

GAO

Report to the Honorable
William Proxmire, U.S. Senate

August 1987

NUCLEAR NONPROLIFERATION

Department of Energy Needs Tighter Controls Over Reprocessing Information



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United States
General Accounting Office
Washington, D.C. 20548

**Resources, Community, and
Economic Development Division**

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August 17, 1987

The Honorable William Proxmire
United States Senate

Dear Senator Proxmire:

On July 8, 1986, you asked that we examine the Department of Energy's activities that may assist foreign countries in the development of nuclear weapons material. Specifically, we focused on the area of reprocessing and assessed the Department's controls over (1) dissemination of reprocessing information, (2) cooperative research activities it conducts with foreign countries, and (3) involvement of foreign nationals in sensitive nuclear activities and research.

Unless you publicly announce its contents earlier, we plan no further distribution until 30 days from the date of this letter. At that time, we will send copies to the Secretaries of Defense, Energy, and State; the Director, Arms Control and Disarmament Agency; the Chairman, Nuclear Regulatory Commission; and the Director, Office of Management and Budget. In addition, we will make copies available to others upon request.

This work was performed under the direction of Keith O. Fultz, Associate Director. Other major contributors are listed in appendix I.

A handwritten signature in cursive script that reads 'J. Dexter Peach'.

J. Dexter Peach
Assistant Comptroller General

Executive Summary

Purpose

Since 1974, when India exploded a nuclear device using plutonium obtained by reprocessing civilian nuclear fuel, the United States has tried to strengthen controls over exports of nuclear technology and hardware in an effort to curb the spread of nuclear weapons. Today, reports of Israel's nuclear arsenal and Pakistan's development of nuclear weapons capability have heightened proliferation concerns.

Because the Department of Energy (DOE) is responsible for controlling the dissemination of reprocessing information, Senator William Proxmire asked GAO to examine DOE's controls over (1) the dissemination of reprocessing information, (2) the transfer of reprocessing technology to foreign countries, and (3) foreign nationals' involvement in sensitive nuclear programs.

Background

The Atomic Energy Act of 1954 places controls over the transfer to foreign countries of unclassified nuclear information that could be helpful to weapons production. The Nuclear Non-Proliferation Act of 1978 established additional controls. The 1978 act allows the transfer of sensitive nuclear technology—which includes, among other things, information that is unclassified, not publicly available, and important to the design of a reprocessing facility—only if the recipient country agrees to U.S. approval rights.

Through reprocessing, plutonium can be obtained from used nuclear fuel to produce a nuclear weapon. Since both plutonium and reprocessing also have commercial applications, the government declassified reprocessing technology and information in 1959.

DOE is the focal point for reprocessing activities in this country. It operates defense-related reprocessing facilities and conducts research in its own laboratories, at universities, and with foreign countries related to reprocessing applications. Currently, no commercial reprocessing plants exist or are planned in this country.

Results in Brief

DOE needs better controls over the dissemination of reprocessing documents because countries that pose a proliferation or security risk routinely obtain reprocessing information published by DOE. DOE tries to withhold some information that has trade value (applied technology) and could use this approach on a broader scale. However, the possibility exists that applied technology information could be obtained under the

Freedom of Information Act, and DOE needs to seek an exemption from that act to protect such information.

DOE has transferred to other countries information appearing to meet the definition of sensitive nuclear technology. Since DOE does not believe this information is sensitive nuclear technology, it has not obtained the required approval rights over the plutonium produced.

DOE places no restrictions on foreign nationals' involvement in DOE-funded reprocessing research at colleges and universities. Although DOE now funds only five such projects, the possibility exists that DOE could contribute to foreign expertise in this area.

Principal Findings

Dissemination of Reprocessing Information

Strong controls exist over the private sector's transfer of information related to the design, operation, and maintenance of commercial or defense reprocessing technology. The same is not true for similar types of information developed by DOE. In 1984 and 1985 DOE produced 258 reports, articles, and presentations related to reprocessing that could be obtained by anyone who wanted them (DOE withheld 24 others as applied technology). GAO found that (1) countries that pose a proliferation or security risk—such as China, India, Iraq, and Pakistan—obtained copies of this information, and (2) some documents contained new information that could benefit foreign nuclear programs, such as improved methods to purify plutonium to weapons-usable levels. If private firms had developed this information, its transfer to countries such as these four may not have been allowed, according to DOE officials.

DOE tries to control some significant reprocessing information as applied technology and does not routinely make this information available to the public. However, applied technology data are not exempt from disclosure under the Freedom of Information Act. Further, GAO found several instances that highlight potential problems with DOE's current use of the applied technology designation to control the distribution of this information. For example, in 1983 a Libyan national obtained two applied technology breeder reactor documents from a university professor, and DOE provided applied technology reprocessing documents to foreign countries outside established policies.

DOE could strengthen its controls over reprocessing information by (1) designating all reprocessing data as applied technology and (2) seeking legislation to exempt reprocessing data from disclosure under the Freedom of Information Act. Although DOE is considering some actions to strengthen its controls, it currently has no plans to expand the applied technology designation or seek the legislative exemption. (See ch. 2.)

Transfer of Sensitive Nuclear Technology

Through technical exchange activities conducted with DOE, countries obtain information that is important to reprocessing facilities and appears to meet the legislative definition of sensitive nuclear technology. Since 1984 DOE has conducted eight different reprocessing activities with foreign countries—five were directed at resolving design or operational problems.

The 1978 act does not preclude such activities, but does require that DOE obtain certain approval rights. DOE did not obtain these rights before providing the information because officials believe that the act allows them, in making sensitive nuclear technology determinations, to evaluate the importance of the assistance on a case-by-case basis considering the recipient country. GAO and others believe that the act requires DOE to make these determinations strictly on the basis of the technical importance of the assistance. GAO previously recommended that DOE establish regulations to delineate sensitive nuclear technology, but it has not done so. (See ch. 3.)

Foreign Nationals' Involvement

Foreign countries can obtain new reprocessing information through DOE-funded research at colleges and universities, and through visits to and assignments at DOE's nuclear facilities. Each year between 15,000 and 20,000 foreign nationals visit or are assigned to work at DOE's facilities. Of these, about 25 percent involve assignees or potentially sensitive visits. In 1983 DOE found that its monitoring of these activities had not been adequate, and significant energy information may have been lost to foreign countries. DOE began to take corrective action in October 1986 to resolve the problems, but officials could not estimate when the actions would be complete. Accordingly, GAO could not assess the effectiveness of DOE's corrective actions.

DOE places no controls on foreign nationals' involvement in unclassified DOE-funded university reprocessing research. DOE currently funds five such projects. Two involve foreign nationals—one from India, a country that has not signed a nonproliferation treaty. GAO previously reported

that such activities may present a proliferation concern and recommended that preference be given to individuals from countries adhering to nonproliferation requirements in DOE-funded nuclear research. (See ch. 4.)

Recommendations

GAO recommends that the Secretary of Energy

- seek a specific exemption from the Freedom of Information Act for reprocessing information developed by the Department concurrent with placing all new reprocessing information under the applied technology controls, and
- establish a policy to limit participation in DOE-funded reprocessing research at colleges and universities only to U.S. citizens and foreign nationals from countries that adhere to nonproliferation requirements.

Matters for Congressional Consideration

Disagreement exists over DOE's interpretation of sensitive nuclear technology as defined by the 1978 act. Although DOE's position concerning transfers to advanced nuclear countries has some merit, it is not supported by the act or its legislative history. Therefore, the Congress should consider amending the act to clarify the practices that DOE should use to identify and control the transfer of sensitive nuclear technology. (See ch. 3.)

Agency Comments

GAO discussed the facts in this report with DOE officials. Although the officials generally agreed with the facts presented, some officials disagreed with GAO's position on the need for better controls over the dissemination of reprocessing data and on DOE's implementation of the sensitive nuclear technology requirements. Their comments were incorporated where appropriate. As requested, GAO did not ask DOE to review and comment officially on this report.

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Abbreviations

DOE	Department of Energy
EMD	Energy and Minerals Division
GAO	General Accounting Office
IAEA	International Atomic Energy Agency
NNPA	Nuclear Non-Proliferation Act of 1978
NTIS	National Technical Information Service
OSTI	Office of Scientific and Technical Information
SNT	sensitive nuclear technology
UCNI	unclassified controlled nuclear information
UK	United Kingdom

Introduction

The proliferation of nuclear weapons remains a critical concern of the United States. Although relatively few countries have acknowledged the detonation and/or possession of a nuclear explosive device, other countries may have nuclear weapons or may be developing the capability to produce these weapons.¹ In fact, recently published data indicate that Israel possesses a nuclear arsenal and Pakistan is developing nuclear weapons capability.

In order to produce a nuclear weapon, a country must have the ability to design and construct these complex devices, as well as the means to acquire or generate the special nuclear material—enriched uranium or plutonium—needed in them. Consequently, to prevent the further proliferation of nuclear weapons, the United States classifies information related to their design and construction and restricts access to it. In addition, the United States attempts to control dissemination of the technology necessary to produce special nuclear material. However, the control of such technology is difficult because both nuclear weapons programs and nuclear power programs produce and use special nuclear material and employ similar facilities to obtain these materials. Although other technologies exist that are common to both weapons and commercial nuclear power programs, the technologies with the greatest proliferation risk are uranium enrichment and spent fuel reprocessing.

Enrichment is the process used to increase the concentration of the material needed to sustain a nuclear chain reaction. Natural uranium contains about 0.7 percent U-235, a fissionable uranium isotope. For most commercial reactors, this level of U-235 is not sufficient to achieve and maintain a chain reaction. Enrichment technology is used to increase the U-235 concentration to about 3 percent (termed low-enriched) for reactor fuel. However, this technology can also be used to produce high-enriched uranium (greater than 20 percent) that can be used directly in a nuclear weapon.

Reprocessing is the technology necessary for obtaining still-usable materials from spent (used) reactor fuel. The spent fuel removed from a nuclear reactor contains a mixture of unused uranium, highly radioactive waste products, and plutonium, a man-made element produced as a byproduct of uranium-fueled reactors. Because plutonium is a fissionable material that can be used in reactors, methods have been developed

¹China, France, Great Britain, India, the Soviet Union, and the United States have acknowledged the detonation of a nuclear device.

to reprocess spent fuel to extract the plutonium. However, plutonium can also be directly used in a nuclear weapon.

Although both of these technologies produce special nuclear material that can be used in weapons, the United States places classification restrictions on enrichment technology but not on reprocessing. As provided by section 141 of the Atomic Energy Act of 1954, as amended, the Department of Energy (DOE) controls the dissemination of nuclear information to protect the national defense and security. In accordance with this responsibility, DOE designates most information related to enrichment as "Restricted Data," a classification that limits its distribution to U.S. citizens holding proper security clearances and having a "need-to-know" the details of the technology. The Atomic Energy Act states that Restricted Data cannot be exchanged with other nations unless authorized by the President.

Until 1959 reprocessing technology was also classified as Restricted Data. In that year, the Atomic Energy Commission (predecessor to DOE) declassified reprocessing technology and information related to it. The Commission declassified this technology because it believed that reprocessing of spent reactor fuel would be an integral part of the fuel cycle for a large-scale commercial nuclear power program. In its declassification decision, the Commission stated that substantial information on reprocessing existed in the public domain, and greater benefit would be achieved through the development of reprocessing for commercial applications than through its continued classification because of proliferation concerns. Consequently, the only reprocessing data that DOE now classifies relate to the quantities and specifications of the plutonium that DOE produces for military purposes. All other reprocessing data related to either commercial or defense applications are unclassified.

