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GAO

Report to the Chairman, Committee on Foreign Relations, U.S. Senate

February 1999

NUCLEAR NONPROLIFERATION

Concerns With DOE's Efforts to Reduce the Risks Posed by Russia's Unemployed Weapons Scientists

GAO/RCED-99-54

GAO

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

Resources, Community, and
Economic Development Division

B-281733

February 19, 1999

The Honorable Jesse Helms
Chairman, Committee on Foreign
Relations
United States Senate

Dear Mr. Chairman:

This report responds to your request that we review DOE's implementation of its Initiatives for Proliferation Prevention program—an effort to develop nonmilitary applications for defense technologies and create jobs for weapons scientists from the former Soviet Union. The report also discusses DOE's Nuclear Cities Initiative—a new effort to create jobs in Russia's 10 closed nuclear cities. This report contains several recommendations to the Secretary of Energy.

We are sending copies of this report to the Secretaries of Energy, State, and Defense; the Director of the Office of Management and Budget; and other interested parties. We will also make copies available to others on request.

Please call me at (202) 512-3841 if you or your staff have any questions. Major contributors to this report are listed in appendix VIII.

Sincerely yours,

(Ms.) Gary L. Jones
Associate Director, Energy,
Resources, and Science
Issues

Executive Summary

Purpose

The risk that unemployed weapons scientists in the former Soviet Union will sell sensitive information to countries or terrorist groups trying to develop weapons of mass destruction poses a national security threat to the United States. In response to this threat, the Initiatives for Proliferation Prevention program was established in 1994 to engage scientists in the former Soviet Union in peaceful commercial activities. In late 1998, the administration launched a new complementary program—the Nuclear Cities Initiative—to create jobs for displaced weapons scientists in the 10 cities that form the core of Russia's nuclear weapons complex.

The Chairman of the Senate Committee on Foreign Relations asked GAO to review (1) the costs to implement the Initiatives for Proliferation Prevention program for fiscal years 1994-98, including the amount of funds received by weapons scientists and institutes; (2) the extent to which the program's projects are meeting their nonproliferation and commercialization objectives; and (3) the Department of Energy's Nuclear Cities Initiative.

Background

The objectives of the Initiatives for Proliferation Prevention program are to (1) engage weapons scientists and institutes in productive nonmilitary work in the short term and (2) create jobs for former weapons scientists in the high-technology commercial marketplace in the long term. It is estimated that Russia's 4,000 scientific institutes employed about 1 million scientists and engineers. The program is limited in scope and is not designed to address the total problem posed by unemployed weapons scientists. Rather, it is one of several U.S. government nonproliferation efforts focused on Russia and other countries of the former Soviet Union, now known as the Newly Independent States. The program is implemented through research and development projects involving the Department of Energy's headquarters and national laboratories, U.S. industry, and scientific institutes in the Newly Independent States. A major purpose of the program is to identify commercial opportunities through these projects that will attract investment by U.S. companies. In this sense, the program functions as seed money that could lead to self-sustaining business ventures and create long-term employment in the Newly Independent States. As of December 1998, the program had funded over 400 projects in four countries. More than 80 percent of the projects were in Russia, and the remainder were in Ukraine, Belarus, and Kazakhstan.

In September 1998, the Department of Energy established, and Russia agreed to participate in, a new nonproliferation effort—the Nuclear Cities Initiative. This effort is not part of the Initiatives for Proliferation Prevention program but has many related elements. It focuses on the 10 nuclear cities that were among the most secret facilities in the former Soviet Union. The Department of Energy and other U.S. government agencies plan to help promote employment opportunities in the nuclear cities, primarily for unemployed weapons scientists, through commercial enterprises.

Results in Brief

The cost to implement the Initiatives for Proliferation Prevention program from fiscal year 1994 through June 1998 are as follows:

- Of the $63.5 million spent, $23.7 million, or 37 percent, went to scientific institutes in the Newly Independent States.
- The amount of money that reached the scientists at the institutes is unknown because the institutes' overhead charges, taxes, and other fees reduced the amount of money available to pay the scientists.
- About 63 percent, or $39.8 million, of the program's funds was spent in the United States, mostly by the Department of Energy's national laboratories in implementing and providing oversight of the program.

