any plans to obtain a reprocessing capability. Even though they have cancelled their reprocessing agreement, they apparently have not given up plans to eventually acquire a capability to produce plutonium. It is known that in May 1975, after having already signed agreements with French firms, South Koreans were negotiating with a Belgian firm concerning a "conceptual study" of a nuclear fuel reprocessing enterprise and the training of technicians. The January 1975 ROK-French agreement included training of technicians in the reprocessing of nuclear fuels and construction of a "research center" and a 20 kg per day fuel reprocessing plant. At least one Korean has spent a year of training in France on fuel reprocessing. Since the reprocessing facility is the only portion of the agreement affected by the cancellation, the French firm and KAERI have been discussing the possiblity of redirecting their contract to another project. The French firm has suggested that it would be interested in the engineering of ancillary facilities such as laboratories or waste treatment facilities at KAERI. The deputy director of KAERI considers the negotiations very sensitive and has recommended that there be no direct communication with Seoul on the subject and that a meeting should be held outside of France or Korea. Since the design of waste treatment facilities is not a sensitive project, the Korean request suggests that KAERI may be continuing to plan for a large research facility equipped to study the reprocessing of nuclear fuel. The South Koreans are also negotiating with a Belgian firm for an experimental research facility. It is unclear exactly what South Korea is trying to obtain but one message designated the facility as "hot laboratories for handling radioactive products."

Clandestine reporting indicates that the South Koreans have initiated efforts to design a nuclear weapon. Until recently Division 3-3, Agency for Defense Development (ADD) of the Ministry of National Defense has been responsible for nuclear weapon development. Under a reorganization in May 1976, Division 3-3 was redesignated Division 10 although for security purposes it will continue to use the Division 3-3 designation and will establish a Division 3-4 to cover the presence of new researchers as the nuclear group expands. ADD facilities are located near Taejon. At least one scientist from ADD had completed a design of a plutonium device and ordered explosives for testing of the design. Apparently disenchanted with the ROK program, the particular scientist resigned from the program. He briefed the Blue House Secretary General on the progress of his work when he resigned, but refused to turn over his design and supporting material to other researchers. The scientist stated he would be willing to return to the program if he were convinced North Korea or Japan were making progress in developing nuclear weapons. Clandestine reporting indicates that South Korea has attempted to purchase a high speed rotating mirror camera from a U.S. firm. Such a camera is necessary for studying nuclear weapons designs. South Korea could have a nuclear device about three years after they begin construction of a fuel reprocessing plant if irradiated fuel is available for reprocessing. They will probably have difficulty, though, in obtaining safeguard-free irradiated fuel. It is unlikely, therefore, that South Korea will have the necessary materials and facilities to produce a nuclear device until the 1980s.

(TS [redacted] ~~NOFORN~~ [redacted] (b)(3):50 USC 403-1(i) ~~WNINTEL)~~ Nuclear Materials and Facilities.

a. Uranium Resources - There is only one known uranium deposit in South Korea. The size of the deposit is not known; however, the ore is low-grade and would be uneconomical to mine for a civilian power program, although it would provide a source of safeguard-free uranium for a weapons program.

b. Ore Processing Plant - South Korea has no ore processing facilities. A French firm is negotiating with KAERI for supply of a pilot plant for converting uranium concentrate to uranium oxide.

c. Fuel Fabrication Plant - The ROK has no fuel fabrication plant but proposed to purchase a plant from Belgium in 1975. The South Koreans have recently held detailed discussions with the French about the purchase of a pressurized water reactor fuel fabrication plant.

d. Research Reactor - KAERI has two research reactors, neither of which are suitable for producing plutonium. The ROK has made unsuccessful attempts to purchase from Canada a 40 MWt heavy water research reactor similar to the CIRUS research reactor in India.

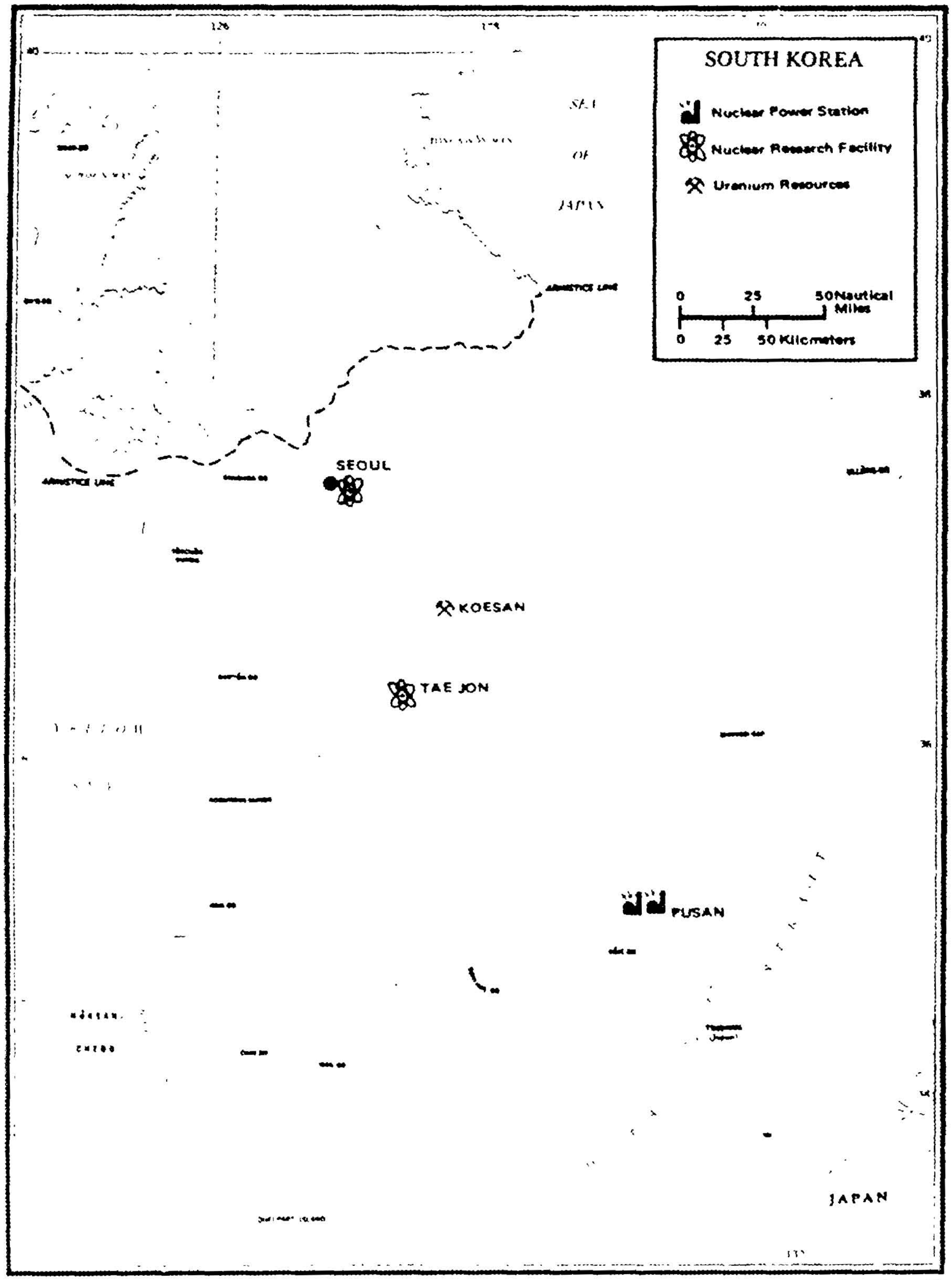
e. Fuel Reprocessing Plant - Even though the U.S. expressed great opposition, the ROK proceeded with attempts to purchase a small reprocessing plant from France. However, the contract with Canada for the purchase of a CANDU power reactor and the upcoming renewal of the nuclear technology exchange agreement with the U.S. has forced an indefinite cancellation of these plans. The Korean Electric Power Company is studying proposals from French and UK companies for the reprocessing of spent power reactor fuels.

f. Power Reactor - The United States is constructing two 600 MWe pressurized water reactors near Pusan. The first reactor is scheduled for operation this year (1976) and the second in 1980. The ROK has signed a contract with Canada for construction of a 600 MWe natural uranium fueled, heavy water moderated, CANDU reactor, which will be operational in 1982. All three reactors will be under safeguards. France recently initialed an agreement to sell South Korea two 922 MWe pressurized water reactors. The ROK envisions 25 nuclear reactors supplying 50% of Korea's energy needs by 1999.

(U) Cooperative Agreements: South Korea has cooperative agreements on atomic energy with the United States, Canada, France and the Republic of China.

SOUTH KOREA
NUCLEAR FUEL CYCLE DEVELOPMENT

	59	61	63	65	67	69	71	73	75	77	79	81	83	85
URANIUM RESOURCES														
ORE PROCESSING PLANT														
FUEL FABRICATION PLANT														
RESEARCH REACTOR														
FUEL REPROCESSING PLANT														
POWER REACTOR														



CIKS 1 6 74

TCS 608518/76

AGENCY FOR DEFENSE DEVELOPMENT TAEJON, KOREA

SPAIN

SPAIN

(~~S/NOFORN~~) Assessment. Spain is capable of developing a nuclear device within one or two years of a decision to do so; however, we do not believe that this decision has been made. Such a decision in the near term would require abrogation of safeguards agreements.

(~~S/NOFORN~~) Discussion. Spain has established a nuclear energy program devoted to research and the applications of nuclear energy, particularly for power. The country has been dependent upon foreign assistance in the past but is increasing its capabilities for industrial participation in a growing nuclear power program. In addition to basic nuclear research facilities, Spain has pilot plants for uranium ore processing, the fabrication of fuel elements, and the reprocessing of irradiated fuel. In addition, there are pilot plants for the production of heavy water, nuclear-grade graphite, and carbide and oxide uranium metal. Therefore, Spain has research and development experience in almost all aspects of the nuclear fuel cycle and reactor construction. Spain is also constructing a research reactor in Chile which attests to its ability to export nuclear technology.