However, the domestic and international nuclear arena has changed drastically since the Commission declassified reprocessing technology. Domestically, the anticipated role for reprocessing in the commercial nuclear industry has not materialized. In fact, U.S. commercial reprocessing efforts were indefinitely deferred in 1977 as part of President Carter's nuclear nonproliferation policy. Although President Reagan lifted the reprocessing deferral, no commercial efforts are anticipated in the foreseeable future. Internationally, however, the proliferation concerns of reprocessing have been realized. India exploded a nuclear device in 1974 that contained plutonium obtained from reprocessed research reactor fuel, and Israel's widely reported nuclear arsenal is believed to use plutonium from a secret reprocessing facility.

Concerns Over the Foreign Development of Reprocessing

The Atomic Energy Act established a policy to promote the development of nuclear energy for peaceful uses. This policy allowed the United States to assist foreign countries in unclassified nuclear research and commercialization. With the passage of the act and the establishment of the Atoms for Peace program in the early 1950s, the United States began to assist foreign countries to develop research and commercial reactors and provide training to foreigners in virtually all aspects of nuclear technology.

From the mid-1950s to the mid-1970s, the United States relied primarily on political commitments and international safeguards to control nuclear proliferation. The political commitments included “Agreements for Cooperation” between the United States and other nations that provide the basic framework for nuclear assistance, and two international treaties—the Nuclear Non-Proliferation Treaty and the Treaty for the Prohibition of Nuclear Weapons in Latin America (referred to as the Treaty of Tlatelolco)—under which each nonnuclear-weapon country agrees not to manufacture or otherwise acquire nuclear weapons. The international safeguards are administered by the International Atomic Energy Agency (IAEA), an autonomous organization of the United Nations. These safeguards attempt to account for all materials at nuclear facilities in IAEA’s 112 member countries through on-site inspections, remote surveillance, and material containment measures.

However, India’s 1974 explosion of a nuclear device caused the United States to reassess its nonproliferation controls because the plutonium used in the explosion was produced, albeit indirectly, with U.S. assistance. In order to reduce the risk of further proliferation, the Congress enacted the Nuclear Non-Proliferation Act of 1978 (NNPA) and provided stronger controls over the export of U.S. nuclear technology. In passing the act, the Congress found that the proliferation of nuclear weapons posed a grave threat to the security of the nation and an urgent and imperative need existed to prevent further proliferation. The Congress wanted effective and efficient controls established on the use of nuclear material and technology exported for peaceful purposes that would provide greater assurance against the diversion of materials and technology essential to the creation of, or the ability to create, nuclear weapons.

The NNPA substantially amended the Atomic Energy Act, revised the terms and conditions for U.S. nuclear cooperation with other countries, and committed the United States to a broad range of unilateral and international initiatives to curb proliferation risks. Among other things,

the NNPA required stronger domestic controls over nuclear-related exports.

Controls Over U.S. Assistance to Foreign Reprocessing Activities

Under the provisions of the Atomic Energy Act as amended by the NNPA, any reprocessing assistance provided to foreign countries must be approved by various federal organizations, depending on the type of assistance—hardware or technology. The Nuclear Regulatory Commission and the Department of Commerce license the exports of nuclear facilities, components, and other hardware. The Commission must license any exports of nuclear reprocessing facilities or specially designed components for such facilities. Components that have a dual use (applications to both nuclear and nonnuclear facilities) must receive a Commerce export license. Such dual-use components are also reviewed by DOE before Commerce issues a license.

Some assistance provided to foreign nuclear programs is not hardware but consists of the technology and know-how to build and operate nuclear facilities. Such assistance must be authorized by the Secretary of Energy. As stated in section 57(b) of the act:

“It shall be unlawful for any person to directly or indirectly engage in the production of any special nuclear material outside the United States except (1) as specifically authorized under an agreement for cooperation . . . or (2) upon authorization by the Secretary of Energy after a determination that such activity will not be inimical to the interests of the United States. . . .”

The act further provides that the Secretary can authorize an export only with the concurrence of the Department of State and after consultation with the Departments of Defense and Commerce, the Arms Control and Disarmament Agency, and the Nuclear Regulatory Commission. Activities requiring the Secretary’s authorization include facility designs and equipment manufacturing technology, engineering services, and the training of foreign nationals in nuclear technology (other than through courses given by universities).

In addition to the requirements of section 57(b), the NNPA added sections 127 and 128 to the Atomic Energy Act. These sections require that any exports that involve, among other things, the transfer of sensitive nuclear technology (SNT)—which the act defines as information that is not Restricted Data, is not publicly available, and is important to the design, construction, operation, or maintenance of a reprocessing,

enrichment, or heavy water production facility—must meet more stringent export conditions.² These conditions require that DOE obtain additional assurances from the recipient country regarding the nuclear equipment or materials produced through, or by the use of, the exported technology.

Section 57(b) of the Atomic Energy Act assigns DOE its basic authority and responsibility for controlling U.S. companies' involvement in foreign nuclear programs. The requirements of section 57(b), however, do not apply to DOE. Nevertheless, DOE must comply with the NNPA's requirements for transfers of SNT. DOE's Office of General Counsel has held that although DOE activities are not required to obtain a specific authorization from the Secretary under the section 57(b) implementing regulations, DOE must comply with the act's export conditions prior to any SNT transfers.

DOE Development and Dissemination of Reprocessing-Related Information

DOE is the primary focus of federal activities in nuclear technology areas. It is responsible for both the U.S. nuclear weapons programs and the research and development programs associated with nuclear energy. In this capacity, DOE conducts a number of reprocessing-related activities for both military and civilian applications, as follows:

- The Assistant Secretary for Defense Programs oversees the production of special nuclear material for nuclear weapons. This office manages reprocessing facilities that are operated in conjunction with production activities and conducts research to improve current processes for separating plutonium from waste products and processing plutonium for weapons use.
- The Assistant Secretary for Nuclear Energy administers DOE's civilian nuclear programs, including programs related to civilian nuclear fuel reprocessing. This office conducts research to improve the economics, safety, and safeguards (mechanisms that account for the special nuclear material produced and help deter the diversion of material to weapons use) of reprocessing facilities. Currently, DOE focuses predominantly on reprocessing research related to liquid metal fast breeder reactor fuels, which use a uranium-plutonium fuel cycle. This office also conducts cooperative nuclear technology exchange activities with foreign countries, including technical exchanges involving reprocessing technology.

²Heavy water (deuterium) is used in certain reactors that operate on natural uranium and produce plutonium without enriched fuel.

- The Office of Energy Research manages DOE's research in basic energy sciences, including the separation of the actinide elements (elements such as plutonium and uranium). This research may not directly involve reprocessing but may relate, and be useful, to reprocessing applications.

Reprocessing activities and research conducted by DOE are performed at its laboratories, or in some cases are contracted out to universities. Further, reprocessing-related research performed with other countries is conducted in DOE laboratory facilities and/or facilities in the foreign countries.

Federal reprocessing activities, although reduced in scope from previous years, are still considerable. During fiscal year 1986, DOE spent \$464 million on reprocessing activities related to weapons production, \$15 million on activities related to commercial reprocessing applications, and \$1.3 million in basic research related to the separation of actinide elements.

Objectives, Scope, and Methodology

On May 1, 1986, we issued a report to the Chairman, Subcommittee on Energy Conservation and Power, House Committee on Energy and Commerce, and Senator William Proxmire that discussed DOE's implementation of its regulations governing the foreign transfer of nuclear technology by U.S. firms.³ Subsequently, in a letter dated July 8, 1986, Senator Proxmire asked us to examine DOE's activities that may assist a foreign country in the development of nuclear weapons material. As agreed with the Senator's office, we reviewed DOE's activities related to reprocessing and addressed the following questions:

- Are DOE's controls over the dissemination of reprocessing-related information adequate?
- Does DOE effectively enforce the SNT provisions of the Atomic Energy Act on its own transfers of technology to foreign countries?
- Does DOE have sufficient controls over foreign national involvement in its reprocessing activities?

To address the question regarding DOE's controls over the dissemination of reprocessing information, we (1) reviewed DOE's information on historical and current systems to control reprocessing data, (2) assessed the significance of data placed in the public domain, the users of the data,

³Nuclear Nonproliferation: DOE Has Insufficient Control Over Nuclear Technology Exports (GAO/RCED-86-144, May 1, 1986).

and the comparability of DOE's controls on itself and those it imposes on the private sector, and (3) evaluated DOE's controls over reprocessing data not placed in the public domain. With regard to historical and current systems for controlling reprocessing data and methods for providing additional controls, we discussed the status of reprocessing technology, the purpose of DOE's reprocessing research activities, the review procedures for publishing reprocessing-related information, and the significance of the information being developed from both a commercial development and a weapons proliferation perspective with officials in DOE's Offices of Nuclear Energy, Defense Programs, and General Counsel. We also reviewed relevant DOE regulations, orders, and correspondence related to the dissemination of nuclear-related information, as well as historical records related to the declassification of reprocessing technology.

On the basis of DOE records, we identified 279 reprocessing-related documents published in 1984 and 1985. Of these, DOE made 256 available to the public; we selected 15 for detailed review to determine the significance of the information being published. Because we wanted to determine whether the information could be beneficial to foreign reprocessing efforts, we selected the 15 documents on the basis of whether they discussed reprocessing problems, improvements, or research activities. Our selection was not based on a statistical sample, and we do not imply, nor do we believe, that our review results can be applied to all reprocessing data published by DOE.

To assess the significance of the 15 documents selected, we reviewed each document to determine whether it contained information related to new reprocessing technology or to resolving operational reprocessing problems. Further, we discussed the benefits of new reprocessing data to foreign nuclear programs with two university professors with nuclear engineering/chemistry backgrounds, five representatives of organizations involved with proliferation concerns such as the Natural Resource Defense Council and the Federation of American Scientists, and officials at the Department of Defense, Arms Control and Disarmament Agency, and Nuclear Regulatory Commission with nuclear nonproliferation oversight responsibilities. Where possible, these individuals performed a detailed review of the documents.

To determine the users of the information published by DOE, we obtained from the National Technical Information Service a listing of purchasers of all U.S.-generated reprocessing data through a subscription method established by the Service. We also obtained listings of purchasers of

various individual reprocessing documents published by DOE and made available to the public through the Service. To assess the comparability of DOE's controls with the controls it places on the private sector, we compared the information contained in the documents with the requirements established by DOE's regulations governing private-sector technology exports. We also asked DOE officials in the Office of Defense Programs responsible for the implementation of these regulations to review the selected documents to obtain their perspective on whether this information would have been authorized for export if it had been developed and disseminated by the private sector.

Further, to evaluate DOE's controls over reprocessing data not placed in the public domain, we obtained DOE's procedures for controlling the data, official distribution lists for such data, and records on documents officially provided to foreign countries. We also discussed the control of such data with DOE officials from its Office of Scientific and Technical Information in Oak Ridge, Tennessee.