Regarding the extent to which the program is meeting its nonproliferation and commercialization goals, GAO found the following:

- The program has been successful in employing weapons scientists through research and development projects, but it has not achieved its broader nonproliferation goal of long-term employment through the commercialization of these projects.
- Program officials do not always know how many scientists are receiving program funding or whether the key scientists and institutes are being targeted.
- Some scientists currently working on Russia's weapons of mass destruction program are receiving program funds.
- Some "dual-use" projects may have unintentionally provided defense-related information—an outcome that could negatively affect U.S. national security interests.
- Chemical and biological projects may not be adequately reviewed by U.S. officials prior to approval.

The Nuclear Cities Initiative may cost $600 million over the next 5 years:

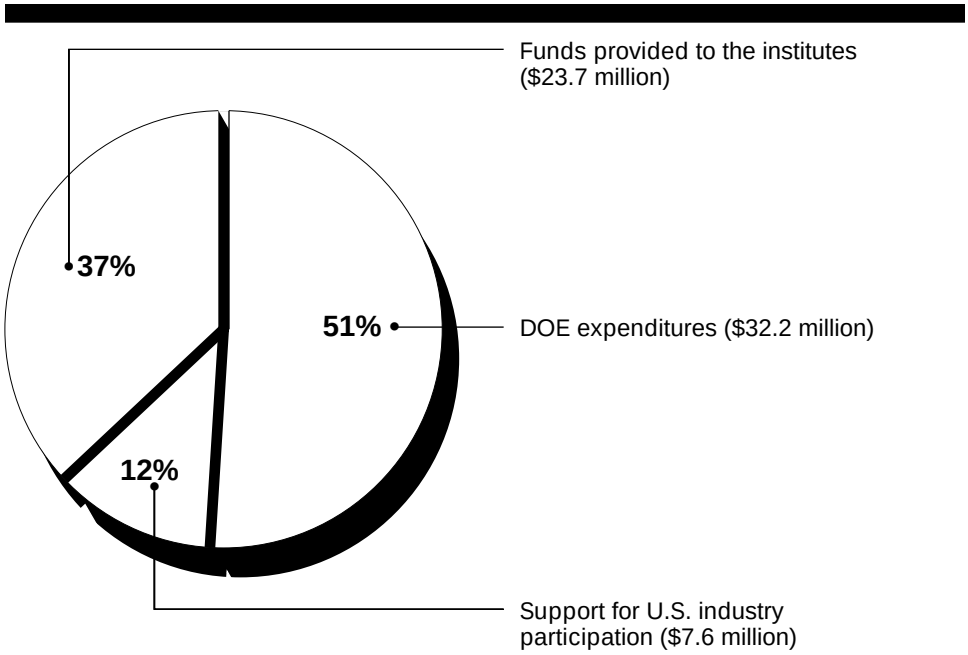
- The initiative is still largely in a conceptual phase, and it is uncertain how jobs will be created in the 10 nuclear cities because of restricted access and the current financial crisis in Russia.
- The initiative is likely to be a subsidy program for Russia for many years, given the lack of commercial success in the Initiatives for Proliferation Prevention program.

Principal Findings

About 37 Percent of Program Funds Is Reaching Institutes in the Newly Independent States

As shown in figure 1, only about 37 percent, or $23.7 million, of the $63.5 million spent for the Initiatives for Proliferation Prevention program through June 1998 went to scientific institutes. Overhead charges, taxes, and other fees reduced the funds that the scientists at the institutes received. The Department of Energy's national laboratories received about 51 percent, or $32.2 million. The remaining 12 percent, or $7.6 million, went to support U.S. industry's participation in the program. Program officials said a significant portion of program funds is provided to the national laboratories because of the oversight role played by laboratory personnel in administering the program and providing technical oversight of the projects. However, laboratory personnel told GAO that (1) the projects were usually not their primary responsibility and took up only a small percentage of their time and (2) most of their efforts were spent in the early stages of the projects developing the paperwork necessary to get the projects started.

Figure 1: Breakout of Expenditures for the Initiatives for Proliferation Prevention Program Through June 1998



Source: Department of Energy.