Although Spain will have large quantities of plutonium from its power reactors, it is all under safeguards. If Spain decided to use this material for a nuclear weapons program, safeguards would have to be abrogated which would probably result in a cut off of the supply of enriched uranium for their light water power reactors. The Spanish-French natural uranium power reactor is well suited for the production of weapons grade plutonium; however, to use this reactor for weapons purposes would require the abrogation of Spanish-French agreements. To obtain unsafeguarded plutonium, both a production reactor and a large fuel reprocessing plant would have to be constructed indigenously. In this regard, it is noted that Spain does have an ample supply of domestic uranium.

(~~S/NOFORN~~) Nuclear Materials and Facilities.

a. Uranium Resources - Spain's domestic uranium oxide is estimated to be about 11,000 tons. Natural uranium has been imported from France, Canada, South Africa, and the USSR.

b. Ore Processing Facility - A 60 ton/year uranium concentration plant went into operation in 1959 at Andujar, province of Jean. A 400 ton/year plant is to be built in western Spain. Completion date is not known.

c. Fuel Fabrication Plant - In 1962, enriched core loadings for two research reactors were fabricated. There has been research conducted on fabrication of elements for various types of fuels. Westinghouse and G.E. have been contacted for assistance in building large facilities for PWR and BWR fuel.

d. Research Reactor - There are five research reactors operating in Spain; the first one began operating in 1958. All these reactors are fueled with safeguarded enriched uranium.

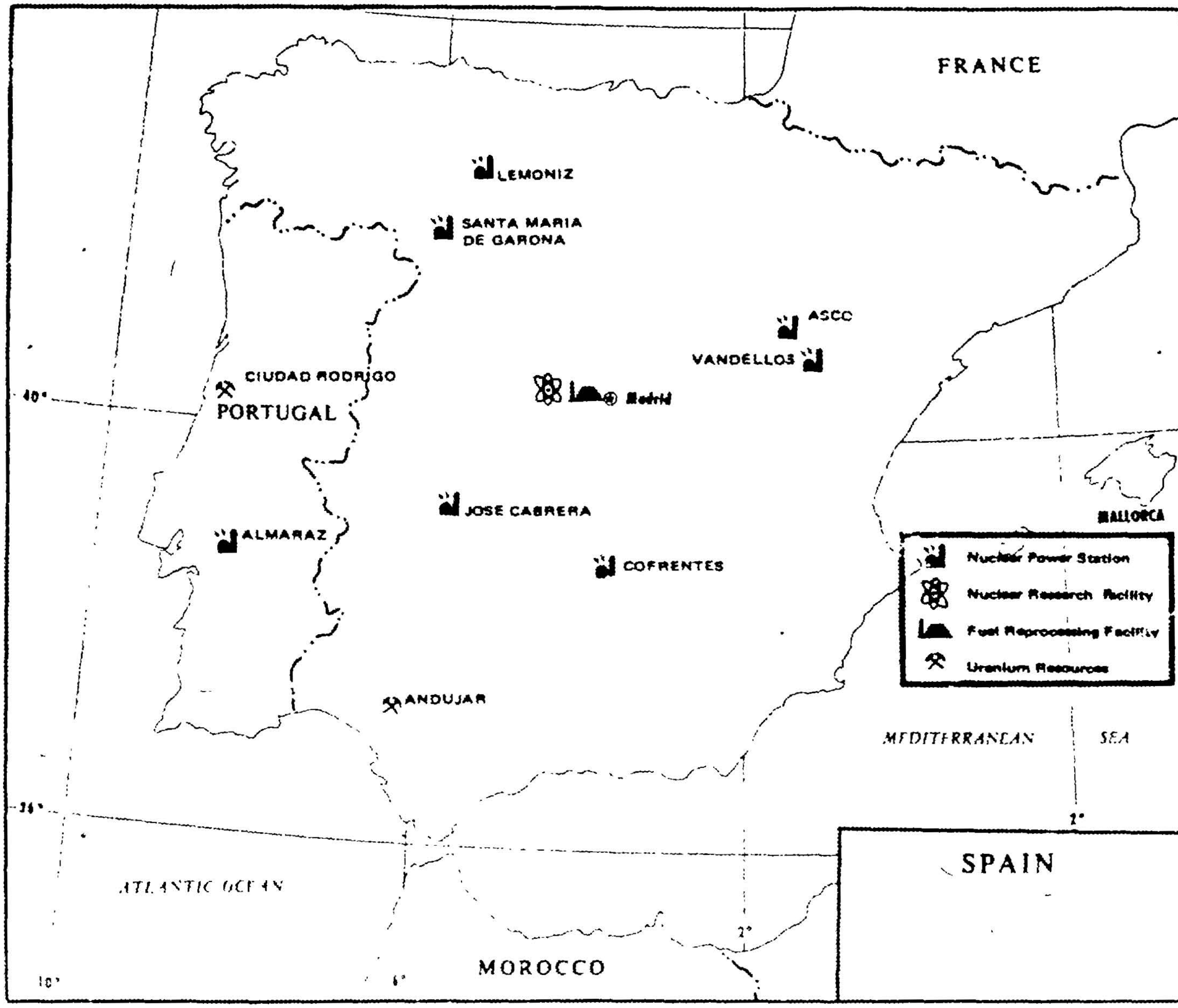
e. Fuel Reprocessing Plant - A pilot plant with a capacity to reprocess 500 grams of irradiated fuel per day went into operation in 1967. This facility has been used to process Spanish and Swiss research reactor fuels that were under safeguards.

f. Power Reactor - Spain has three operating reactors. A U.S. PWR became operational in 1968 and a U.S. BWR was connected to the grid in 1970. The third is a Spanish-French 480 MWe, natural uranium fueled reactor. It is located at Vandellos. This reactor is well suited for the production of weapons grade plutonium; however, an agreement between France and Spain prohibits the plutonium from being in a weapons program. Several other U.S. LWRs are under construction or planned.

SPAIN
NUCLEAR FUEL CYCLE DEVELOPMENT

	59	61	63	65	67	69	71	73	75	77	79	81	83	8
URANIUM RESOURCES														
ORE PROCESSING PLANT														
FUEL FABRICATION PLANT														
RESEARCH REACTOR														
FUEL REPROCESSING PLANT														
POWER REACTOR														

CI SP-1-8/74



TCS 60518/76

UNCLASSIFIED

60

SWEDEN

~~(S/NOFORN)~~ Assessment. Sweden is capable of developing a nuclear device in about one year after the decision to do so; however, we do not believe that this decision has been made. The Swedish military has done high explosives and weapons design research.

~~(S/NOFORN)~~ Discussion. The Swedish Parliament authorized the military to conduct nuclear defense research in 1955. This work is carried out at the National Defense Research Institute (FOA). The authorization was broadly interpreted to permit the FOA to conduct research basic to the design of nuclear weapons as well as to develop methods to defend against them. Reportedly, this research was terminated in 1972; [redacted] (b)(1),1.4 (c) Sweden's first power reactor, the Agesta, operated from 1963 to 1974. The fuel from this reactor is unsafeguarded and [redacted] (b)(1),1.4 (c) All subsequent power reactors are LWRs fueled with safeguarded U.S. and USSR enriched uranium. Sweden has vast uranium resources; however, until recently they have not proven economical to mine. Although Sweden has done some research on uranium enrichment, they are not expected to build an enrichment plant. Sweden had a joint fuel reprocessing agreement with Norway in the mid-1960s but they have no plans at present to construct a plant. Should Sweden decide to start a major weapons program, it will have to first construct a natural uranium reactor for the production of plutonium and build a plant for processing of the irradiated fuel.

~~(S/NOFORN)~~ Nuclear Materials and Facilities.

a. Uranium Resources - Sweden's domestic deposits of uranium ore are estimated to be one of the world's largest. However, the ore is very low grade and expensive to mine. As the price of uranium increases, Sweden's uranium may well become competitive on the world market. Currently, however, Sweden imports the majority of its uranium requirements.

b. Ore Processing Plant - A 120 ton per year uranium oxide processing facility became operational at Ranstad in 1965. By 1980, the capacity of this facility will be increased to 1300 metric tons per year.

c. Fuel Fabrication Plant - Sweden began manufacturing fuel elements on a small scale in 1958. Their first plant became operational in 1967 at Vasteras and the plant's capacity was considerably increased in the early 1970s; however, its capacity is not known.