To address whether DOE effectively enforces the SNT provision of the Atomic Energy Act on its own activities, we discussed with DOE Office of Nuclear Energy officials the reprocessing activities that DOE conducts with foreign countries, the scope of these activities, and the benefits derived. We obtained a DOE list of all the cooperative research activities it conducts with foreign countries, obtained copies of all the agreements that relate to nuclear reactor and/or fuel cycle research, and determined which agreements related to reprocessing. We then discussed with DOE Office of Nuclear Energy officials each of the specific cooperative activities being conducted that related to reprocessing. We also visited the Oak Ridge National Laboratory, which conducts these activities as part of DOE's Consolidated Fuel Reprocessing Program, to discuss the activities in more detail with laboratory officials. We reviewed relevant records and other available data on the activities being conducted.

To assess the SNT implications of these activities, we utilized data we had previously obtained for our May 1, 1986, report.⁴ We also discussed DOE's interpretation of the SNT provision with DOE officials from the Office of Nuclear Energy as well as congressional staff who had been instrumental in drafting the NNPA. We compared DOE's cooperative activities in the reprocessing area with the SNT criteria established by the act. We also discussed the SNT provision with officials involved in nuclear

⁴GAO/RCED-86-144.

nonproliferation at the Department of Defense, Arms Control and Disarmament Agency, and the Nuclear Regulatory Commission. Finally, we reviewed DOE's December 1986 revision to its regulations governing unclassified assistance to foreign nuclear activities and assessed how well the revision met the recommendation we made in our previous report that DOE develop criteria for identifying sensitive nuclear technology.

To determine how DOE limits foreign nationals' involvement in reprocessing, we discussed with DOE officials in the Office of Defense Programs and the Office of International Affairs and Energy Emergencies the various methods by which foreign nationals can be involved in DOE's nuclear programs. We discussed with them the policy and procedures DOE uses to control foreign national participation in its nuclear activities. We obtained from DOE a list of foreign nationals working directly for DOE's nuclear facilities in sensitive nuclear areas and obtained from each DOE facility involved in sensitive nuclear activities listings of foreign nationals who were either visitors or assignees at each facility. Further, we identified five DOE-funded research efforts being conducted at universities that related to reprocessing and contacted each university to determine if foreign nationals were involved in these activities. We also obtained and reviewed two DOE studies that addressed the issue of foreign national involvement at DOE facilities and discussed this issue with members of a DOE task force that examined policies and procedures for controlling the involvement of foreign nationals in DOE nuclear research activities.

We discussed the facts in this report with DOE officials from the Offices of Nuclear Energy, Defense Programs, General Counsel, and International Affairs and Energy Emergencies. Although these officials generally agreed with the facts presented, some officials disagreed with our position on the need for better controls over the dissemination of reprocessing data and our position on DOE's implementation of the sensitive nuclear technology requirements. Their comments were incorporated where appropriate. As requested, we did not ask DOE to review and comment officially on a draft of this report. Our work was performed between July 1986 and April 1987 and in accordance with generally accepted government auditing standards.

Controls Over the Dissemination of DOE Reprocessing Information Need to Be Strengthened

DOE has little control over the dissemination of information related to the design, operation, and maintenance of commercial or defense reprocessing technology that it produces. Because reprocessing technology is not classified, most of DOE's reprocessing-related information is readily available to anyone who wants it. As a result, DOE publishes new and potentially significant reprocessing information that is being purchased by countries that the United States considers a proliferation risk, such as Pakistan.

DOE does attempt to withhold some important reprocessing information—termed applied technology—from public dissemination. DOE controls the distribution of these documents to keep the information in domestic hands and thereby retain its foreign trade value. However, instances of weaknesses in DOE's control over applied technology exist. For example, applied technology documents have been found in the possession of a Libyan national and have been provided by DOE officials to foreign countries without adherence to agency procedures for doing so. In addition, applied technology documents can be obtained under a Freedom of Information Act request. Although the Department of Defense has a Freedom of Information Act exemption for some of its comparably sensitive unclassified information, DOE has not sought such an exemption.

Few DOE Controls Over the Public Dissemination of Reprocessing Information

Substantial controls exist over private-sector dissemination of reprocessing information. The private sector itself ensures that it does not disclose information that could enhance its competitors. As discussed by DOE in its comments on a 1980 GAO report,¹ companies do not publicize their information since the commercial value of such information is reduced, if not destroyed, if the information is made available to the public. Consequently, foreign countries must purchase reprocessing data and knowledge possessed by U.S. firms. Such purchases of reprocessing information and technology must be approved by the Secretary of Energy in accordance with the requirements of section 57(b) of the Atomic Energy Act.

DOE's regulations implementing these requirements mandate that any transfer of reprocessing information, unless it is already publicly available, must be reviewed by DOE and other federal agencies involved in non-proliferation oversight to ensure that such a transfer is not "inimical",

¹Evaluation of Selected Features of U.S. Nuclear Non-Proliferation Law and Policy (EMD-81-9, Nov. 18, 1980).

Chapter 2
Controls Over the Dissemination of DOE
Reprocessing Information Need to
Be Strengthened

or detrimental, to the interests of this country. Information that would require specific authorization includes any proprietary data related to reprocessing plant design, systems, and equipment; technical embellishment or enhancement that is itself not publicly available; and knowledge or “know-how” gained through experience with reprocessing applications or research.

In contrast, the controls over the dissemination of reprocessing information that DOE develops for either commercial or defense-related applications are not as strong. According to officials from DOE’s Offices of Defense Programs and General Counsel, DOE is required to make this information available to the public. They point out that section 3 of the Atomic Energy Act directs DOE to provide for the dissemination of unclassified information to encourage scientific and technical progress. Consistent with the provision of this act, DOE policy is to make available as much scientific and technical information as security, patent, and policy considerations permit.

Further, the General Counsel and Defense Programs officials added that DOE can withhold data from the public only if it is (1) classified or (2) has been otherwise granted a specific exemption from the Freedom of Information Act. In this regard, section 148 of the Atomic Energy Act provides such an exemption for information that meets the criteria established for unclassified controlled nuclear information (UCNI) and establishes penalties of up to \$100,000 for its unauthorized disclosure. The UCNI control was established because of concerns over terrorist or other acts against nuclear defense facilities and is limited to information concerning atomic energy defense programs. Specifically, it prohibits the unauthorized dissemination of unclassified information relating to the (1) design of nuclear defense facilities, (2) security measures for such facilities or the nuclear material in such facilities, or (3) design, manufacture, or utilization of any nuclear weapon as UCNI. According to DOE officials, the only reprocessing technology that could fall within the current UCNI criteria would be information involving reprocessing-related activities at defense facilities. However, under DOE’s current regulations implementing the UCNI statute, these activities are not included.

Since reprocessing technology does not qualify as UCNI, virtually all reprocessing information developed by DOE is made publicly available through reports, articles, and presentations. According to information maintained by DOE’s Office of Scientific and Technical Information (OSTI) in Oak Ridge, Tennessee, DOE published 161 and 97 reprocessing reports, articles, and presentations in 1984 and 1985, respectively. Information

contained in these documents and presentations includes data related to breeder reactor reprocessing research, defense reprocessing activities, reprocessing component development, and basic research related to new reprocessing technology.

DOE does, however, attempt to control its most significant reprocessing information. Although it cannot prohibit access to reprocessing information, DOE and its predecessor agencies have limited since 1965 the distribution of unclassified scientific research results through an administrative control called applied technology. Under this control, information relating to technological advances on particular projects or facilities that DOE believes can be traded with other countries is designated applied technology and the existence of this information is not announced to the general public.

DOE's Office of Nuclear Energy has designated three categories of nuclear research that could generate applied technology: consolidated fuel reprocessing (primarily reprocessing for breeder reactors), nuclear converter reactor fuel cycle (including reprocessing), and liquid metal fast breeder reactor research. During 1984 and 1985, DOE produced 24 reprocessing documents that were given controlled distribution as applied technology. As of October 1986, DOE had a total of 421 reprocessing-related documents that had been designated as applied technology. Although DOE does not publicly distribute applied technology information, it is not exempt from the Freedom of Information Act. To date, however, DOE has not received an information act request for applied technology information related to reprocessing.

Information Released by DOE May Benefit Foreign Reprocessing Programs

During 1984 and 1985, DOE and its contractors placed in the public domain 258 articles, presentations, and reports that related to nuclear materials reprocessing. Our examination of 15 of these documents showed that the information included new reprocessing data on technical advances and solutions for operational problems that, in the view of some nuclear experts, could assist foreign nuclear programs. In addition, we found that foreign countries viewed by DOE as a proliferation risk routinely obtain these documents. If private firms had developed these documents, it is unlikely that they would have been approved for transfer to these proliferation-risk countries under DOE's nuclear technology transfer regulations.

Potentially Significant Reprocessing Information Being Released by DOE

Substantial information has already been published regarding the design, construction, and operation of reprocessing plants. However, according to DOE officials and reprocessing experts, this information alone is not sufficient to construct a reprocessing plant. Additional information and know-how is needed to complete a plant and to maintain efficient and reliable operations. Many problems occur with reprocessing plants that limit their operation, as illustrated by Pakistan's apparent inability to complete and operate a partially built reprocessing plant.

The reprocessing information published by DOE may help resolve technical reprocessing problems facing foreign countries or improve activities to recover and purify plutonium. Eight of the 15 DOE reprocessing documents we reviewed provided information related to resolving operational reprocessing problems or improving the technology, as illustrated in the following examples:

- One paper addressed the problem of solvent (the solution that separates plutonium and uranium from waste products) degradation caused by acid and radiation and discussed procedures for removing degradation products. Solvent degradation reduces reprocessing plant efficiency, creates equipment problems, and can lead to plutonium losses.
- Another paper addressed the design of plates in a pulse column, a major component of reprocessing plants, and discussed various designs that could improve their performance. Pulse columns are the components that actually separate plutonium and uranium from waste products.
- A third paper discussed the hydraulic characteristics of an improved centrifugal contactor, an advanced technology for separating plutonium and uranium from fission products.

We discussed the significance of new DOE reprocessing information with university and other federal agency officials and public interest group representatives. They agreed that publication of this information could potentially assist the reprocessing efforts of foreign countries. For example, one university official compared the data in the documents to information available in a college reprocessing textbook. He said that the book, published in 1981, contained much of the up-to-date information available at that time. However, the items discussed in the 1984 and 1985 DOE documents, such as improved solvent cleanup and advanced centrifugal contactors, go beyond the information contained in the text. Further, one Defense Department official stated that one condition for publication, particularly in journals or international seminars, is that

information presented must be new and contribute to the overall knowledge base of the particular subject. Therefore, he said it is difficult to argue that the information DOE develops is not beneficial to foreign reprocessing efforts.

Officials of public interest groups expressed similar concerns. They stated that, because of the high cost to build reprocessing plants and the multiplicity of operational problems associated with them, current reprocessing technology serves as a form of proliferation control. However, in their view, the publication of any information that resolves these difficulties could significantly assist foreign reprocessing efforts. One official added that the publication of these data takes on extra significance over time. He said that although one document by itself may not provide information on an easier method for reprocessing, the accumulation of new data over a period of years may result in the publication of significant improvements in reprocessing technology. Further, the two university officials with a knowledge of reprocessing systems stated that many problems exist with the practical application of reprocessing technology, and information that discusses reprocessing problems and solutions may help other countries avoid “blind alleys” and shorten the time needed to develop their reprocessing capability.