Impact of the Program on U.S. Nonproliferation Goals Is Uncertain

Although, in general, the program is employing weapons scientists on a part-time basis, it has not achieved its broader nonproliferation goal of long-term employment through the commercialization of projects. The lack of investment capital and markets and the inadequate training of scientists in business skills are factors impeding the program's commercial success. GAO reviewed 79 projects and determined that none was a commercial success, although several showed commercial potential, including projects dealing with solar panels, metals recycling, and technology to eradicate insects in lumber.

Nevertheless, Department of Energy officials believe that the program is successful because it has at least temporarily employed thousands of scientists at about 170 institutes and organizations throughout Russia and other Newly Independent States. However, while over one-half of program funds have been spent on implementation and oversight, GAO found that program officials do not always know how many scientists are receiving funds or whether the key scientists and institutes are being targeted. In addition, program guidance is unclear on whether funds should be going exclusively to former or previously employed weapons scientists. Some

scientists currently working on Russia's weapons of mass destruction are receiving program funds. GAO also found scientists working on nine dual-use projects that could unintentionally yield useful defense-related information and could, therefore, negatively affect U.S. national security interests. Finally, GAO found that proposed chemical and biological projects may not be adequately reviewed by U.S. officials.

Recent Nonproliferation Initiative Focuses on Russia's Nuclear Cities

The Nuclear Cities Initiative represents the most ambitious effort by the United States to assist Russia in downsizing and restructuring its vast nuclear weapons complex. According to Department of Energy officials, the initiative may cost $600 million over the next 5 years. Because the initiative is new, no funds had been spent at the time of GAO's review, but the Department expects to receive $15 million to $20 million in fiscal year 1999. The initiative will start in 3 of the 10 nuclear cities—(1) Sarov, formerly Arzamas-16, (2) Snezhinsk, formerly Chelyabinsk-70, and (3) Zheleznogorsk, formerly Krasnoyarsk-26—and expand later.

There are many uncertainties and questions related to this initiative. For example, it may be difficult for the Department of Energy to create jobs in Russia's nuclear cities, which are still considered sensitive and afford limited access to visitors. Furthermore, as a result of the August 1998 devaluation of the Russian currency, the Russian banking system has virtually collapsed, and the ability of Russian banks or the willingness of foreign investors to support job creation in the closed cities is questionable for the foreseeable future. Given the limited commercial success evidenced in the Initiatives for Proliferation Prevention program and economic conditions in Russia, GAO believes that the Nuclear Cities Initiative is likely to be a subsidy program for Russia for many years rather than a stimulus for economic development.

Recommendations

GAO is making several recommendations to the Secretary of Energy to improve the implementation and oversight of the Initiatives for Proliferation Prevention program. Specifically, GAO recommends, among other things, that the Secretary of Energy review the role and costs associated with the national laboratories' implementation and oversight of the program; require that more accurate data be obtained on the background and number of key scientists participating in the program; and clarify program guidance to determine whether scientists currently working in weapons of mass destruction programs are eligible for program funding.

GAO further recommends, among other things, that the Nuclear Cities Initiative not be expanded beyond the three nuclear cities until the Department has demonstrated that its efforts are achieving the intended results, including the creation of employment opportunities for unemployed weapons scientists.

Agency Comments

The Department of Energy, in commenting on a draft of this report, concurred with the report's findings and recommendations and said that GAO's evaluation will assist the Department in significantly strengthening the program. The Department's comments are presented in appendix VII. The Department also provided technical comments that were incorporated into the report as appropriate. The Department wanted to clarify three issues raised in the report, including (1) the dual-use potential of some projects, (2) the provision of program funding to Russian weapons scientists currently working on their own nuclear weapons programs, and (3) the lack of progress in commercializing program projects.

Regarding dual-use technologies, the Department noted that the projects identified in the report date from an earlier period of the Initiatives for Proliferation Prevention program and, at worst, might have provided only incidental military benefits to Russia. The Department noted that over the past 18 months, the program's management team has intensified its reviews of projects to reinforce understanding that they are to be directed exclusively to peaceful purposes. Furthermore, the Department said that it has been particularly sensitive to the dual-use potential of projects in the Newly Independent States' chemical and biological institutes. Nonetheless, the Department recognizes that improvements are needed in the review process and accepts GAO's recommendation to strengthen the process.