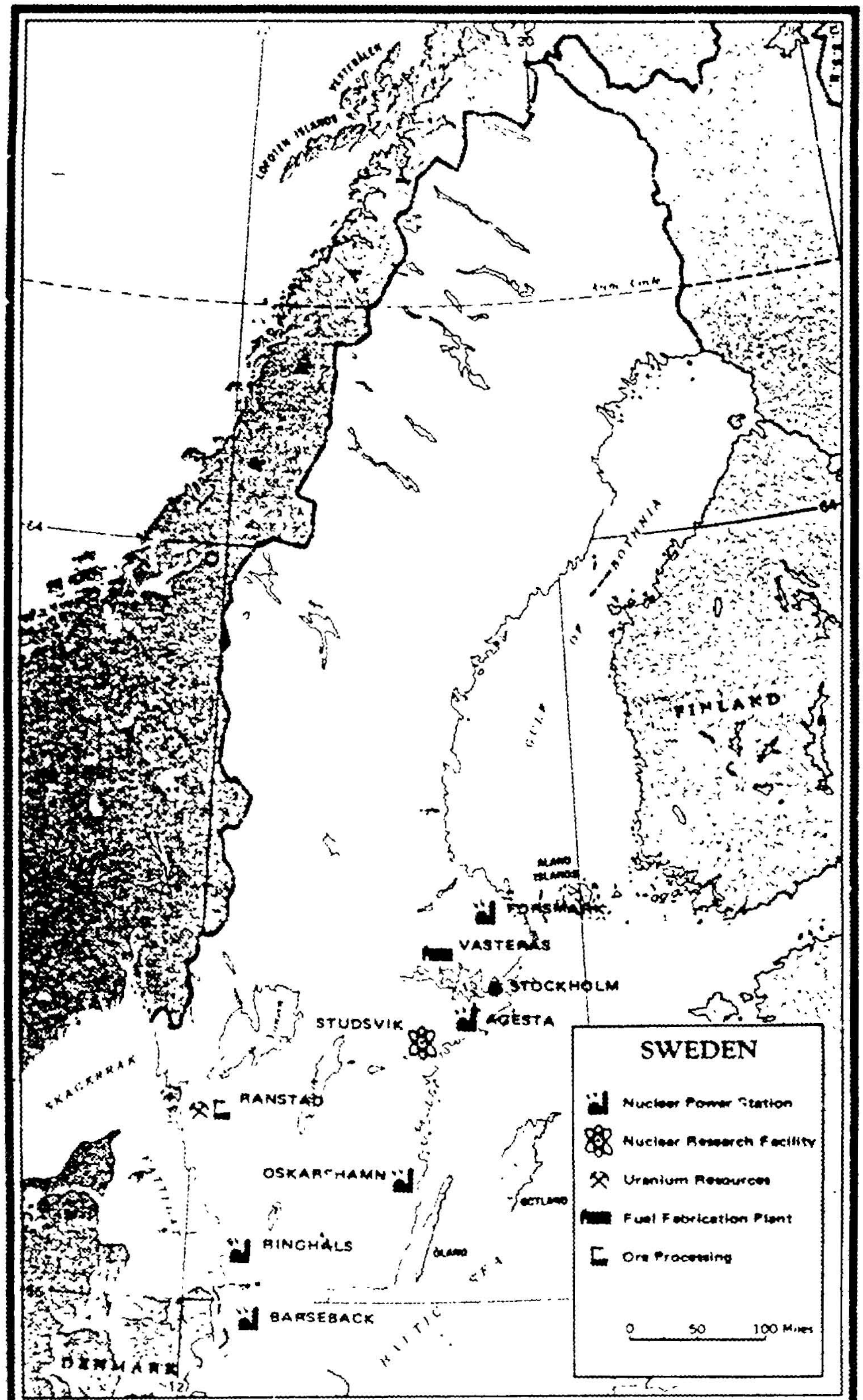
d. Research Reactor - Of the five research reactors that have or are operating in Sweden, none of them is suitable for plutonium production. The power levels are low and they are fueled with safeguarded enriched uranium.

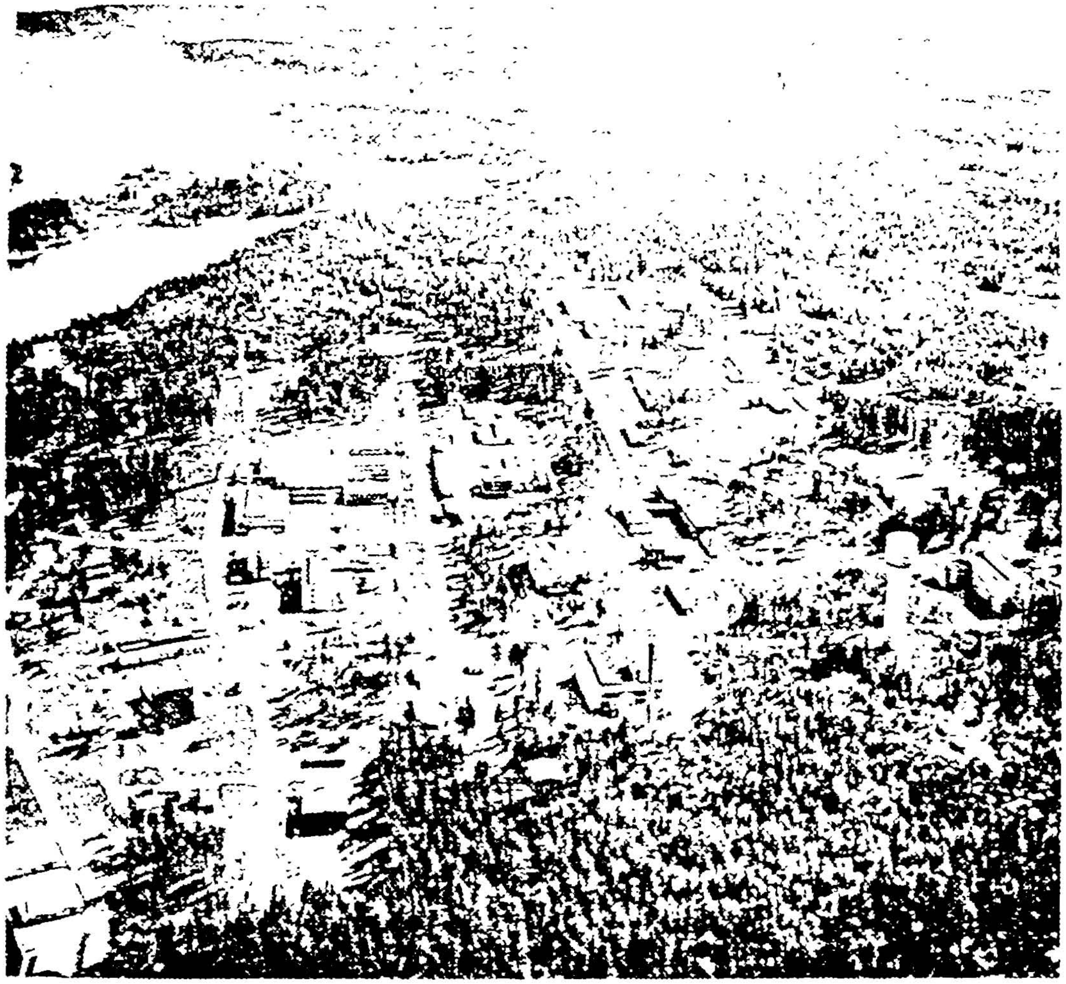
e. Power Reactor - Sweden's first power reactor became operational in 1963 and was shut down in 1974. This indigenously built reactor, Agesta, was fueled with natural uranium and was not safeguarded. [redacted] (b)(1),1.4 (c) All other power reactors are Swedish BWRs and U.S. PWRs. Because of the recent change in government, the future of nuclear power is uncertain. The new prime minister advocates stopping construction of nuclear power plants and dismantling those in operation.

SWEDEN

NUCLEAR FUEL CYCLE DEVELOPMENT

	59	61	63	65	67	69	71	73	75	77	79	81	83	8
URANIUM RESOURCES														
ORE PROCESSING PLANT														
FUEL FABRICATION PLANT														
RESEARCH REACTOR														
POWER REACTOR														


SWEDEN
Nuclear Power Station
Nuclear Research Facility
Uranium Resources
Fuel Fabrication Plant
Ore Processing
0
50
100 Miles
FORSMARK
VASTERAS
STOCKHOLM
AGESTA
STUDSVIK
RANSTAD
OSKARSHAMN
RINGHALS
BARSEBACK
FINLAND
DENMARK
SKAGERRAK
ALAND ISLANDS
GOTLAND
OLAND



STUDSVIK NUCLEAR RESEARCH CENTER

TAIWAN

TAIWAN

~~(S/NOFORN/~~ [redacted] ~~WNINTEL)~~ Assessment. Taiwan is actively pursuing a nuclear weapons program and could have a nuclear device as early as 1978, but probably not before 1980. High explosive design work and testing necessary for a nuclear device have already been completed.

~~(S/NOFORN/~~ [redacted] ~~WNINTEL)~~ Discussion. Following the detonation of the People's Republic of China's (PRC) first nuclear device in 1964, President Chiang Kai-shek ordered the establishment of the Chung-shan Science Institute (CSSI) for the purpose of developing a nuclear weapons capability. The Institute of Nuclear Energy Research (INER), collocated with CSSI, is publicly charged with conducting research on the nuclear fuel cycle while covertly it is developing the technology necessary to acquire a nuclear weapons capability. INER was formally separated from CSSI in 1968 and placed under control of the Atomic Energy Council (AEC). Public announcements have indicated that INER is not associated with the military or with CSSI and that its activities are limited strictly to peaceful purposes. [redacted] Funding for nuclear research has appeared in the Ministry of Defense's classified operation plan at least through fiscal year 1975 while much of the equipment purchased for INER is handled through military procurement channels. Although supposedly under the AEC, INER recently had a plan to purchase nuclear fuel reprocessing technology. Moreover, the final decision on the purchase was to be made by the Deputy Minister for National Defense, the Chief of the General Staff, CSSI's Executive Director and Deputy Director. Most important, a recent report indicates that the INER's physics branch has completed the necessary design and high explosive testing for nuclear devices. A rapidly expanding program at INER has enabled Taiwan to obtain all necessary facilities for a nuclear weapons program except for a fuel reprocessing plant. Facilities at INER include a 40 MWt Canadian built research reactor, fuel fabrication plant, and laboratory scale fuel reprocessing plant. The research reactor at INER has operated long enough to produce enough plutonium for three or four nuclear devices.

There have been numerous attempts since 1970 to acquire a small fuel reprocessing plant. In 1972, Taiwan had a contract with a West German Company for a 50 metric ton per year capacity plant. [redacted] At the same time, discussions were held between U.S. and Taiwanese officials. The Taiwanese promised not to proceed with plans to purchase a reprocessing plant.