DOE Reprocessing Information Obtained by High Proliferation-Risk Countries

Although DOE publishes documents involving nuclear technology, the actual sale of such documents is performed by the National Technical Information Service (NTIS), a branch of the Department of Commerce. NTIS is the central source for the public sale of U.S. government-sponsored research, development, and engineering reports. Complete texts of such reports are sold in printed form and on microfiche. In addition to sales of documents to individuals, NTIS sells subscriptions for certain categories of information it has established. Subscribers receive all documents in each data category for which they have a subscription. NTIS sells subscriptions related to reprocessing under the categories “Nuclear Fuel Cycle” (printed copies) and “Reactor Fuels and Fuel Processing” (microfiche copies). NTIS sells this information to both foreign and domestic customers.

NTIS records show that reprocessing documents are being purchased by foreign countries, including some that have been identified by DOE as a proliferation and/or security risk. At our request, NTIS searched its records to determine purchasers of all copies of DOE-developed reprocessing information through subscriptions. According to NTIS records, the majority of the purchasers of this information are foreign countries. As

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shown in table 2.1, 25 of the 43 subscriptions are sent to foreign addresses or to domestic addresses of organizations representing foreign governments or firms. Further, 2 of the remaining 18 purchasers are information clearinghouses that may sell the information to foreign countries.

Table 2.1: Purchasers of Reprocessing Documents Through NTIS Subscription Services

	Total	U.S. purchasers	Clearing-houses	Foreign purchaser
Printed copy subscriptions	25	9	•	16
Microfiche subscriptions	18	7	2	9
Total	43	16	2	25

At our request, NTIS also identified the purchasers of individual copies of 18 reprocessing reports being sold through NTIS. According to its records, 29 individual purchases had been made of these documents. Foreign countries obtained 17 (59 percent), while 12 were obtained by U.S. companies or DOE laboratories.

Some of the foreign countries that are purchasing DOE reprocessing information are viewed as a proliferation or security risk. Four countries that purchase reprocessing documents through subscription—China, India, Iraq, and Pakistan—have been identified in DOE’s regulations governing private sector technology transfers as proliferation and/or security risks because they have not agreed to the Nuclear Non-proliferation Treaty, have not placed all their nuclear facilities under IAEA safeguards, and/or are in volatile or sensitive areas. Further, both Taiwan and South Korea obtain reprocessing documents through subscription. Although DOE does not include these on its list of restricted countries, it has stated that the development of reprocessing in these two countries would pose a potential proliferation concern.

Information Not Transferrable Under DOE Export Regulations

The Atomic Energy Act exempted DOE from meeting the section 57(b) authorization requirements for transfers of nuclear technology and information to foreign countries. Consistent with the provisions of the act, DOE’s regulations implementing these technology transfer controls—10 CFR 810—apply only to individuals and entities other than itself. However, if these regulations did apply to DOE, it is unlikely that some foreign countries could have obtained DOE-developed reprocessing documents.

DOE's regulations contain a general authorization that allows the transfer of reprocessing information to a foreign country without specific authorization from the Secretary of Energy if the information is available to the public. In this regard, DOE's regulations provide that public information "does not include any technical embellishment, enhancement, explanation or interpretation which in itself is not public information. . . ." However, 10 of the 15 DOE-developed reprocessing documents we reviewed contained such embellishments, enhancements, explanations, or interpretations, as illustrated in the following examples:

- One document discusses problems with solvent degradation during reprocessing plant operations. This paper reviews the problems encountered, discusses methods for minimizing degradation products, evaluates solvent clean-up options, and makes recommendations for improved solvent clean-up.
- Another document discusses methods to recover plutonium from plutonium nitrate (a process step after plutonium has been separated from other products). This document summarizes experimental work to obtain optimum performance from a system designed to aid in semicontinuous operation and reduce operating problems, and contains conclusions as well as recommendations for the design of such equipment.
- A third document discusses processes for converting impure plutonium into high-purity plutonium. This report details a pyrochemical process for removing impurities in plutonium oxide, metal, and scrap that produces 95-percent-pure plutonium that is suitable for weapons production.

DOE officials responsible for reviewing and processing authorization requests stated that if private firms or individuals had developed these documents instead of DOE and had requested DOE authorization to transfer them to foreign countries, they could see little possibility that the Secretary would have authorized sending the documents to countries such as Pakistan, India, and Iraq. They point out that current administration policy prohibits assistance to the reprocessing programs of these countries.

Officials with nonproliferation oversight responsibility at the Nuclear Regulatory Commission, the Arms Control and Disarmament Agency, and the Department of Defense agreed that DOE's dissemination of reprocessing information that addresses technical problems and presents solutions was not consistent with the section 57(b) controls on the transfer of reprocessing technology to other countries. Defense officials expressed particular concern that countries such as Pakistan are

obtaining this type of information. In their view, it is only logical that countries developing reprocessing capabilities will encounter the same technical problems as does the United States. Therefore, DOE's information could save these countries time and resources to not only develop but also resolve problems with their reprocessing facilities.

Officials from all three agencies added that they have the opportunity to review proposed information transfers by the private sector and provide their opinions on the authorization decisions made. They have no oversight, however, concerning DOE's actions that disseminate similar information. They stated that DOE should be subject to the same standards and reviews as is the private sector.

Applied Technology Not Fully Effective in Controlling Sensitive Information

DOE does not routinely disseminate all its reprocessing data. The most significant reprocessing information that it develops is designated as applied technology and withheld from public distribution. Reprocessing information that DOE has designated as applied technology includes information on key reprocessing steps and equipment, such as head-end shearing, dissolvers, and fuel disassembly, as well as new processing steps. This information is not provided to other countries unless the United States receives information of equal significance in return. However, limited distribution of this information is made to various DOE and laboratory officials, as well as some U.S. commercial firms, in order to disseminate knowledge of technology advancements.

However, applied technology is not a category of information exempt from disclosure under the Freedom of Information Act. According to DOE's Office of General Counsel, under the provisions of this act, DOE must make available all government information unless the information is classified or specifically exempted from the Freedom of Information Act requirements. Consequently, DOE must provide applied technology information to any person who requests it.

To date, DOE has not received a Freedom of Information Act request for applied technology information related to reprocessing. OSTI officials responsible for controlling the distribution of these documents stated

that they occasionally receive requests for these documents from companies, universities, and foreign countries that do not invoke the Freedom of Information Act.² In those cases, they consult with the appropriate DOE program office to determine whether the document should be provided. They stated that these decisions are based on who requested the information and the reasons why the information is needed; however, not all requests have been approved. Nevertheless, if these requests were made under the Freedom of Information Act, it is DOE's position that such requests would have to be honored.

Instances of Weak Control Over Applied Technology

No evidence exists that reprocessing-related applied technology documents or information have been provided to foreign countries that are a proliferation or security risk. However, we found three instances that highlight potential problems with DOE's using the applied technology designation to control reprocessing information. These are discussed below.

- In 1983 the Customs Service detained a Libyan national in Detroit who was attempting to leave the country. The Customs Service found two applied technology documents in the Libyan's possession. According to DOE officials at OSTI, the Libyan picked up the documents from the office of a university professor who was on the distribution list for certain applied technology documents. An OSTI official stated that the applied technology documents related to breeder reactors and not reprocessing. Nevertheless, he pointed out that DOE has no mandatory controls over applied technology documents after they are distributed. Further, since possession of applied technology documents does not violate any law, DOE could not seek prosecution of the Libyan for taking these documents.
- DOE maintains a distribution list of individuals and organizations that routinely receive applied technology documents. We found that a DOE-contractor employee with a suspended security clearance was on the distribution list for certain reprocessing-related applied technology documents. DOE suspended the clearance in March 1986 as a result of potential concerns about the employee's contacts with foreign countries. As of March 1987, this employee was still on the distribution list to receive applied technology documents. We brought this matter to DOE's attention, and DOE has now removed this individual from the distribution list.

²Until 1980, new applied technology reports were identified in DOE-developed abstracts available to the public. Therefore, the existence of applied technology documents developed before that time is publicly known.

- DOE Order 1430.2 (Dec. 13, 1983) establishes procedures for the internal handling of applied technology documents. The order states that only OSTI can make external distribution of applied technology reports outside the originating organization, and it is to maintain a complete inventory of documents sent to foreign countries. DOE has, however, distributed applied technology documents to foreign countries outside the established procedure. DOE documents show Office of Nuclear Energy and/or the Oak Ridge National Laboratory provided applied technology reports to Japan and the United Kingdom, but OSTI records do not show that it conducted the document transfer. In addition, OSTI officials told us they were not even aware of the transfers.

According to OSTI officials, these problems are not indicative of weaknesses in its overall control of applied technology; nevertheless, they do highlight the potential problems with controlling access to applied technology without a specific legislative mandate. They pointed out that DOE does place a notice on the cover of applied technology documents, but the notice only states that the release of applied technology to foreign countries should be coordinated with DOE; it does not prohibit such disclosure. These officials believe that individuals knowledgeable about the applied technology category and its intent are not likely to disclose this information, but they admit that they cannot prohibit the dissemination of applied technology information by those who receive it.

Options for Providing Stronger Controls Over Reprocessing Information

DOE's strongest control over reprocessing information is to classify such information and limit access to it. As discussed in chapter 1, the Atomic Energy Act allows DOE to restrict dissemination of information related to the production of special nuclear material by designating the information as Restricted Data and thereby limiting its distribution. The government declassified reprocessing information in 1959. Although the Atomic Energy Act did not specifically address whether information that was removed from the Restricted Data category could be reclassified, section 11(y) of the act excludes from the definition of Restricted Data any information "declassified or removed from the Restricted Data category pursuant to section 142." On the basis of this definition, DOE's Office of General Counsel has held for many years that once specific information has been removed from the Restricted Data category, it can never again be considered Restricted Data. DOE's Office of General Counsel has also held that such information cannot be controlled under other classification categories, such as National Security Information.³

³We did not assess the validity of DOE's position on the reclassification issue.

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Nevertheless, mechanisms exist that DOE could pursue to control the dissemination of reprocessing information. Specifically, DOE could (1) seek legislatively authorized controls exempting reprocessing information from the Freedom of Information Act and (2) establish stronger administrative controls over its practices for disseminating this information.

DOE Office of General Counsel and Defense Programs officials told us that there are two options for exempting reprocessing information from the Freedom of Information Act. First, DOE could modify the UCNI regulations to include reprocessing. According to DOE officials, its regulations for implementing the currently existing UCNI requirements (section 148 of the Atomic Energy Act) could be expanded to include reprocessing-related activities at defense facilities. They point out, however, that broadening the UCNI regulations would likely not cover commercial reprocessing data or basic research in reprocessing areas since by statute UCNI is restricted to atomic energy defense programs. Consequently, legislative action would be necessary to ensure that all reprocessing data could be protected under this provision.

Second, DOE could obtain a specific legislative exemption from the Freedom of Information Act for reprocessing data. DOE General Counsel and Defense Programs officials remarked that the Department of Defense has been granted this type of exemption for unclassified information with military or space applications under its control. They believe that a similar provision could protect reprocessing information.

In conjunction with obtaining a Freedom of Information Act exemption for reprocessing technology, DOE could further restrict its practices for disseminating reprocessing data. As discussed earlier, DOE makes the majority of the reprocessing information it develops publicly available. DOE could, however, expand the procedures it has for limiting the distribution of certain kinds of information. DOE Order 1430.2 (Implementation of the Scientific and Technical Information Management Program, Dec. 13, 1983) requires that all DOE documents pertaining to research results be reviewed before issuance and that special distribution controls be placed on information that is classified, contains patentable data, is UCNI, or is designated applied technology. The DOE officials said that a specific exemption for reprocessing data from the information act, along with a designation of reprocessing data as information subject to special distribution controls, would provide a mechanism to limit further disclosure of reprocessing information.