Regarding GAO's finding that the program is supplementing the salaries of some Russian scientists currently working on weapons of mass destruction, the Department stated that program policy does not allow for payment to scientists to perform weapons work and, therefore, the program is not subsidizing this work. However, the Department agreed that program guidance is unclear on whether funds should be going exclusively to former, or previously employed, weapons scientists or whether scientists currently working in weapons of mass destruction programs are eligible for program funding. The Department concurred with GAO's recommendation and said it will issue explicit program guidance on this matter within 90 days.

Finally, regarding GAO's finding that the program is not achieving its long-term commercialization goals, the Department commented that the commercialization of science and engineering projects is very difficult in the United States and much more so in Russia, particularly in the wake of the August 1998 financial crisis. The Department noted that the Initiatives for Proliferation Prevention program cannot by itself create commercial entities. It can only set measures and procedures to maximize the likelihood of their creation by U.S. industry. GAO's report recognizes the challenges faced by the Department in commercializing projects in Russia and other Newly Independent States. Given that commercialization is one of the purposes of the program, GAO recommends that the Department reevaluate the large number of projects and eliminate those that do not have commercial potential. The Department concurred with this recommendation.

Contents

Appendixes

Tables

Figures

Abbreviations

DOD	Department of Defense
DOE	Department of Energy
GAO	General Accounting Office
IPP	Initiatives for Proliferation Prevention
ISTC	International Science and Technology Center
MINATOM	Russian Ministry of Atomic Energy
NIS	Newly Independent States
USIC	U.S. Industry Coalition
VECTOR	State Research Center of Virology and Biotechnology
VNIIEF	All-Russian Scientific Research Institute of Experimental Physics
VNIIGAZ	All-Russian Scientific Research Institute of Natural Gases and Gas Technologies
VNIINM	All-Russian Scientific Research Institute of Inorganic Materials

Introduction

The collapse of the Soviet Union in 1991 heightened U.S. policymakers' concerns about the dangers posed by the Soviet Union's arsenal of nuclear, chemical, and biological weapons. The U.S. government is concerned that unemployed former Soviet Union weapons scientists pose a significant risk to nonproliferation goals because they may provide their weapons-related expertise to countries that are trying to develop weapons of mass destruction (known as countries of proliferation concern), criminal elements, or terrorist groups. It has been estimated that about 1 million scientists and engineers were employed in Russia's 4,000 scientific institutes.

Background

Public Law 103-87, "The Foreign Operations, Export Financing and Related Programs Appropriations Act, 1994" made funds available for a cooperative program between scientific and engineering institutes in the former Soviet Union and the Department of Energy's (DOE) national laboratories and other qualified institutions in the United States. In response to the act, DOE undertook a program to curb the potential for proliferation posed by weapons scientists in the Newly Independent States (NIS) of the former Soviet Union through the Industrial Partnering Program. The name of this program was changed to the Initiatives for Proliferation Prevention (IPP) in 1996. The purpose of the program is to stabilize the technology base in these countries as they attempt to convert defense industries to civilian applications. Immediate near-term attention was to be focused on institutes and supporting activities that would engage NIS weapons scientists and engineers in productive nonmilitary work. The program was expected to be commercially beneficial to the United States and the NIS. IPP was also expected to promote long-term nonproliferation goals through the commercialization of NIS technologies. While commercial benefit is a major emphasis of the program, the nonproliferation goals of the IPP program are the foundation for all program activities.

In 1998, DOE initiated another program that has complementary goals and focuses on creating jobs in 10 cities (commonly referred to as the nuclear cities) that formed Russia's nuclear weapons complex. This program, known as the Nuclear Cities Initiative, is discussed in more detail in chapter 4. It has been estimated that Russia's 10 closed nuclear cities contain about 1 million inhabitants. This total includes the families of the closed cities' weapons scientists and support personnel, such as teachers and technicians. The cities are called "closed" because access to them is restricted and they are geographically isolated. These cities have

performed the most sensitive aspects of nuclear weapons production. Two of the cities, Arzamas-16 (now Sarov) and Chelyabinsk-70 (now Snezhinsk), are primarily research institutes, responsible for weapons design. The remaining eight were originally production facilities and are now involved in dismantling weapons and in securing and disposing of nuclear materials.