Despite its pledge, Taiwan continued to show interest in acquiring a reprocessing facility. In May 1973, a team of nuclear scientists from the Taiwan Power Company (Taipower) and the INER toured reprocessing facilities in France and West Germany. [redacted] (b)(1),1.4 (d) The FY 75 budget for the AEC, however, showed a $2.5 million increase from the previous year in a single classified line item which has been identified as the effort to acquire a reprocessing plant. In January 1975, it was learned that a French company has agreed to sell Taiwan $2 million worth of blueprints and patent rights for a reprocessing plant, but in March the French Ministry of Foreign Affairs forced the company to cancel the sale. Since late 1975, INER has been attempting to purchase the technology and equipment for a reprocessing plant from the Netherlands company, Comprimo. [redacted] (b)(1),1.4 (c) indicates that this $20 million project is scheduled for completion approximately two years after Comprimo begins design engineering assistance. Actual purchase of equipment will be handled by another company in order to protect the security of the transaction. [redacted] (b)(1),1.4 (c) (b)(1),1.4 (c) provides strong evidence that INER has been reprocessing fuel from the Taiwan Research Reactor since at least mid-1975. During this period, INER reportedly has reprocessed ten fuel elements in the plutonium chemistry laboratory. Less than one-half kilogram of plutonium has been extracted from the TRR fuel thus far. At present, plutonium production appears to be limited by Taiwan's reprocessing capacity rather than the supply of spent fuel elements.

[redacted] (b)(1),1.4 (c) has provided other evidence that Taiwan is well advanced in their weapons design program. A good knowledge of high explosive properties is necessary in order to obtain an efficient implosion system. To obtain the knowledge, several Taiwan scientists received training in Israel on the production, casting, and machining of high explosive shaped charges. In May 1975, it was reported that the physics branch of the INER has already completed all necessary design work and high explosive testing for an initial nuclear device. The testing was done in a small bunker complex just west of INER. For monitoring high explosive tests, very sophisticated, ultra-high-speed cameras are used to record the shock waves produced by the blast. Since 1971, Taiwan has purchased several of these cameras from a company in the U.K. Although at least two of these cameras are probably being used for monitoring rocket engine tests, the remaining ones are unaccounted for and may have been used for high explosive testing. In 1974 they purchased an ultra-high-speed simultaneous streak and framing camera from a U.S. company. The camera's framing rate ranged from 10,000 to 7.84 million frames per second. A U.S. engineer installed the camera in the bunker apparently used for their high explosive testing and reported that other cameras had been previously installed in the bunker. Calculations done on computers at CSSI during 1974 and 1975 were used to verify the theoretical feasibility of the INER nuclear device design.

Although IAEA continues to conduct safeguard inspections at INER, Taiwan was expelled from IAEA when the PRC was admitted and hence could refuse IAEA inspections at any time. If INER starts construction of a reprocessing plant immediately, it is technically possible that Taiwan could have a nuclear device as early as 1978. Since construction delays and design problems are expected, it is more likely that Taiwan will not have a nuclear device until 1980. Although CSSI is developing missiles, Taiwan could have to rely on fighter aircraft as a delivery system until the mid-to-late-1980s.

~~(S/NOFORN/~~[redacted] (b)(3):50 USC 403-1(i) ~~NOCONTRACT/WNINTEL)~~ <u>Nuclear Materials and Facilities</u>.

a. Uranium Resources - Taiwan does not possess any uranium ore deposits; however, it has purchased 162 tons of uranium ore from South Africa for use in its research reactors. South Africa will convert the latest purchase of 50 tons to metallic uranium before shipping to Taiwan.

b. Ore Processing Plant - Taiwan does not have any ore processing facilities. The ore from South Africa is reduced to metal in the UK and then returned to Taiwan.

c. Fuel Fabrication Plant - A $2 million fuel fabrication plant is operational at INER. It can produce 600 fuel rods per year for the reactor at INER. A second plant for producing mixed oxide fuel elements for power reactors is under construction at INER. A team of metallurgists from INER have received several months training in mixed oxide fabrication techniques from Battelle Laboratories.

d. Research Reactor - The only research reactor at Taiwan capable of producing plutonium is the Taiwan Research Reactor (TRR) at INER which began operation in 1973. This 40 MWt, natural uranium fueled, heavy water moderated, Canadian built research reactor is capable of producing about 10 kilograms of plutonium per year - equivalent to one to two nuclear devices per year.

e. Fuel Reprocessing Facility - A small laboratory scale reprocessing facility was essentially complete in early 1976. The facility is designed to reprocess one fuel element per week of spent fuel from the Tsing Hua Univ ersity research reactor and only handles gram quantities of plutonium. Designation of facilities other than the Taiwan Research Reactor (TRR) at INER as principal nuclear facilities and installation of new surveillance systems at the TRR are designed to eliminate nuclear materials controversies in Taiwan. International Atomic Energy Agency reports in April 1976 indicate that probably 10 spent fuel rods were missing. Apparently the rods in question were new rods shipped to another facility for testing. Taiwan is negotiating with a Netherlands company for the purchase of nuclear fuel reprocessing technology and equipment. Environmental sampling and clandestine reporting provides strong evidence that INER is reprocessing TRR fuel at the plutonium chemistry laboratory.

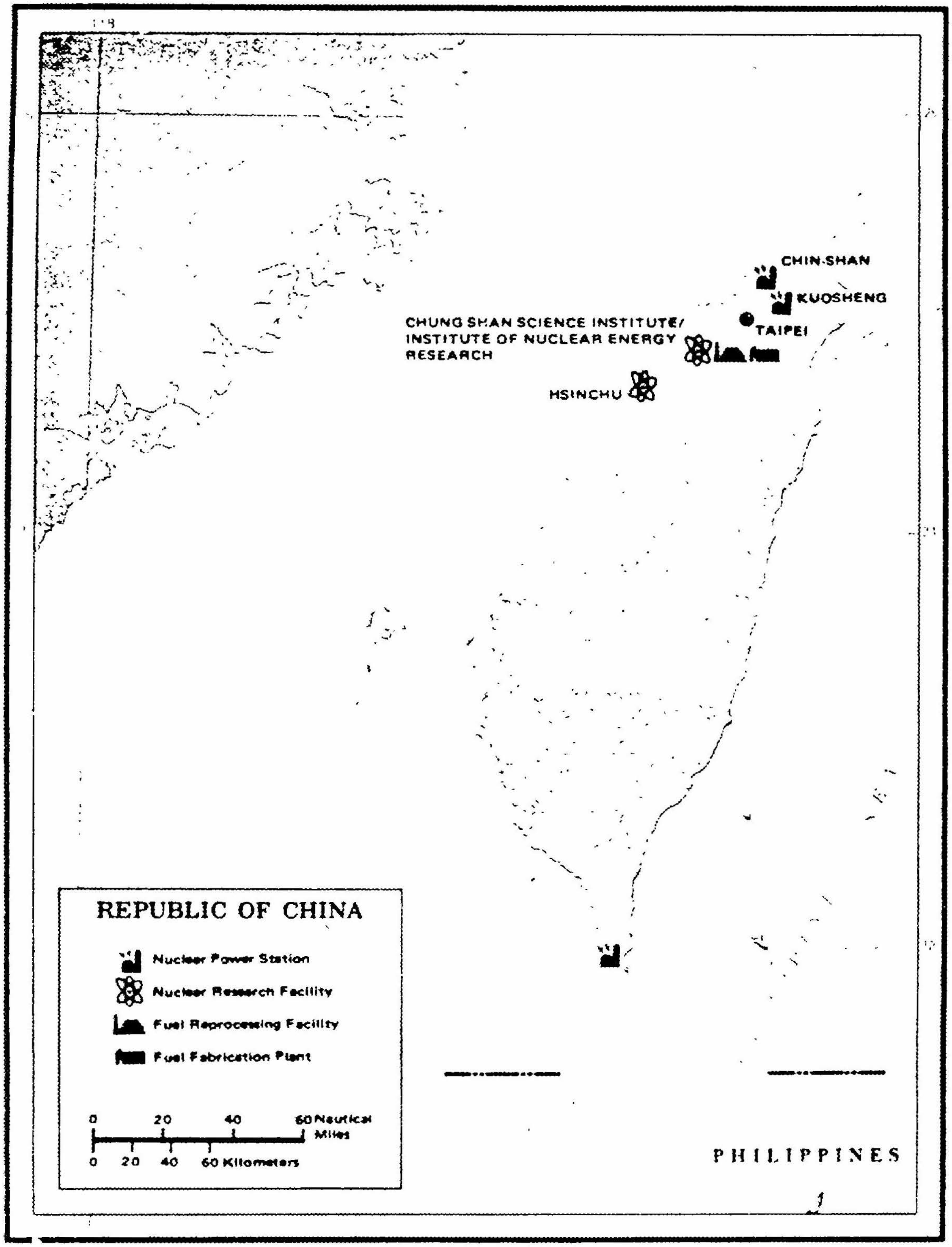
f. Power Reactor - Taiwan Power Company has four light water power reactors under construction and two in the planning stages. All will be built by the U.S. and will be under bilateral safeguard agreements.

g. Heavy Water Plant - INER has no heavy water production plant, although it does have a small heavy water clean-up facility to purify contaminated heavy water. INER has a 10 year contract with Canada to supply the needed heavy water for the TRR. INER now has plans to build a heavy water plant which is to be co-located with an existing fertilizer plant. Under current planning, the design of the plant would be contracted to a Swiss company.

TAIWAN

NUCLEAR FUEL CYCLE DEVELOPMENT

	59		61		63		65		67		69		71		73		75		77		79		81		83		8
URANIUM RESOURCES																										
ORE PROCESSING PLANT																										
FUEL FABRICATION PLANT																										
RESEARCH REACTOR																										
FUEL REPROCESSING PLANT																										
POWER REACTOR																										
HEAVY WATER PLANT																										



CI TW 1 5/74

Page 72 is Denied in Full

(b)(1),1.4 (c)

WEST GERMANY

WEST GERMANY

~~(S/NOFORN)~~ Assessment. West Germany is capable of developing a nuclear device within one or two years of a decision to do so; however, we do not believe that this decision has been made. West Germany has only small deposits of uranium ore and, therefore, must import its uranium supplies. A weapons program in the near future would require the abrogation of safeguards.