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Officials from DOE's Offices of General Counsel and Defense Programs said that the imposition of stronger controls over reprocessing information appears warranted. They point out that stronger controls would better ensure that proliferation-risk countries are not obtaining indirect assistance from the United States. These officials acknowledged that although substantial information on the design, construction, and operation of reprocessing plants exists in the public domain, problems have to be overcome in any fledgling reprocessing program. Any information that contributes to solving such problems or improving the technology can only aid foreign countries' reprocessing efforts. They added that reprocessing technology and know-how is as important as the actual hardware; thus, controlling DOE-developed reprocessing data is a logical step in reducing the flow of such information.

Although DOE General Counsel and Defense Programs officials believe stronger controls over reprocessing information are necessary and beneficial, officials of DOE's Office of Nuclear Energy disagree. In their view, (1) the reprocessing information placed in the public domain is not significant and only relates to refinements of existing technology and (2) the applied technology controls placed on the most significant reprocessing data have been effective in controlling the disclosure of this type of information. Consequently, they see little benefit to stronger controls. They stated that enough reprocessing information exists for any country to develop and use this technology should it desire to do so, and actions now to limit the spread of reprocessing technology would be about 30 years too late. Further, they point out that controls would limit the open exchange of reprocessing information between the U.S. and other advanced nuclear nations and could have a negative impact both on maintaining domestic reprocessing expertise and influencing the reprocessing activities of other countries.

Despite these conflicting positions, DOE is considering some action to strengthen its controls over the dissemination of reprocessing information. The Office of Defense Programs is considering placing some advanced, defense-related reprocessing activities within the scope of the regulations implementing the UCNI controls. The official developing the regulations to implement these controls said that concerns have been raised within DOE about some reprocessing technology, particularly pyrochemical reprocessing technology. Therefore, DOE is examining whether this information, and what aspects of it, should be controlled as UCNI.

DOE currently, however, has no plans to seek legislative authority to increase its controls over reprocessing information. Officials from the Office of Defense Programs and the Office of General Counsel stated that they have not contemplated seeking such authority in the form of a revision to section 148 of the Atomic Energy Act or a specific exemption from the Freedom of Information Act.

Conclusions

The Atomic Energy Commission declassified reprocessing technology and information in 1959 because it viewed reprocessing as an integral part of the optimistic future for nuclear power. By the mid- to late-1970s, however, commercial nuclear power played a much smaller role than previously projected, and the expected need for commercial reprocessing capability in this country has not materialized. During that time, concerns over the proliferation risks associated with reprocessing increased. As a result, the Congress passed the NNPA and established as the act's overall objective the efficient and effective control over the proliferation of nuclear explosive capability.

Much important information on reprocessing technology exists now and has been made available here and in other countries. Nevertheless, although there is some disagreement within DOE over the significance of new reprocessing data, it appears clear that information that DOE has or is developing through research could provide assistance to foreign reprocessing programs. DOE's information can improve the safety, efficiency, and reliability of reprocessing operations; it can result in reprocessing activities that cost less; and it can reduce the potential environmental hazards of this technology. Such information may benefit this country's defense-related reprocessing activities or, in the longer term, commercial reprocessing. Unless carefully controlled, however, this information can also benefit other nations—some of which pose a proliferation risk—that could use it in their efforts to separate plutonium for weapon purposes.

DOE's controls over reprocessing information that could benefit foreign nuclear programs are inadequate. The Atomic Energy Act, as amended by the NNPA, establishes strong controls over the dissemination of reprocessing information, technology, and expertise to foreign countries by non-DOE organizations. However, similar information developed or possessed by DOE is not under equally strong controls. DOE only controls its most significant reprocessing information—under the designation of applied technology—because it has trade value with other countries. Although the applied technology designation provides limited control, it

is not sufficient. DOE must release applied technology information to the public through Freedom of Information Act requests. Therefore, any person—whether or not a U.S. citizen—can obtain these documents with no prohibition on transferring them to a foreign country. DOE places all other reprocessing information that it develops in the public domain. Experts believe that much of this information could be beneficial to a foreign reprocessing program.

Our major concern with DOE's lack of control over reprocessing information is that it does not afford the United States the assurance that the data we develop is used only to assist our nuclear program or the nuclear programs of other nations that we have decided, as a matter of national policy, to assist. Although we recognize this country's policy to advance science by disseminating new information, new reprocessing information could be used by countries, such as Pakistan, that have not agreed to the Nuclear Non-Proliferation Treaty, do not have full-scope IAEA safeguards (safeguards on all their nuclear facilities), and/or have exhibited questionable motives for undertaking advanced nuclear programs.

Our evaluation of DOE's controls over reprocessing information shows that these concerns are warranted. First, the reprocessing information DOE places in the public domain contains new and potentially significant information, and such information is being openly purchased by countries DOE has identified as posing a proliferation risk without assurances that the technology will be used only for peaceful purposes. Further, DOE itself would likely not have allowed this information to be transferred to these countries had the transfer been conducted by the private sector. Second, with regard to information DOE tries to control as applied technology, weaknesses in this form of control are evident, as illustrated by the incidents of the Libyan found with applied technology documents and the DOE-contractor employee who no longer held a security clearance because he posed a security risk but remained on the distribution list for certain reprocessing-related applied technology documents.

We recognize that DOE is currently required to make available much of the reprocessing information it develops. However, options exist under which DOE could impose stronger control over reprocessing information and, in our opinion, provide considerable benefits to the United States' nonproliferation efforts. DOE can, for example, obtain an exemption to the Freedom of Information Act for reprocessing data and only make it available to countries meeting high nonproliferation standards. By doing so, DOE would

- better ensure that reprocessing information that it develops is available only to countries that the United States decides, as a matter of policy and in accordance with applicable statutes, to assist in their reprocessing efforts;
- reduce the likelihood of any indirect assistance to the nuclear programs of countries that pose a nuclear weapons proliferation risk; and
- remove the inconsistency between the controls over DOE's dissemination of reprocessing information and the controls placed on private-sector activities.

Although we anticipate that DOE or others may raise some concerns over limiting the dissemination of unclassified information developed with federal funds, we believe that little overall detriment to the U.S. nuclear program would occur from limiting the dissemination of this information. No enterprise exists in this country outside of DOE that is interested in pursuing reprocessing on a commercial basis and, consequently, little, if any, harm would come to U.S. industry. Further, if the private sector wanted such data, DOE could make it available on a need-to-know basis, similar to the approach it has taken on restricted enrichment data in the past.

Limitations on the open exchange of information with foreign countries may also have some detrimental effects. The most significant is the possibility that the U.S. would be limited in its efforts to influence other nuclear programs if stronger controls over reprocessing data were applied. However, DOE could still provide reprocessing information, as it currently does with applied technology, on a country-by-country basis as a policy decision, without putting such information in the public domain for any country to readily obtain.

Recommendations

To make its controls over reprocessing information more consistent with those placed by the Atomic Energy Act on the private-sector transfer of reprocessing information to foreign countries, as well as to ensure that DOE-developed reprocessing information does not assist high-proliferation-risk countries, we recommend that the Secretary of Energy take the following actions:

- Seek an exemption from the Freedom of Information Act for all reprocessing technology developed by the Department. Such an exemption can take the form of a revision to section 148 of the Atomic Energy Act or a provision specifically exempting reprocessing data from the information act.

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- Concurrent with the action above, limit the public dissemination of reprocessing data by placing all new reprocessing data in the applied technology category and make it subject to the special distribution controls specified in DOE Order 1430.2.

Better Enforcement Needed Over Transfer of Sensitive Nuclear Technology

In some instances, DOE has not enforced the SNT export conditions on activities it conducts with foreign countries under technical exchange agreements. The NNPA created the category of SNT and required that countries receiving this information provide certain guarantees and U.S. approval rights over its use. Some of DOE's reprocessing-related activities conducted with foreign countries appear to meet the statutory definition of SNT. However, on the basis of its interpretation of SNT, DOE has concluded that no SNT has been transferred. DOE identifies SNT on the basis of a number of factors, including the technical capability of the recipient country. DOE's interpretation, however, does not appear consistent with the NNPA definition of SNT that requires DOE to determine if information to be provided is important to the design, construction, operation, or maintenance of a reprocessing facility.

We previously recommended that DOE develop a clear interpretation of SNT and establish in its regulations criteria by which to identify SNT in proposed technology transfers. DOE did not agree with our recommendation. As a result, we believe the Congress needs to reexamine the SNT issue and provide more direct guidance to DOE on implementing SNT controls.

DOE Activities With Foreign Countries in Sensitive Technology Areas

Enrichment, reprocessing, and heavy water production facilities pose the greatest proliferation concerns. These facilities can provide countries with the capability to directly produce weapons-grade material or to fuel and operate nuclear reactors and convert the reactor fuel into usable weapons material. With the passage of the Atomic Energy Act in 1954, the United States has followed a policy of promoting the peaceful foreign uses of these technologies and providing related assistance—by both the private sector and DOE—to foreign countries where it is determined that no proliferation risk exists. However, the NNPA placed domestic controls on U.S. exports of nuclear materials, equipment, and technology to ensure efficient and effective control over the proliferation of nuclear explosive capability.

DOE conducts cooperative research and development and technical exchange activities with foreign countries in various nuclear technology areas. Between 1984 and 1986, DOE had 30 cooperative nuclear research and/or technical exchange agreements in force with foreign countries. For the most part, the activities conducted under these cooperative agreements related to nuclear reactors, nuclear waste, and other non-sensitive technology. None of the agreements related to heavy water production and only one—involving a test release of uranium hexafluoride

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in France—had any relationship to enrichment. According to DOE enrichment officials, the activity with France related to environmental and safety aspects of handling uranium hexafluoride without any discussion or transfer of enrichment technology. They stated that, as a matter of policy, DOE does not perform any technology-related cooperative enrichment activities with any country.

DOE does, however, conduct cooperative activities that involve the development and/or transfer of reprocessing technology. Twelve of the 30 agreements included reprocessing among their scope of activities. Four of these—all liquid metal fast breeder reactor agreements with France, Japan, West Germany, and the United Kingdom—did not actually involve reprocessing data, as they are “umbrella” agreements that serve as a basic framework for country-to-country technical exchanges. The remaining eight agreements, however, did involve information related to reprocessing; these are shown in table 3.1.

Table 3.1: DOE Reprocessing-Related Activities With Foreign Countries, 1984 to 1986

Agreement	Country	Date	Scope of activities
Spent fuel treatment development	West Germany	2/77 to 2/87	Fuel recycling, including reprocessing and refabrication
Remote systems technology	France	9/85 to 9/88	Research in remote systems technology for reprocessing applications
Remote systems technology	Japan	2/85 to 2/88	Research in remote systems technology for nuclear fuel cycle applications
Fast breeder fuel criticality data development	Japan	8/83 to 3/88	Verification of computer code calculations in reprocessing applications
Fast reactor fuel—head-end shearing	United Kingdom	10/80 to 10/85	Investigation of shearing equipment performance and the handling of dismantled fuel
Liquid metal fast breeder reactor fuel head-end waste	United Kingdom	5/83 to 5/88	Loan of U.S.-developed equipment for measuring residual plutonium
Dissolution of fuel	United Kingdom	10/83 to 10/86	Loan of U.K.-developed equipment for use in test facility at Oak Ridge
Fiber-optic spectrophotometry	United Kingdom	12/85 to 12/90	Loan of U.S.-developed equipment for sampling material in a high-radiation area

DOE’s Office of Nuclear Energy conducts all the reprocessing-related cooperative activities with foreign countries. According to officials of that office, exchange activities provide considerable benefits to U.S. reprocessing programs. Specifically, they stated that cooperative exchange activities

- provide new information to the U.S. nuclear program and improve the domestic reprocessing data base,
- result in a lower U.S. dollar expenditure for nuclear research in some cases because foreign countries share in the cost of research done in the United States,
- help to ensure that U.S. technology is keeping pace with foreign programs, and
- promote harmonious relationships with foreign countries.

Further, these DOE officials point out that it is in this country's interest to maintain a reprocessing program through international exchange activities because the cooperative activities provide the United States with some influence over the direction of foreign nuclear programs and help promote the use of reprocessing technology within effective safeguards. Additionally, they believe that breeder reactor fuel reprocessing may ultimately be commercialized in this country, and cooperative activities with foreign countries in this area help maintain the technology base that will be needed to construct and operate these facilities.

Cooperative Reprocessing Activities Meet the Statutory Definition of Sensitive Nuclear Technology

Assistance to foreign reprocessing programs may indirectly aid in the proliferation of nuclear weapons through the development of (1) expertise that could be transferred to a weapons program and/or (2) commercial reprocessing plants that increase the risk for plutonium diversion or theft. Consequently, assistance to foreign reprocessing programs is subject to stringent export requirements established by the NNPA. Subsection 4(a)(6) of that act created the category of SNT, which it defines as any information (including information incorporated in a production or utilization facility or important component part thereof) that is

- not available to the public;
- important to the design, construction, fabrication, operation, or maintenance of a uranium enrichment, reprocessing, or heavy water production facility; and
- not Restricted Data.

The act placed controls on SNT comparable to those it placed on nuclear facilities licensed for export by the Nuclear Regulatory Commission. Specifically, no SNT can be exported to any country unless the country agrees that any nuclear material produced, or nuclear facility constructed, through the use of such SNT will be (1) subject to IAEA safeguards, (2) used only for peaceful purposes and not for an explosive device, (3) protected by adequate physical measures, (4) retransferred

to another nation only after approval of the United States, and (5) reprocessed or altered only with U.S. approval. In addition, nonnuclear-weapons countries must accept full-scope IAEA safeguards before they can receive SNT from the United States.

Our review of DOE's cooperative reprocessing activities shows that some technology transfers meet all three tests for identifying SNT. DOE meets the third test—that an activity must not include Restricted Data—for all transfers of reprocessing information since reprocessing technology is no longer classified as Restricted Data. A comparison of DOE's activities against the other two tests—that the activity does not involve publicly available information and that it is important to the design, construction, operation, or maintenance of a reprocessing facility—shows that some DOE activities meet the three-part statutory definition of SNT.

Information Transferred Not Publicly Available

As discussed in chapter 2, DOE disseminates the majority of the reprocessing information it develops. However, information DOE categorizes as applied technology is not routinely made available to the public. Applied technology information is withheld from public dissemination specifically to prevent its disclosure to foreign countries, but can be obtained upon request under the Freedom of Information Act.

DOE's cooperative activities with foreign countries involve the transfer and/or development of applied technology information. DOE records show that the agreements with the United Kingdom and Japan have involved the direct transfer of applied technology information to those countries. Information from OSTI and the Office of Nuclear Energy show that DOE provided the United Kingdom with at least 44 applied technology documents related to breeder reactor fuel reprocessing, specifically, head-end shearing and dissolution. Further, at least six reprocessing applied technology documents related to criticality data development and remote systems technology were transferred to Japan.

Virtually all the cooperative reprocessing activities involve the transfer of applied technology and/or the development of new data that will be designated applied technology when compiled, according to DOE Nuclear Energy officials. For example, they stated that the criticality data development efforts with Japan will provide new information on the handling of plutonium in solutions, and the data will be controlled in the United States as applied technology while being provided to Japan. They see little purpose in a foreign country performing cooperative activities

with DOE if it could not obtain the results of that research or if only published information were involved. They stress that the data produced from such efforts will eventually be published and available to anyone. Nevertheless, at the time information is provided to foreign countries, it is not publicly available and therefore meets this criteria for SNT.

Information Provided Is
Important to a
Reprocessing Facility

Since DOE's cooperative reprocessing activities with foreign countries do not involve Restricted Data or information generally available to the public, the crucial test to determine if an activity involves SNT is its importance to the design, construction, operation, or maintenance of a reprocessing facility. Our review of documents related to these activities shows that the criticality data development activity with Japan provides information important to the design of a reprocessing facility, and the four activities with the United Kingdom provide similar important design information to demonstrate reprocessing technology. These activities are discussed below.

Japan

DOE's activity with Japan in criticality data development involved experiments to verify computer codes that enable fuel recycling facilities to operate more safely and efficiently. Criticality is the state in which fissionable material develops a self-sustaining chain reaction, and the subsequent release of intense neutron and gamma radiation. Because inadvertent criticalities could result in a nuclear accident, reprocessing systems need to be sized and configured such that it is physically impossible for a critical amount of fissionable material to accumulate.

Under this agreement, DOE is conducting a series of criticality experiments at the Pacific Northwest Laboratory in Richland, Washington, to determine the point at which solutions could become critical. The research includes assessing various plutonium concentrations and critically safe tank sizes and shapes. According to a paper presented jointly by DOE and Japanese representatives at a September 1985 conference, an intense interest in these data exists because the research will enhance facility safety, efficiency, and reliability. Further, Japan expects to pay DOE about \$6.3 million to develop the data and will use it to aid in the design of a pilot-scale reprocessing plant. According to an April 1986 Pacific Northwest Laboratory report, Japan needs the results of this research to support the design and operating activities associated with this plant.

United Kingdom

DOE's four activities with the United Kingdom in reprocessing assist that country in the design of a reprocessing facility. DOE's Consolidated Fuel Reprocessing Program progress reports show that these activities cover the areas of (1) design parameters for a reprocessing plant demonstration facility, (2) mechanical head-end shearing (dismantling of nuclear fuel), dissolution, and flowsheet technology, (3) process control, (4) instrumentation, and (5) analytical chemistry. For example, the head-end shearing agreement involved data to help the United Kingdom select and design equipment to dismantle commercial fast breeder reactor fuel. As stated in the agreement, this activity will allow the United Kingdom to assess the suitability of massive shearing equipment that DOE developed and to use these data to design the equipment if it selects massive shearing for its program. Further, under other agreements, DOE provided the United Kingdom with information related to, and a computer program for the design of, centrifugal contactors, a reprocessing plant component that separates plutonium and uranium from waste products, and equipment for detecting levels of fissionable materials in reprocessing plant solutions. The United Kingdom exchanged personnel with DOE to develop components under both the head-end shearing and fuel dissolution agreements. According to a June 1986 DOE study, the United Kingdom expects to have a demonstration plant operational by 1993; DOE currently has no plans for such a plant.

In addition, the information DOE provides to Japan and the United Kingdom is similar in scope to information possessed by private companies that DOE has determined to be SNT because it is important to a reprocessing facility. DOE has on one occasion—involving proposed private-sector assistance to a West German reprocessing plant in 1983—deemed that the activity involved SNT. This assistance involved services in which the company planned to provide advice on the application of safeguards and equipment and facility design. Although no proprietary data were involved, DOE determined that the company's experience and know-how involved SNT because it would provide information that is not publicly available and is important to the design of a reprocessing facility. In contrast to the DOE activities, the company amended the scope of activities to be provided, eliminated key aspects related to separating plutonium, and substituted only information related to ancillary activities—such as fuel receiving and storage, waste management, and acid and solvent recovery. Nevertheless, the SNT concerns could not be resolved, and DOE consequently could not allow the company to undertake these activities.

Further, DOE's cooperative agreements with Japan and the United Kingdom center on the specific areas identified by the IAEA as the critical components of a reprocessing facility. The IAEA has developed a "trigger list" of components that are critical and unique to nuclear facilities. With regard to reprocessing facilities, the trigger list identified machines that chop or shear irradiated fuel elements and critically safe tanks as unique and critical reprocessing components. The assistance DOE provided to the United Kingdom involved fuel shearing machines, and the assistance it is providing to Japan relates to the design of critically safe tanks.

The other three technical exchange agreements that DOE has with Japan, France, and West Germany have the potential to transfer important reprocessing information. However, we were unable to assess whether these activities met the test of importance because little activity had occurred, little documentation existed upon which to make such a judgment, or the activity was not directly related to reprocessing.

For example, the remote systems technology agreements with Japan and France both provide state-of-the-art information necessary to the safe operation of advanced reprocessing plants. According to reprocessing experts, advanced reprocessing concepts seek to reduce costs and improve safety by using smaller facilities with enhanced remote maintenance capability. In addition, the spent fuel treatment development activity with West Germany related to activities to prepare high-temperature, gas-cooled reactor fuel for storage. The scope of the activities included head-end reprocessing and fuel dissolution steps, both of which are necessary to reprocess this fuel. According to DOE officials, although a relationship exists with reprocessing in this activity, the thrust of the cooperative activity was to develop technology for storing this type of nuclear fuel. They further point out that West Germany has no ongoing activities to develop high-temperature, gas-cooled reactor fuel reprocessing capability.

DOE Has Not Met NNPA Conditions for Transfer of Sensitive Nuclear Technology

DOE has not fully met NNPA conditions for transferring SNT on any of the cooperative reprocessing activities with other countries. According to Office of Nuclear Energy officials, they did not seek to meet the SNT export conditions because they do not believe that the activities involved SNT. Nevertheless, the officials said that most of the conditions for transferring SNT—that the nuclear facilities will be subject to IAEA safeguards, used only for peaceful purposes, and protected by adequate physical security, and that the information will not be retransferred to

another country without U.S. approval—were met in all cases. However, the prior approval rights required by the act were not obtained on any of the cooperative reprocessing activities.

DOE officials in the Office of Nuclear Energy do not believe that any of their activities with foreign countries involve the transfer of SNT, and therefore they are justified in not obtaining U.S. approval rights over foreign reprocessing efforts. They said that although the information transferred may meet the first two SNT criteria—not Restricted Data and not publicly available—the activities do not meet the importance criterion. The DOE officials said that in considering this criterion, they must weigh (1) the technological and nuclear status of the recipient country and (2) the relationship of the information to the ability of the country to operate a reprocessing plant.

In this regard, DOE established a committee in 1983 to review these activities and determine if they involve information important to a reprocessing facility. This committee reviewed both the criticality data development activity with Japan and the head-end shearing activity with the United Kingdom. The committee concluded that the criticality data activity did not transfer important information because it related to safety and economics, and the head-end shearing activity was not important to the reprocessing program of the United Kingdom because of that country's advanced nuclear capabilities. However, the committee added that this information would be considered SNT if it were going to a less advanced country.

Office of Nuclear Energy officials said that their interpretation and implementation of the SNT provision complies with the act's requirements for controlling important reprocessing information. They point out that both the United Kingdom and Japan possess reprocessing technology; therefore, little information exists that would be important to either country. Further, the information being transferred to foreign countries under these activities improves economics, safety, and safeguardability of reprocessing activities, and does not represent a proliferation threat. They stressed that the information being provided only serves to refine already existing data, and these countries can continue to design, build, and operate reprocessing facilities without DOE assistance and information. Consequently, they believe that although the information is "valuable," it is not "important" in the sense intended by the NNPA and is, therefore, not SNT.