~~(S/NOFORN)~~ Discussion. West Germany has one of the most advanced and diversified nuclear programs in the world. Except for the lack of large uranium deposits, it possesses most of the elements of the fuel cycle necessary to initiate a weapons program. A weapons program would require the abrogation of safeguards agreements and would seriously jeopardize the future supply of enriched uranium for the civilian power program.

(b)(1),1.4 (c) [redacted]

processing plant is scheduled to become operational in the mid-1980s. If the pilot centrifuge enrichment program is successful and Germany builds a large enrichment plant, an ample supply of enriched uranium for a weapons program will exist. West Germany has shown its ability to export nuclear technology with the sale of a natural uranium power reactor to Argentina and the agreement with Brazil for the construction of pilot fuel reprocessing and uranium enrichment plants as well as eight power reactors.

~~(S/NOFORN)~~ Nuclear Materials and Facilities.

a. Uranium Resources - West Germany has only limited deposits of low grade uranium ore; therefore, almost all its uranium requirements are met by imports. German companies participate in the working of uranium deposits in Canada and Niger. In addition, Germany is prospecting for ore on a world-wide scale.

b. Ore Processing Plant - There is a prototype ore processing plant at Ellweiler. The plant processes domestic as well as imported ore and is also used to develop improved concentration processes.

c. Fuel Fabrication Plant - West Germany has facilities to fabricate fuel elements for light water reactors; sodium cooled fast breeder reactors; high temperature, gas-cooled reactors and plutonium fueled reactors.

d. Research Reactor - There are 17 research reactors in Germany. The first one became operational in 1957. They all use enriched uranium.

e. Fuel Reprocessing Plant - Since 1971, Germany has operated a pilot reprocessing plant for slightly enriched fuel elements and has a research reprocessing facility under construction for uranium-thorium fuel. A large reprocessing plant is expected to be operational in the mid-1980s.

f. Power Reactor - By 1978 there will be 18 power reactors in operation with many more planned. They include boiling water; pressurized water; fast breeder; gas-cooled, heavy water; and thorium, high temperature, gas-cooled reactors. They are all fueled with enriched uranium except for one 58 MWe natural uranium fueled reactor.

g. Breeder Reactor - The breeder reactor program began in 1960. Their first experimental reactor achieved criticality in 1971 utilizing a thermal core. This reactor is currently being modified to receive a fast core. Under construction is a 300 MWe FBR that is expected to be operational in 1981.

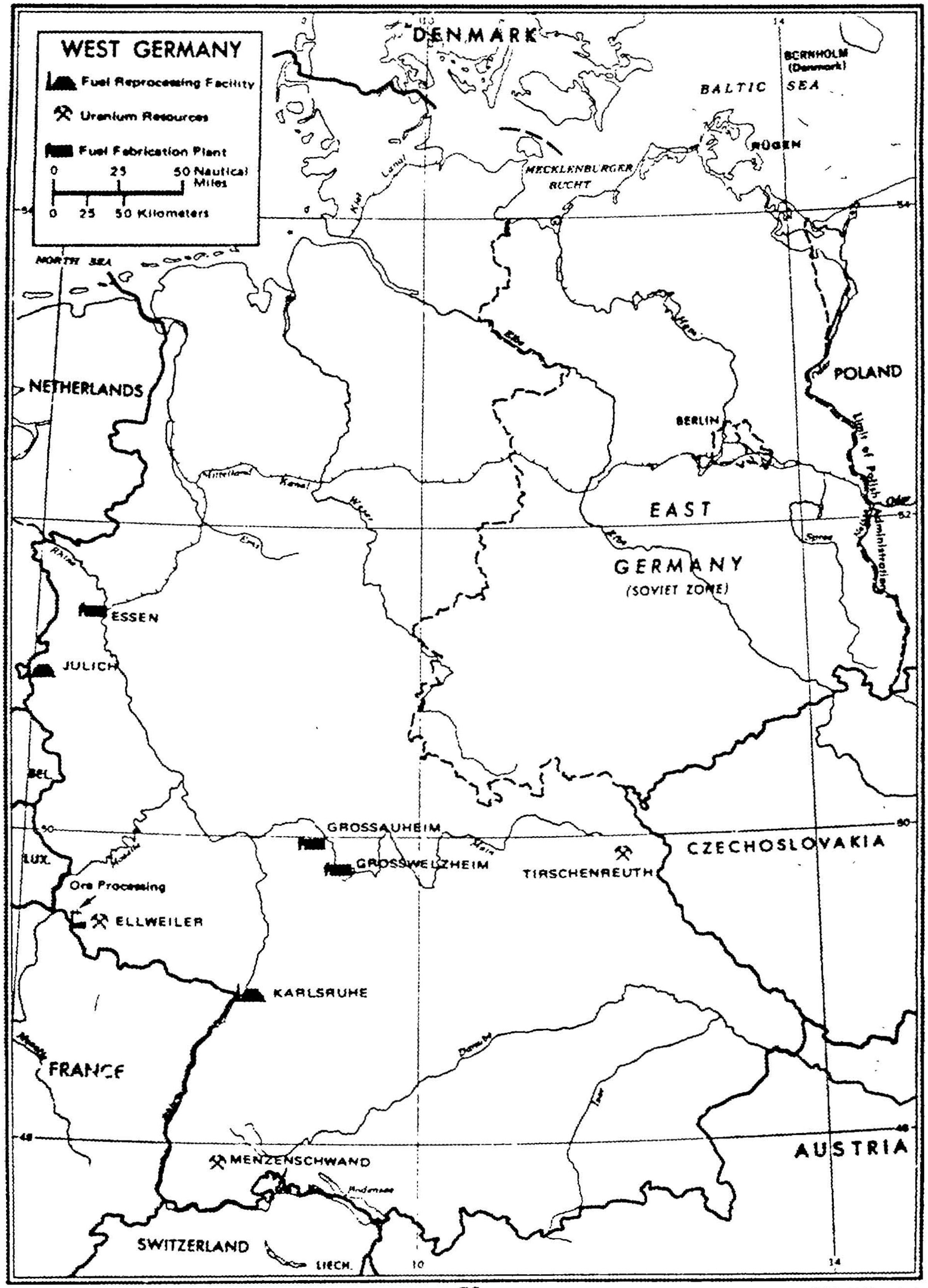
h. High Temperature Reactor - A 15 MWe high temperature, gas-cooled reactor became operational in 1967. Under construction is a 300 MWe thorium, high temperature, gas-cooled reactor. It will be operational in 1978.

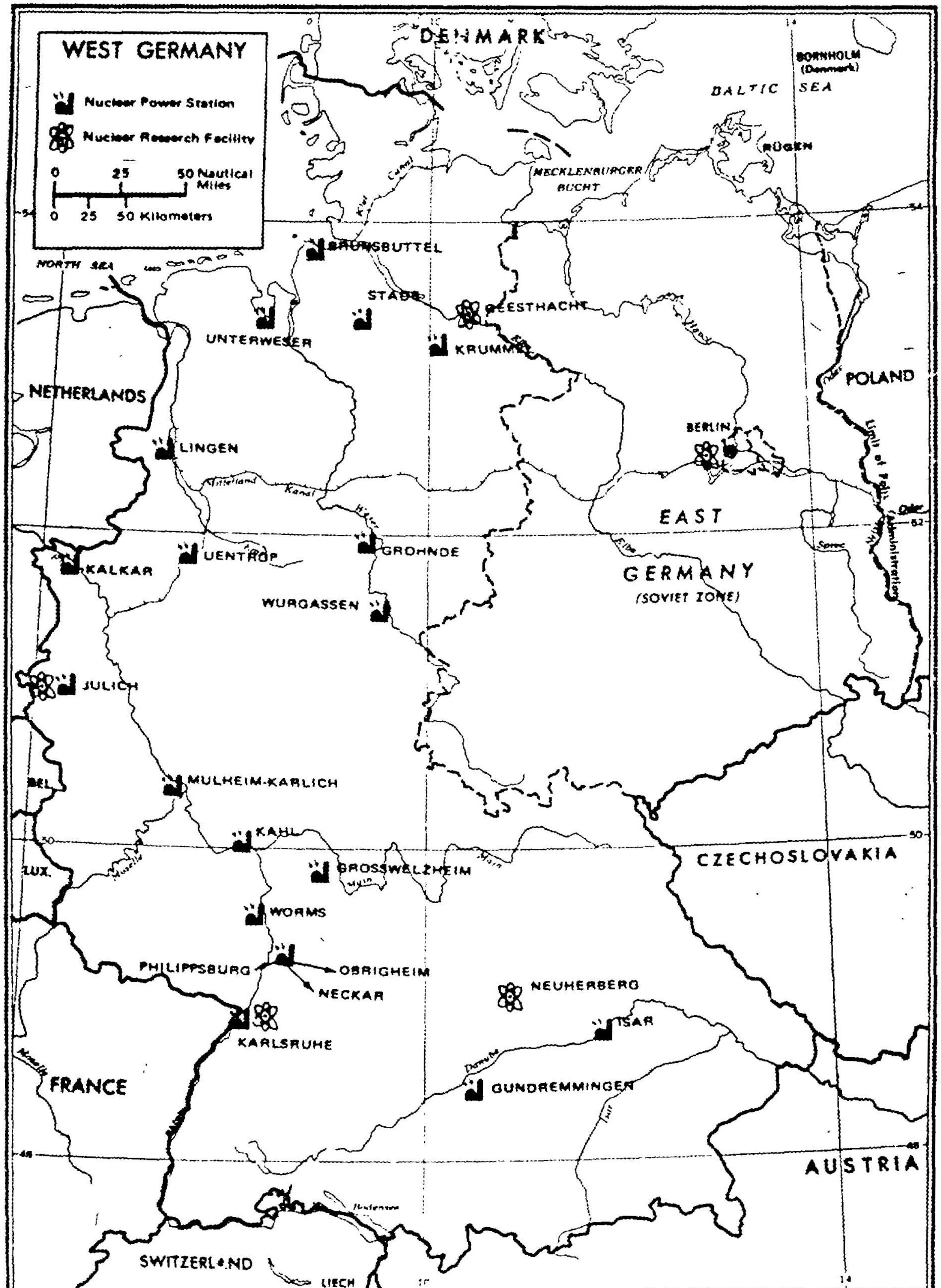
i. Marine Propulsion Reactor - West Germany's first nuclear powered ship, the ore carrier OTTO HAHN, became operational in 1968 and continues to operate satisfactorily.