However, DOE's interpretation is not fully consistent with the intent of the NNPA. The act's overall objective was to establish efficient and effective controls over the proliferation of nuclear weapons capability. To achieve this goal, the act places strong domestic controls over nuclear-related exports and provides clear and consistent standards on which to base export decisions. The Congress wanted the United States to have some assurances over the use of nuclear materials and equipment produced with U.S. assistance regardless of the country receiving the assistance.

In addition, the act provided a 3-part SNT definition and required strict export controls over the transfer of any information covered by this definition. Neither the definition nor the export requirements indicate that SNT decisions were to be based on the nuclear proficiency of the recipient country. Rather, the focus was on the importance of the information provided. The SNT requirements do not prevent the export of important reprocessing technology; they only require that certain conditions, including the guarantee of U.S. approval rights, be met in exchange for U.S. assistance.

DOE officials in the Office of Nuclear Energy said that the approval rights cause problems with implementing the SNT provisions. They said that other advanced countries will not grant the United States approval over their reprocessing activities in exchange for U.S. assistance because it is viewed as an infringement on their national sovereignty. Further, enough information exists to enable advanced nuclear countries to reprocess without any U.S. help, and if the export conditions were applied to DOE exchange activities, no international cooperation would take place. They see the loser in this situation as being the United States because countries such as the United Kingdom and France are more advanced in reprocessing than we are, and any reduction in exchange activities would result in a loss of technology to our nuclear program.

Further, Nuclear Energy officials believe that the cooperative exchange activities are consistent with the administration's policy regarding foreign reprocessing activities. The President's July 16, 1981, statement on United States nuclear nonproliferation policy says that the administration will not inhibit or set back civil reprocessing and breeder reactor development in nations with advanced nuclear power programs where it does not constitute a proliferation risk.

Although we recognize the logic of DOE's position, particularly with respect to countries with advanced nuclear programs, we do not find

support for DOE's position in the NNPA and its legislative history. Neither the act nor its legislative history distinguish among countries, their nuclear capabilities, or their nonproliferation status to determine what information constitutes SNT. The act simply requires DOE to determine if information to be provided to a foreign country is important to the design, construction, operation, or maintenance of a reprocessing facility. In keeping with the intent of the act, this definition should be consistently applied to all countries on the basis of objective criteria. In addition, numerous officials from Defense, the Arms Control and Disarmament Agency, and the Nuclear Regulatory Commission involved in nonproliferation and nuclear export issues, and congressional staff who developed the NNPA agree that DOE's interpretation is not fully consistent with the act. They stated that the act intended that DOE evaluate the importance of the technology involved—not the recipient country.

In our May 1986 report we recommended that the Secretary of Energy develop a clear interpretation of SNT and establish criteria to evaluate proposed assistance to foreign nuclear programs for SNT.¹ Further, we recommended that DOE establish the criteria through a rulemaking procedure to the agency's regulations. DOE has not, however, established such criteria in its regulations.

In December 1986 DOE published in the Federal Register the final rule that revised its regulations governing U.S. assistance to foreign nuclear programs. In its discussion of the revised regulations, DOE stated its belief that the Congress intended DOE to make SNT determinations on a case-by-case basis, using its technical expertise, experience, and judgment. DOE said that it considers many factors, including the technical capability of the recipient country, in making SNT determinations. As a result, the final regulations did not contain any specific criteria to identify SNT.

Conclusions

In establishing SNT controls over reprocessing assistance to foreign countries, the Congress recognized that the commercial use of reprocessing may pose a threat to nuclear weapons proliferation. Operating commercial reprocessing plants increase the potential for large amounts of plutonium to be available in international commerce. Therefore, its potential theft and/or diversion for weapons use represents a significant risk. The SNT provision established by the NNPA was an attempt by the Congress to place strict controls and provide the United States some

¹GAO/RCED-86-144.

assurance that foreign commercial reprocessing activities would be conducted for peaceful purposes in return for significant U.S. assistance in the conduct of such activities.

We previously found that DOE did not have an effective process to identify SNT in private-sector activities or its own activities with foreign countries. Our current review of DOE's assistance to foreign nuclear programs raises further concerns. The assistance DOE provides directly to the reprocessing programs of other countries—albeit allied countries that meet high nonproliferation standards—qualifies in our view as SNT as defined in the NNPA. The act established three specific tests to determine SNT. Our evaluation shows that in some instances, particularly assistance to Japan and the United Kingdom, DOE's foreign reprocessing assistance met all three tests. However, DOE did not believe that these activities involved SNT and did not obtain subsequent approval rights, as required by the NNPA.

DOE does not agree with our view; it maintains that the recipient country should be considered in determining the “importance” of the technology exported. Under DOE's interpretation of SNT, information transferred to advanced nuclear nations cannot be “important” because these nations already have reprocessing capabilities; therefore, it cannot be SNT. DOE believes that other nations would not accept required conditions on the transfer of SNT and that such a strict interpretation of SNT would result in the loss of U.S. influence in foreign reprocessing activities. DOE also believes that this would result in greater harm to our own nuclear program and to our nonproliferation objectives than it would to the nuclear programs of the foreign nations currently involved in reprocessing activities with DOE.

While DOE's views have merit, we do not believe they are fully consistent with the intent of the NNPA. In our view, the act requires DOE to make SNT determinations on the basis of the importance of the technology involved. The NNPA established the SNT category, provided a specific definition, and specified the controls that would be required over its export. These controls apply equally to all countries, with the exception that full-scope IAEA safeguards are required for nonnuclear-weapon states but not for nuclear-weapon states. DOE's interpretation is not consistent with these controls, as it essentially allows it to modify the “importance” test on activities involving allied countries that have advanced nuclear programs. Other federal agencies involved in nuclear export matters, as well as congressional staff involved in the passage of the NNPA, agree that DOE's view is not consistent with the act.

We previously recommended that DOE develop a clear interpretation of SNT, establish criteria to evaluate activities for SNT, and include the criteria in its regulations. DOE has not implemented this recommendation; it continues to believe that SNT determinations need to be performed on a case-by-case basis that takes into account the recipient country.

Matters for Consideration by the Congress

Although we find some merit in DOE's views regarding the impact of a strict interpretation of the SNT definition, we continue to believe that DOE's practices for identifying and controlling SNT are not fully consistent with the intent of the NNPA. DOE has not implemented our past recommendation that it develop a clear interpretation of SNT, establish criteria to evaluate activities for SNT, and include the criteria in its regulations. In addition, DOE has no plans to do so absent more specific directions from the Congress. Consequently, the Congress should consider providing DOE with specific directions to develop regulations that implement the SNT definition.

Alternatively, the Congress should consider amending the act to clarify the practices that DOE currently uses to identify and control the transfer of SNT. Using the information in this report, the options the Congress should consider include amending the NNPA specifically to

- allow DOE to consider other factors, such as the recipient country, in making SNT determinations, thereby establishing a statutory basis for DOE's current practices; or
- require DOE to make SNT determinations in accordance with the NNPA, but allow DOE to waive the approval rights requirements for allied countries with advanced nuclear programs on a case-by-case basis after prior notification to the Congress.

In its deliberations, the Congress should consider the potential reduction of United States' involvement and influence in the international nuclear arena against the potential that U.S. assistance to foreign nuclear programs may indirectly aid in the proliferation of nuclear weapons through the development of commercial reprocessing plants and the greater availability of plutonium.

Better Controls Needed Over Foreign Nationals' Involvement in Nuclear Research Activities

DOE has various controls over foreign involvement in its sensitive nuclear activities. DOE's strongest and most effective controls govern the direct employment of foreign nationals in sensitive activities. DOE limits such involvement, and has established procedures that require that foreign nationals be granted a security clearance before they are employed. As a result, few foreign nationals are employed at DOE facilities.

However, DOE has not had effective administrative controls over foreign visits and assignments to its facilities. DOE officials estimate that between 15,000 and 20,000 foreign nationals visit or are assigned to DOE facilities annually. As early as 1983, DOE found that its monitoring of foreign visits and assignments had not been adequate and that significant unclassified energy information may have been lost to foreign countries. In 1986 DOE initiated actions to improve its controls for foreign visits and assignments. Since DOE has not completed these actions, we were unable to determine whether its revised controls will be adequate.

In addition, because reprocessing information is unclassified, DOE places no restrictions on foreign nationals involved in DOE-funded research at universities. Currently, DOE has funded only five reprocessing-related research projects; two of the five involved foreign nationals, and one of these was from India, a country that does not adhere to the Nuclear Non-Proliferation Treaty. Although we could not determine the proliferation risk or significance of foreign national involvement in DOE-funded research, the possibility exists that new knowledge could be gained by a foreign country through participation in such research.

Controls Over Foreign Nationals Working Directly in DOE's Nuclear Programs

DOE is not prohibited from allowing foreign nationals to work directly in its laboratories. The Oak Ridge National Laboratory, for example, had 67 foreign nationals employed in various activities as of October 1985. However, those working in sensitive nuclear areas must be granted a security clearance. DOE Order 5631.2A (Personnel Security Program, Dec. 2, 1985) provides that security clearances must be granted before an individual can have access to classified information, special nuclear material, or a security area. According to DOE security officials, all DOE enrichment, reprocessing, heavy water production or research facilities, as well as weapons-related activities, are located in security areas.

According to the Director of DOE's Office of Safeguards and Security, only three foreign nationals have been granted access or clearances to

work for DOE laboratories in sensitive nuclear areas. Two of these individuals—a British citizen and a Canadian citizen—are employed at the Los Alamos National Laboratory in New Mexico. The third—a West German citizen—is assigned to the Rocky Flats Plant in Colorado. Further, Office of Safeguards and Security officials point out that foreign nationals are hired only when they possess a special expertise needed by DOE, and their backgrounds are checked extensively before DOE grants a clearance.¹

Controls Over Foreign Visits and Assignments

By far the largest involvement of foreign nationals in DOE's programs is through visits and assignments. Visits—periods up to 2 weeks—allow foreign nationals to participate in technical discussions, conduct orientation tours, observe projects or experiments, or collaborate on problems of mutual interest without extensive participation in the work of DOE facilities. Assignments—periods greater than 2 weeks but not exceeding 2 years—allow foreign nationals to gain experience or to carry out projects or research that are a part of, or consistent with, the facility's objectives.

DOE officials in its Offices of International Affairs and Defense Program estimate that 15,000 to 20,000 visits and assignments occur each year. Of this total, about 75 percent represent visits by foreign nationals from nonsensitive countries and involve nonsensitive subjects. The remaining 25 percent represent (1) visitors from sensitive countries, (2) visitors from nonsensitive countries to discuss a sensitive subject or going to a sensitive facility, or (3) foreign nationals on assignments.

DOE Order 1240.2 (Visits and Assignments by Foreign Nationals, Jan. 5, 1981) establishes DOE's policy and procedures for foreign visits and assignments to its facilities. The order states that DOE's policy is to support a program of unclassified visits and assignments by foreign nationals as long as the visits are consistent with DOE's missions and do not unduly interfere with its programs. Further, the order establishes procedures for field and headquarters approval of foreign visits and assignments, and contains requirements for (1) indices checks² of visitors and assignees from sensitive countries who have access to secure areas of

¹A March 1987 report, *Nuclear Security: DOE's Reinvestigation of Employees Has Not Been Timely* (GAO/RCED-87-72) discussed problems with certain aspects of DOE's security clearance process. For this report, we did not attempt to review the clearance records related to these three foreign nationals.

²Reviews of investigative and intelligence files of appropriate government agencies to determine whether a particular foreign national may endanger national security interests.

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sensitive facilities, (2) escorts for visitors and assignees in security areas, and (3) submission of reports by the sponsoring organization to DOE headquarters after the conclusion of visits and assignments involving sensitive subjects.

According to information that DOE provided, a total of 1,169 visitors and 18 assignees were at DOE laboratories between 1983 and 1985 and had access to unclassified information related to nuclear technology. Table 4.1 shows, for seven DOE laboratories involved in national security activities, the number of visits and assignments from 1983 to 1985.

Table 4.1: Foreign Visits and Assignments at DOE Laboratories, 1983 to 1985

Laboratory	1983		1984		1985	
	Visits	Assign.	Visits	Assign.	Visits	Assign.
Idaho Falls	•	•	•	•	•	•
Lawrence Livermore	52	•	132	•	21	•
Los Alamos	25	•	3	•	19	•
Oak Ridge	172	1	258	7	255	6
Richland	5	•	6	4	•	•
Sandia	51	•	59	•	65	•
Savannah River	4	•	19	•	23	•
Total	309	1	477	11	383	6

A number of the visits and assignments shown in table 4.1 relate to sensitive nuclear technology areas. According to the data provided by Oak Ridge, 427 of the visitors and 1 of the assignees went to enrichment facilities, and 141 of the visitors and 13 assignees were involved with the Consolidated Fuel Reprocessing Program. Laboratory officials stated that all these visits and assignments related to unclassified information and no sensitive nuclear technology was involved. Further, the laboratory stated that the one assignee to the Oak Ridge enrichment plant—a citizen of Taiwan—is a consultant in the business office and is not involved with the technology itself. The assignees to the Consolidated Fuel Reprocessing Program—nine from Japan and four from the United Kingdom—were all part of formal technical exchange agreements. According to Oak Ridge, only the assignees from the United Kingdom had any involvement with reprocessing technology, but this involvement is not viewed as transferring sensitive nuclear technology.

Potential Problems With Controls Over Visits and Assignments Being Addressed by DOE

Three DOE efforts that examined foreign visits and assignments to DOE facilities have identified problems in this area. In 1983 DOE funded a study to review the implementation of Order 1240.2 because of concerns that harmful technology transfers may occur in the course of foreign access to DOE facilities and personnel. Although the review did not specifically address the sensitive technology areas of enrichment or reprocessing, the September 1983 report stated that "it appears that a significant amount of unclassified, yet important, technology may have been lost to potential adversaries through these activities. . . ." The report identified a number of problems, such as

- lack of clarity in, and DOE headquarters guidance over, the program goals and objectives for foreign visits and assignments;
- low priority given to this program within DOE;
- drastic reductions in resources devoted to the control of foreign visits and assignments; and
- failure of responsible officials to submit the required post-visit and assignment reports to DOE headquarters.

The report concluded that DOE needed to institute controls to better monitor foreign visits and assignments, better define the goals and objectives established, and make a greater commitment to managing these activities.

In addition, a special project team, established by the Secretary of Energy in March 1985 to assess DOE's safeguards and security program, identified problems in this area. Among 94 recommendations, the special project team recommended that DOE Order 1240.2 be reviewed to determine whether it provided adequate technology protection. Consequently, DOE established Operation Cerberus in October 1985 to address implementation of the 94 recommendations. Operation Cerberus consisted of 11 committees that reviewed various security issues. One committee examined DOE's controls over foreign visits and assignments.

One conclusion of this committee was that the order needed to be revised to provide DOE with greater administrative controls over visits and assignments, according to DOE officials from the Office of International Affairs and the Office of Defense Programs who participated on this committee. The officials said that Operation Cerberus participants determined that DOE knew too little about what was occurring in this area. Specifically, they stated that little data were available at headquarters on the number and scope of foreign nationals at DOE facilities, and approval authority for visits and assignments was not centralized.

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As a result, DOE did not have the capability to easily determine the extent of foreign involvement in its programs or to monitor activities in this area.

DOE is currently taking actions to address these problems and improve its controls over foreign visits and assignments to DOE facilities. In an October 27, 1986, memorandum, the Deputy Assistant Secretary for International Affairs and the Deputy Assistant Secretary for Security Affairs directed that the DOE order governing visits and assignments be revised to improve the administrative oversight of foreign nationals at DOE facilities. According to the milestone chart established in this memorandum, revisions to the order will (1) modify the current delegations of approval authority, (2) provide clearer definitions of sensitive facilities and subjects covered by the order, (3) clarify administrative procedures for authorizing and reporting on foreign visitors and assignees, and (4) strengthen information requirements. DOE expects to have a draft of the revised order completed by the summer of 1987; DOE officials could not estimate when it would be made final.

In addition, both the Offices of International Affairs and Defense Programs are developing computer systems to track foreign visitors and assignees at DOE facilities and prepare monthly listings of visitors and assignees from sensitive countries that will be distributed to DOE management. Officials from these offices stated that these actions will provide DOE headquarters with current information on the extent of foreign participation in DOE programs and allow DOE to analyze trends in visits and assignments by individual and/or country to ensure that it does not disseminate too much information in a given subject to a particular country.

Controls Over Foreign
Nationals'
Involvement in DOE-
Funded Research

A large portion of nuclear graduate students at U.S. universities are foreign nationals. According to a March 1986 DOE study, Nuclear Engineering Enrollments and Degrees, foreign nationals comprised 30 percent of masters program enrollments and 50 percent of doctoral program enrollments in U.S. university nuclear engineering programs in 1985.

Although a considerable number of foreign nationals are enrolled in nuclear-related programs at universities, few controls exist over their involvement in DOE-funded research related to reprocessing. According to DOE officials in the Office of Safeguards and Security, classified research conducted for DOE must be performed in restricted areas and only by individuals who have received security clearances from DOE. In

these cases, DOE performs site surveys to ensure that the access controls are adequate and the foreign nationals do not have access to the area containing classified information.

However, no such requirement exists for unclassified research. Defense Programs officials said that reprocessing research, since it is unclassified, could be performed without any access controls or site security surveys by DOE. They said that any restriction on the involvement of foreign nationals in unclassified research would have to be imposed by the DOE office funding the research. As a result, foreign nationals from countries that do not meet high nonproliferation standards can be involved in DOE-funded reprocessing research at universities.

We identified five activities being conducted by universities for DOE that have some relationship to reprocessing. Two of the five activities—research in actinide chemistry at Florida State University and development of new extractants for use in analyzing actinide solutions at the University of New Mexico—involved foreign national graduate students in the research. The other three research activities did not involve foreign nationals.

According to the primary researcher on the Florida State University project, this work involves basic chemistry of the actinide elements; a Korean national was assisting in this. The researcher added that this effort is directed at developing information that could improve processes for separating actinide elements, including plutonium. The primary researcher on the University of New Mexico project stated that this project is directed at finding new ways to detect the actinide elements that are present in solutions such as those used in reprocessing. He said that the project is being conducted with a post-doctoral student from India—a country that has not signed the Nuclear Non-Proliferation Treaty. Both researchers said that their work does not focus directly on reprocessing applications but could result in information useful to reprocessing.

The other three research activities—electrochemical reprocessing applications at the Georgia Institute of Technology, research on new extractants suitable for actinide separations at the University of New Mexico, and engineering design data associated with nitric acid sampling systems at the Savannah River reprocessing facility by Clemson University—have a more direct relationship to reprocessing technology or facilities, but do not involve foreign nationals. For example, the Georgia Institute of Technology is testing the applicability of electrochemical

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concepts, which use electrons to separate uranium and plutonium instead of the chemicals now used.

The researchers at the five universities told us that they received no instructions from DOE not to involve foreign nationals in the DOE-funded projects. The researcher whose project involved the foreign national from India said that he attempted to obtain a U.S. citizen to participate in the project, but none was available who met the necessary qualifications. He added that although he was not specifically instructed to use only U.S. citizens in such research, he normally attempts to do so because he sees the university role as training our own citizens in these technologies and providing the next generation of scientists and researchers for our national laboratories. Further, the researcher from the Georgia Institute of Technology said that DOE did not place any restrictions on the involvement of foreign nationals in the project. He said that the decision not to involve foreign nationals was made by the university because the project would involve applied technology information.

The university officials and DOE program and security officials stated that foreign national involvement in DOE-funded research could represent a problem. However, since research in the reprocessing area is limited and most does not relate directly to reprocessing, they believed the potential was very small. Further, they stated that limiting foreign national involvement in research that has some relationship to reprocessing will cause greater harm to our nation in terms of reduced technical advancement.

Nevertheless, the possibility exists that foreign nationals could participate in research that could result in new findings and conclusions concerning reprocessing. In a 1979 report, we examined the issue of foreign participation in DOE research.³ We could not determine if training of foreign nationals contributes to weapons proliferation, but a limited number of foreign nationals were gaining experience on projects that could be of proliferation concern if applied to a nonpeaceful project. Further, we recommended that DOE give preference to individuals from countries adhering to the Non-Proliferation Treaty in government-sponsored research.

³Difficulties in Determining if Nuclear Training of Foreigners Contributes to Weapons Proliferation (ID-79-2, Apr. 23, 1979).

Conclusions

Foreign nationals can and do participate in DOE's reprocessing activities through direct employment, visits and assignments, and DOE-funded research at universities. At this time, DOE believes it has effective controls over foreign nationals employed at DOE facilities. Although considerable numbers of foreign nationals work in DOE facilities, very few are hired to work in sensitive technology areas. Currently, only three are employed to work in classified and/or secured areas. These individuals have been subjected to DOE's security clearance process and have been granted access to work in their assigned areas.

In our view, a greater concern exists over foreign visits and assignments to DOE facilities. DOE has not had effective controls in this area and has not had information on the extent of visits and assignments or the risk of these activities. However, DOE has recognized that weaknesses exist and is taking actions to strengthen its control of this area. Since DOE has not completed these efforts, we were unable to determine whether the actions will resolve the weaknesses identified.

In addition, the involvement of foreign nationals in DOE-funded reprocessing research at universities remains a potential problem because foreign nationals could obtain important information. We recognize that such research is currently limited, only two foreign nationals are involved, and the research is not directly related to the design or operation of a reprocessing facility. Nevertheless, the possibility exists that DOE could contribute to the development of foreign expertise in reprocessing technology through DOE-funded research. Further, it appears inconsistent with U.S. nonproliferation policy for DOE to fund research that may involve foreign nationals from countries that have not agreed to the Nuclear Non-Proliferation Treaty, such as India, and have not accepted safeguards on all their nuclear facilities.

Because reprocessing is not classified, no mechanisms exist to prevent a foreign national from participating in, and learning from, reprocessing research that DOE funds outside its laboratories. Although the current level of research is low and the future of nuclear energy and reprocessing is uncertain, the potential exists that DOE could seek to have significant reprocessing research performed by universities. Consequently, DOE should ensure that foreign national involvement in unclassified, sensitive technology research is limited.

Recommendation

We recommend that the Secretary of Energy establish a policy that DOE-funded reprocessing research at colleges and universities be carried out

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Research Activities

only by U.S. citizens or, at a minimum, citizens from countries that adhere to the Nuclear Non-Proliferation Treaty.

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