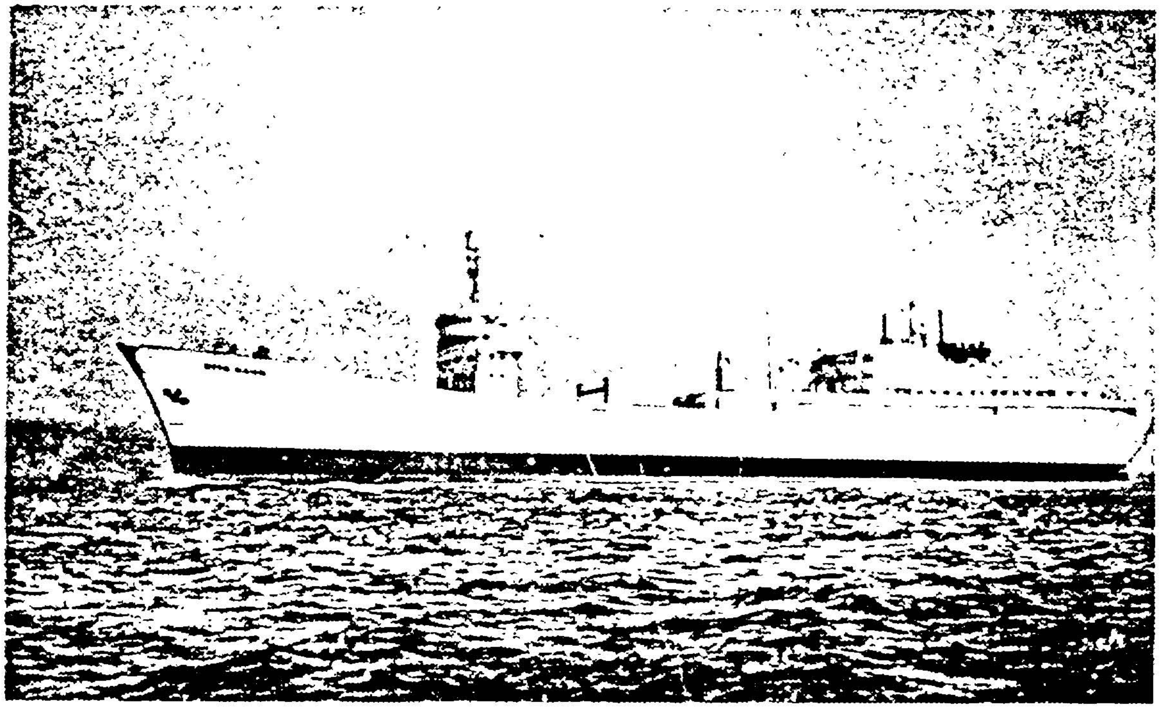
j. Uranium Enrichment Plant - Germany has operated a small prototype gas centrifuge enrichment plant since 1973 at Almelo, the Netherlands. Currently, enriched uranium for the power reactors is imported from the U.S. and USSR. While the main emphasis of the uranium enrichment effort is the gas centrifuge, significant work continues on the Becker jet nozzle aerodynamic process.

WEST GERMANY
NUCLEAR FUEL CYCLE DEVELOPMENT

	59	61	63	65	67	69	71	73	75	77	79	81	83	8
URANIUM RESOURCES														
ORE PROCESSING PLANT														
FUEL FABRICATION PLANT														
RESEARCH REACTOR														
FUEL REPROCESSING PLANT														
POWER REACTORS														
BREEDER REACTOR														
HIGH TEMPERATURE REACTOR														
MARINE PROPULSION REACTOR														
URANIUM ENRICHMENT PLANT														


WEST GERMANY
Fuel Reprocessing Facility
Uranium Resources
Fuel Fabrication Plant
0 25 50 Nautical Miles
0 25 50 Kilometers
DENMARK
BORNHOLM (Denmark)
BALTIC SEA
RÜGEN
MECKLENBURGER BUCHT
NORTH SEA
NETHERLANDS
POLAND
BERLIN
EAST GERMANY
(SOVIET ZONE)
ESSEN
JULICH
BEL.
LUX.
GROSSAUHEIM
GROSSWELZHEIM
TIRSCHENREUTH
CZECHOSLOVAKIA
Ore Processing
ELLWEILER
KARLSRUHE
FRANCE
AUSTRIA
MENZENSCHWAND
SWITZERLAND
LIECH.


WEST GERMANY
Nuclear Power Station
Nuclear Research Facility
0 25 50 Nautical Miles
0 25 50 Kilometers
DENMARK
BORNHOLM (Denmark)
BALTIC SEA
RÜGEN
MECKLENBURGER BUCHT
NORTH SEA
STADE
GEESTHACHT
UNTERWESER
KRUMMEL
NETHERLANDS
POLAND
BERLIN
LINGEN
EAST
GERMANY
(SOVIET ZONE)
UENTROP
GROHNDE
KALKAR
WURGASSEN
JULICH
BEL.
MULHEIM-KARLICH
KAHL
CZECHOSLOVAKIA
LUX.
GROSSWELZHEIM
WORMS
PHILIPPSBURG
OBRIGHEIM
NECKAR
NEUHERBERG
ISAR
KARLSRUHE
FRANCE
GUNDREMMINGEN
AUSTRIA
LIECH



NUCLEAR SHIP OTTO HAHN

TERRORISM

NUCLEAR TERRORISM*

~~(S)~~ Some subnational terrorist groups which use systematic violence for the furtherance of political aims might be motivated to attempt to acquire nuclear explosives in the pursuit of their goals. There are, however, certain inherent constraints on these groups. These constraints are:

a. Most terrorist groups are subject to some degree to internally generated limits to the level of violence they are willing to inflict. They are much concerned with the propaganda value of their deeds and are aware that the level of violence inherent in the threatened or actual use of nuclear explosives might well be counterproductive in the sense that it would alienate vastly more people than it would attract.

b. All terrorist groups are subject to some degree to externally imposed limits on the level of violence they dare inflict. Terrorists operate relatively successfully today in a permissive environment fostered in large part by international rivalries. Politically sophisticated terrorist leaders would certainly be aware that the threatened use of a nuclear explosive---and certainly its actual use--might bring about unprecedented levels of international cooperation and determination which could result in the destruction of their movement.

c. Terrorist groups, even the more important ones, are not usually attracted to difficult targets. Typically they have not conducted open assaults against well-defended targets or undertaken schemes entailing long-term commitment of resources, rather preferring schemes yielding the greatest quick result for the least investment.

None of these points is sufficient in itself to provide comfortable assurance that no terrorist group will seriously consider acquisition of nuclear explosives. In the near term, the combination of factors, however, probably constitutes a greater constraint than is generally thought. Over the long term, if the current trend of increasing terrorist violence continues, we would expect a correponding erosion of the constraints against terrorist use of nuclear explosives.

*This section presents the main points formulated in Interagency Intelligence Memorandum 76-002, 8 Jan 76, The Likelihood of the Acquisition of Nuclear Weapons by Foreign Terrorist Groups for Use Against the United States.

~~(S)~~ Any terrorist group determined to acquire a nuclear explosive has only two choices: it can attempt seizure of an existing weapon or it can undertake the theft of nuclear material and the fabrication of its own device. Either method would entail great difficulty, but neither can be said to be beyond the capabilities of all groups. Even the less sophisticated groups might, by a combination of luck and daring, successfully accomplish seizure of an existing weapon. The option of actually fabricating a device would be foreclosed to all but a few of the more sophisticated groups. A terrorist leader of a large, competent group might be attracted initially to the option of fabricating a device, given the terrorist preference for easy targets. He would assume--and could easily confirm--that in all countries nuclear weapons are more securely guarded than are nuclear materials. He would reason that not only could he acquire nuclear material more readily, but that he could have a much better chance of making a successful theft. On the other hand, the complexity of all the necessary steps, from stealing the material to successfully fabricating a device, would serve as a considerable deterrent. The work would necessarily proceed with the full knowledge that failure, including catastrophic failure, would be a distinct possibility. It is our judgment that none of the individual steps involved--through successful design and fabrication of a device--would be beyond the capabilities of a sophisticated, well funded group, but that the cumulative difficulties of carrying through all the steps in the necessary order make the probability of success fairly low. More importantly, we find it unlikely that any terrorist group as now constituted would be inclined to invest the time, patience, and long-term commitment of resources to an undertaking of such dubious outcome. Undertakings of this sort are inconsistent with the behavior patterns of most terrorist groups which are chiefly interested in achieving maximum return on minimum investment. Therefore, we believe that any group committed to the acquisition of nuclear explosives in the next year or two would more likely be motivated to attempt seizure of an existing weapon rather than fabrication of a device because of their likely perception that they would have a greater chance of success of achieving their objective.

~~(S/NOFORN)~~ We have reviewed available information on the major terrorist groups now operating or recently operating in various parts of the world. Based on this review, we have no evidence that any of these groups intend to acquire nuclear weapons. After considering the relative capabilities of groups, areas of operation, etc., we have identified those which appear to constitute the greatest potential threat. Terrorist organizations associated with the Palestinian Movement which have successfully conducted extraterritorial operations of some significance, such as the Popular Front for the Liberation of Palestine (PFLP) and the present-day version of the Black September Organization (BSO), probably have the capability to successfully conduct the type of operation required to seize a nuclear weapon. They have demonstrated the ability to obtain and analyze targeting intelligence data, to sustain an effective logistics support apparatus either unilaterally or with the aid of friendly states, and to obtain, transport and use sophisticated weapons. Their operations are characterized by a degree of fanaticism and motivation quite apart from their Western European contemporaries. Additionally they have opened channels of cooperation (in terms of logistics support, intelligence acquisition, and training) with many of the Western European terrorist organizations. All of these capabilities, coupled with the training received by these Palestinian organizations from the USSR and China in unconventional warfare techniques and the experience gained from the crossborder guerrilla activities against the state of Israel, make these two groups (BSO and PFLP) bona fide potential threats to the security of nuclear weapons.

APPENDIX

FUEL CYCLE DESCRIPTION

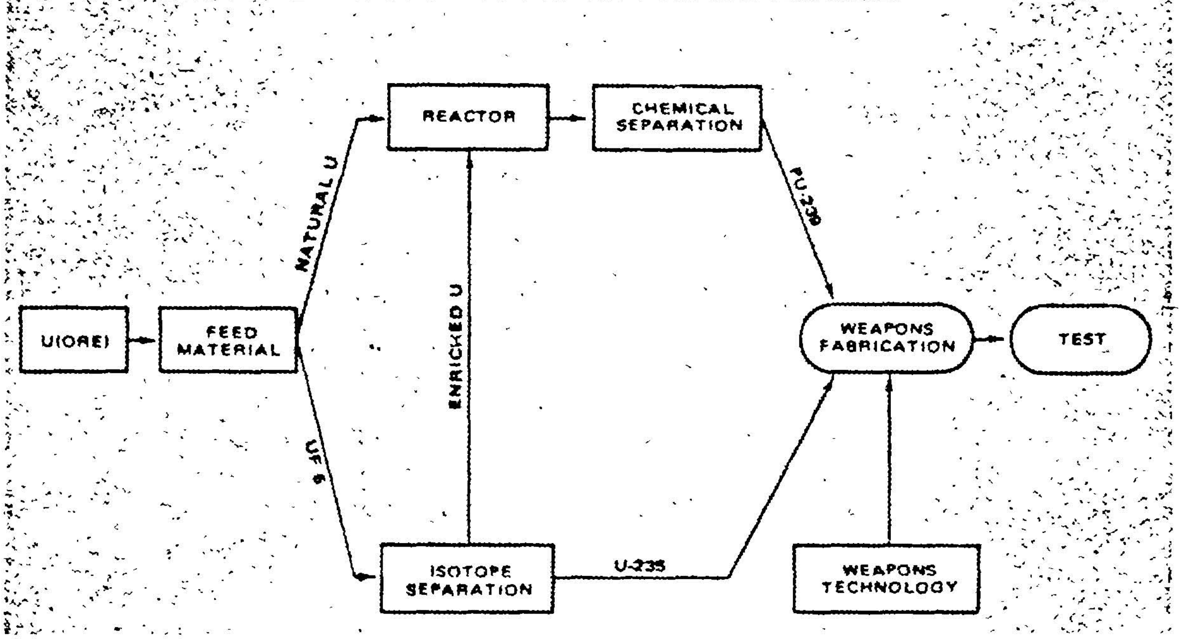
THE NUCLEAR FUEL CYCLE

The nuclear fuel cycle starts with the mining of uranium ore. Since uranium ore contains less than 3% uranium, it is concentrated, usually near the mine, for more efficient shipping to the feed materials processing facility. At the processing facility the ore is purified and converted to an oxide, fluoride or metal depending upon the type of reactor fuel to be produced. Two types of reactors--light water reactors which use slightly enriched uranium fuel and heavy water reactors which use natural uranium fuel--are commercially available. Uranium to be used in light water reactor fuels must be enriched from its natural state of 0.7% U^{235} to about 3% U^{235} in an isotope separation plant. Gaseous diffusion is currently the most common method of enrichment on a commercial scale; however, gas centrifuge, aerodynamic, and laser isotope separation methods are under intensive development. The enriched uranium is then fabricated into fuel either as an oxide or a metal alloy and placed in the reactor. The fuel for natural uranium reactors, of course, by-passes the enrichment stage. After irradiation in the reactor, the fuel is moved to a cooling pond to permit the decay of various radioactive nuclides and then to the fuel reprocessing plant. The reprocessing plant chemically separates the fuel to obtain uranium oxide and plutonium nitrate. These products may then be recycled as feed materials for a power program, or the plutonium may be used in weapons fabrication. While most Nth countries considering nuclear weapons development will opt for a plutonium device, the nuclear fuel cycle does provide an alternate route which can lead to development of a nuclear weapon. If a country has an enrichment plant, highly enriched uranium (>90% U^{235}) can be produced for direct use in a nuclear device.

Concurrently, a country proceeding along either of these two paths for the development of a military capability can be working on weapons-related technologies such as high explosive phenomena, neutron initiation, detonators, equations of state and electronics.

At this point a test could be conducted· however, a country need not actually detonate the device if it had enough confidence in its design calculations. Testing of components, individually or in various combinations, could provide this assurance.

ELEMENTS OF A NUCLEAR WEAPONS PROGRAM



UNCLASSIFIED

SUPPLIER STATUS

INTERNATIONAL NUCLEAR MARKET
MATERIAL AND SERVICES
SUPPLIER

NTH COUNTRY	(b)(1),1.4 (d)	CANADA	FRANCE	WEST GERMANY	SOUTH AFRICA	USSR	UK
ARGENTINA	[redacted]	◇D ◇R		Ⓡ			
BRAZIL	[redacted]						
INDIA	[redacted]	Ⓓ Ⓡ				Ⓓ ◇D	
IRAN	[redacted]			◇F	◇U		
ISRAEL	[redacted]		Ⓡ Ⓓ		Ⓤ		
JAPAN	[redacted]		◇C		Ⓤ		Ⓒ ◇C Ⓡ
LIBYA	[redacted]						
PAKISTAN	[redacted]	Ⓡ Ⓓ					
SOUTH AFRICA	[redacted]						Ⓕ
SOUTH KOREA	[redacted]		◇C				◇C
SPAIN	[redacted]	Ⓤ	Ⓤ	Ⓕ	Ⓤ	◇E	Ⓒ
SWEDEN	[redacted]	Ⓤ	Ⓤ	Ⓕ		◇E	Ⓔ
TAIWAN	[redacted]	Ⓓ Ⓡ					◇C
WEST GERMANY	[redacted]	Ⓤ	Ⓤ		Ⓤ	Ⓔ ◇U	Ⓔ Ⓤ

~~NOFORN/NOINTEL—ORCON—NOCONTRACT~~

R - REACTOR FUEL
U - URANIUM
D - D_2O
E - URANIUM ENRICHMENT SERVICE
F - FUEL FABRICATION SERVICE
C - REPROCESSING SERVICE
○ - MATERIAL/SERVICE ALREADY PROVIDED
◇ - PLANNED/NEGOTIATION

INTERNATIONAL NUCLEAR MARKET TECHNOLOGY AND FACILITIES

SUPPLIER

NTH COUNTRY

	(b)(1),1.4 (d)	CANADA	FRANCE	WEST GERMANY	BELGIUM	USSR	UK	NETHERLANDS	ITALY
ARGENTINA	[redacted]	⬡P ◇P		○P					○C
BRAZIL	[redacted]		◇E	◇P ◇C ◇E ◇F					
INDIA	[redacted]	○R	⬡R ○D	⬡D					
IRAN	[redacted]		◇P	⬡P					
ISRAEL	[redacted]		○R						
JAPAN	[redacted]		⬡C	◇R			○P		
LIBYA	[redacted]		◇P			◇F ◇R			
PAKISTAN	[redacted]	○P ◇P ◇F	◇C ◇P	◇D					◇F
SOUTH AFRICA	[redacted]		◇P						
SOUTH KOREA	[redacted]	◇P	◇F		◇C				
SPAIN	[redacted]		○P	◇P					
SWEDEN	[redacted]								
TAIWAN	[redacted]	○R			○F			◇C	
WEST GERMANY	[redacted]								

~~NOFORN/WNINTEL ORCON NOCONTRACT~~

D - HEAVY WATER TECHNOLOGY/PLANT

F - FUEL FABRICATION TECHNOLOGY/PLANT

P - REACTOR (POWER)

R - REACTOR (RESEARCH, 20 MWt OR GREATER)

C - REPROCESSING TECHNOLOGY/PLANT

○ - OPERATIONAL

⬡ - UNDER CONSTRUCTION

◇ - PLANNED/NEGOTIATION

E - ENRICHMENT PLANT

NUCLEAR NON-PROLIFERATION TREATY STATUS

COUNTRY	PARTY TO TREATY	SIGNED BUT NOT RATIFIED	NON-SIGNATORY
ARGENTINA			√
BRAZIL			√
INDIA			√
IRAN	√		
ISRAEL			√
JAPAN	√		
LIBYA	√		
PAKISTAN			√
SOUTH AFRICA			√
SOUTH KOREA	√		
SPAIN			√
SWEDEN	√		
TAIWAN	√		
WEST GERMANY	√		

T
H
E
N
P
T

THE NUCLEAR NON-PROLIFERATION TREATY AND ITS EFFECTIVENESS

The Treaty on the Non-Proliferation of Nuclear Weapons (NPT) became effective on 5 March 1970. The objectives of the Treaty are: 1) to prevent the spread of nuclear weapons to countries other than the five that possessed them at the end of 1966; 2) to promote international cooperation in developing the peaceful uses of nuclear energy, and particularly to help developing countries in this regard; 3) to afford all parties whatever benefits may be derived from the peaceful uses of nuclear explosives; and 4) to pursue negotiations towards the cessation of the arms race, nuclear disarmament and eventually a treaty on general and complete disarmament.

The basic features of the Treaty are:

a. Nuclear Weapons States (NWS) Party to the Treaty will furnish no one with nuclear weapons "or other explosive devices" nor will they aid any Non-Nuclear-Weapon State (NNWS) in acquiring a nuclear explosive capability.

b. NNWS Party to the Treaty will not accept transfer of nuclear explosive devices, will not make or otherwise acquire them, and will not seek assistance in making them.

c. NNWS Party to the Treaty will accept safeguards and verification as negotiated with the IAEA.

d. All States party to the Treaty will not provide any NNWS with special fissionable material--or equipment for processing, using, or producing it--for peaceful purposes except under IAEA safeguards.

e. NPT safeguards shall not hamper the economic or technological development of the parties or international co-operation in peaceful nuclear activities.

f. Peaceful nuclear explosion services to NNWS Party to the Treaty shall be provided on a nondiscriminatory basis.

g. Any State party to the Treaty may withdraw from the NPT upon ninety days notice.

The principal tool in the administration of the NPT is the safeguards agreements which the NNWS negotiate with IAEA. The objectives of safeguards are the timely detection of diversion of significant quantities of nuclear material from peaceful nuclear activities to the manufacture of nuclear weapons or of other nuclear explosive devices, and deterrence of such diversion by the risk of early detection. These goals are to be accomplished by effective nuclear materials accountability. In addition to requiring member states to maintain production and operating records, and to submit reports of their operations to the IAEA, inspectors from the IAEA examine safeguarded facilities to verify that such materials are indeed accounted for in the system.

The main drawbacks to the NPT are that not all countries are full parties, and furthermore, any country which is a party can withdraw after giving ninety days notice. This lack of total and complete acceptance thus prevents the agreement from having the effect that was originally intended--to prevent the spread of nuclear weapons. While some of the countries considered in this book to be likely proliferators have signed and ratified the NPT (i.e. Iran, Libya, South Korea, Sweden, Taiwan, and West Germany), others (i.e. Argentina, Brazil, India, Israel, Pakistan, South Africa, and Spain) have adamantly refused. Thus, signatory status cannot be looked upon as a clear indicator of weapons intentions. If a country desiring a nuclear option must have external assistance to help establish research, power, and related fuel cycle facilities, it might well become a party to expedite the necessary technology transfer.

The reasons given by nations for refusing ratification point out the various deficiencies in the document as the countries perceive them. The primary areas causing discontent include the following:

a. The requirements for inspections under a safeguards system are imposed upon NNWS but not upon the NWS; this requirement is considered by the NNWS as being politically inequitable and discriminatory.

b. Claims of commercial advantages cause discontent in many nations. The allowing of NWS to develop peaceful nuclear explosives is frequently viewed as such an advantage. On the other hand, the claim of not wanting to endanger proprietary secrets, thereby losing a commercial advantage, has been made by South Africa in regard to its enrichment plant and is given as a reason for non-participation in the NPT.

c. Stating that the NWS should work toward arms control without explicit goals required: the NNWS see this condition as allowing a so-called vertical proliferation while restricting a horizontal spread.

d. A fear by the NNWS that their security might be in jeopardy without they themselves having a nuclear deterrant; the fact that a NWS such as the PRC is not a party to the NPT probably will continue to provide good reason for India to proceed along its chosen path of nuclearization; similarly, Pakistan will be reluctant to change its status since India now has demonstrated its nuclear capability.

e. A claim by some countries, notably the PRC, that the NPT is a plot by the USSR and the U.S. to perpetuate their status as super powers in the realm of international diplomacy.

Other drawbacks to the NPT, in addition to incomplete acceptance, relate to the safeguards measures and their effectiveness. The safeguards apply to all nuclear facilities, including both research and power reactors, as well as fuel reprocessing plants. The role of the IAEA, in regard to these facilities, is to verify that material is not diverted to nuclear weapons or other nuclear explosive devices. Due to the ever growing number of facilities involved in the safeguards system, the IAEA will be hard pressed to supply technically competent personnel to perform the actual inspections as new plants become operational. Despite recruiting attempts, the agency has not been able to attract large numbers of scientific people on a permanent basis. The approaching IAEA manpower shortage may force the current inspection system to be revamped to allow more practical verification means. Another problem relating to the inspections is the uncertainty involved in accounting for all materials. The IAEA has estimated that when a new fuel reprocessing plant initiates operations there could be as much as five percent discrepancy between the amount of plutonium calculated to be in the irradiated fuel and the actual amount recovered. This uncertainty, the material unaccounted for (MUF), opens the way for possible covert diversion of the potential weapons material. In a large commercial scale reprocessing plant, the MUF could represent sufficient plutonium for several nuclear devices per year. If an inspector believes material has been diverted, his secret report would be forwarded to the director general of the safeguards division and it would be completely up to this one person as to whether or not to publish the suspicion. The difficulties associated with not having hard confirmatory evidence would probably tend to keep the possible diversion secret unless a very high degree of confidence existed which pointed toward covert activities.

The various problem areas associated with the NPT and the safeguards system indicate that an absolute guarantee cannot be given that any of the potential proliferating countries discussed in this book can be prevented from acquiring fissile materials if the country in question has the necessary fuel cycle facilities and the political motivation to proceed with a weapons program.

GLOSSARY

GLOSSARY

Becker Jet Nozzle Process	An aerodynamic uranium enrichment process under development in West Germany. Centrifugal force through a curved nozzle is used to separate the uranium isotopes.
Boiling Water Reactor (BWR)	A type of nuclear reactor employing ordinary water (H_2O) as both coolant and moderator and allows bulk boiling in the core, thus generating steam in the primary reactor vessel.
Breeder Reactor	A nuclear reactor that produces from fertile material more fissionable material per unit time than it consumes. Such a reactor may be cooled by liquid metals or gases and the neutrons causing the fissioning may be either fast or thermal.
Burn-up	A measure of the consumption of a given material in a nuclear reactor. It can be expressed as energy per unit mass of fuel (megawatt-days per metric ton).
Concentrate, uranium	Refers to the products of uranium ore milling operations. This is the feed material for uranium refining plants.
Controlled Thermonuclear Reaction (CTR)	A reaction, produced under controlled conditions, in which the fusion of two light nuclei is achieved to form the nucleus of a heavier atom with the concurrent release of a large amount of energy.
Coolant	The fluid, usually in direct contact with the fuel, which removes the heat from the heat generating part of the reactor.

Enriched uranium	Uranium whose U-235 isotopic content has been increased above that found in nature.
Exposure	See burn-up.
Fast Breeder Reactor (FBR)	A reactor which operates on fast neutrons (neutrons with energy greater than 0.11 million electron volts). Coolant may be either liquid metals or gases. It produces more fissionable material (by conversion of contained fertile material) than it consumes.
Fertile material	A material, not itself fissionable by thermal neutrons, which can be converted into a fissile material by irradiation in a reactor.
Fissile material	Material which will undergo fission by neutrons of all energies. Sometimes used as a synonym for fissionable material.
Fissionable material	Material which will fission by fast neutrons only. Commonly used as a synonym for fissile material.
Fuel cycle	Sequence of operations involved in supplying fuel for the nuclear power industry.
Fuel element	An assembly of fissionable and inert materials, several of which form the core of a nuclear reactor. The inert materials serve to achieve proper concentration of the fissionable material to contain and protect the fissionable material and fission products from reactions with moderator, coolant, etc.

Fuel fabrication	Fabrication of reactor fuel materials into the desired shapes. Power reactors generally use fuel rods while research reactors may use rods or plates.
Fuel reprocessing	Chemical or metallurgical treatment of irradiated reactor fuel for the purpose of recovering the fissionable and fertile materials separated from the fission products.
Gas centrifuge process	A method of isotope separation based on the property that when a fluid mixture is subjected to a centrifugal force field, the heavier component moves more rapidly away from the axis of the rotating body.
Heavy water (D_2O)	Water whose hydrogen (H) has been replaced by the heavy isotope of hydrogen, deuterium (D). Its nuclear properties make it extremely desirable as a moderator for certain reactor designs. Generally, it must be at least 99.5% D_2O and 0.5% or less H_2O.
High temperature reactor (HTR)	A reactor which has a high coolant outlet temperature (500-1600°C). It is hoped that these reactors will have some process heat application.
Irradiated fuel	Fuel that has been exposed to irradiation in a nuclear reactor.
Light water reactor (LWR)	A reactor that uses ordinary water (H_2O) as the coolant and the moderator. It includes pressurized water reactors (PWRs) and boiling water reactors (BWRs).

Laser isotope separation (LIS)	A method of isotope separation in which a laser beam excites the U^{235} atom and deposits it in a charged collector. This program theoretically requires less power and fewer stages than other enrichment processes.
Megawatt electric (MWe)	Unit of electrical power.
Megawatt thermal (MWt)	Unit of thermal power. For a nuclear reactor, the thermal efficiency is about 33% hence a 1000 MWt reactor would produce about 333 MWe.
Moderator	Material used in a reactor to reduce neutron energy. Some examples are water, heavy water, beryllium, graphite.
Nth country	Expression used to denote those countries that could become 7th, 8th,....Nth nuclear powers.
Nominal yield weapon	A weapon with a yield of 20 Kt of high explosives.
Nuclear device	Nuclear device is an assembly of fissile material together with the necessary high explosion and detonation systems.
Nuclear weapon	A nuclear weapon is a nuclear device plus suitable arming, fusing, and firing systems and a drop case for a bomb or a re-entry vehicle structure for a missile payload. The nuclear device may also require modification to meet operational and environmental requirements.
Pressurized water reactor (PWR)	A reactor type, cooled and moderated by ordinary water in which the coolant is under high pressure so that it remains liquid and does not turn to steam.

Radioisotope	A radioactive isotope. An unstable isotope of an element that decays or disintegrates spontaneously, emitting radiation.
Safeguards	International agreements and/or inspections used to prevent or detect unauthorized use of nuclear materials or facilities.
Uranium metal	Basic form of uranium. Due to poor mechanical properties and susceptibility to radiation, it is generally alloyed with oxide, carbide or other suitable compound.
Weapons grade plutonium	Plutonium primarily containing Pu-239 and less than 10% Pu-240. Larger Pu-240 content decreases weapon efficiency and yield predictability due to high spontaneous fission rate.