The director of DOE's Office of Nonproliferation and National Security stated that the IPP program's main objectives are to (1) identify and develop nonmilitary applications for NIS defense technologies and (2) create long-term jobs for NIS weapons scientists and engineers in the high-technology commercial marketplace. DOE defines a weapons of mass destruction scientist or engineer as an individual with direct experience in designing, developing, producing, or testing weapons of mass destruction or the missile systems used to deliver these weapons. While not all workers on a project are required to satisfy the weapons of mass destruction requirement, the majority of the scientific personnel should have experience related to such weapons. The national laboratories, which supervise IPP projects are responsible for ensuring that NIS facilities and personnel were directly linked to weapons of mass destruction. The program focuses on preventing the proliferation of nuclear weapons but also addresses certain aspects of NIS chemical and biological warfare systems. The program aims to use about 70 percent of its funding for nuclear-related projects and 30 percent for chemical and biological projects.

An underlying principle of IPP is that the program is expected to have an "exit strategy" to limit U.S. government involvement. By serving as a catalyst to forge industrial partnerships between U.S. industry and NIS institutes, the program anticipated "handing off" commercial activities to the marketplace as they evolved and matured. In this sense, IPP was expected to provide the seed money that would lead to self-sustaining business ventures and help create a climate that would foster long-term nonproliferation benefits.

The IPP program is one of a number of U.S. nuclear nonproliferation programs focusing on the NIS. According to DOE officials, the program is limited in scope and is not designed to address the total problem posed by unemployed weapons scientists. Table 1.1 provides information on the various U.S. nonproliferation programs focusing on the NIS.

Table 1.1: U.S. Government Programs Focusing on Nuclear Nonproliferation Assistance to the NIS

Dollars in millions

Program name	Year established	U.S. government agency responsible for oversight	Focus of program	Funds received through fiscal year 1998
Initiatives for Proliferation Prevention (IPP)	1994	DOE	Stabilize NIS defense institutes and promote long-term employment opportunities for weapons scientists	$114
Cooperative Threat Reduction	1992	Department of Defense	Destroy and dismantle NIS weapons of mass destruction and conduct certain demilitarization activities	1,346[a]
Defense Enterprise Fund	1994	Defense Threat Reduction Agency[b]	Assist defense conversion by financing U.S.-NIS business partnerships	67
Materials Control, Protection, and Accounting (Lab to Lab)	1994	DOE	Through cooperative efforts, bring NIS nuclear materials protection, control, and accounting measures to higher standards	428
The International Science and Technology Center (ISTC)	1994	Department of State	Engage NIS weapons scientists in peaceful research to prevent proliferation	98[c]
Nuclear Cities Initiative	1998	DOE	Assist Russia in reducing the size of its nuclear weapons complex by redirecting the work of nuclear weapons scientists	0[d]

[a]Does not include activities such as certain chain-of-custody activities, Arctic Nuclear Waste, and funds transferred to other agencies for defense conversion activities, such as IPP and ISTC.

[b]This agency is part of the Department of Defense.

[c]Total from all contributors equals $215 million.

[d]DOE plans to spend about $600 million on the program over the next 5 years.

Sources: Departments of Defense, Energy, and State.

According to DOE officials, IPP complements these other programs. Department of State officials, who oversee the U.S. portion of the

International Science and Technology Center (ISTC) program, which also provides funds to NIS weapons scientists, said the two programs share similar objectives and can have a mutually beneficial effect.[1] The programs do have some important differences. For example, ISTC is a multilateral program, funded by several countries and organizations, while IPP is a bilateral program, funded solely by the United States. Unlike ISTC, which is implemented by an intergovernmental agreement, IPP is implemented through a series of national laboratory contracts with NIS scientific institutes and laboratories.

IPP Program Relies Heavily on DOE's National Laboratories and U.S. Industry

IPP is implemented by DOE headquarters, DOE's national laboratories,[2] and U.S. industry partners. The program is managed at DOE headquarters by an office director and is part of DOE's Office of Arms Control and Nonproliferation. The director has a staff of seven technical and support personnel. In addition, the office has five technical and support personnel who work on the recently established Nuclear Cities Initiative. The IPP program office is responsible for the program's overall direction, DOE and interagency coordination, final project approval, and budgetary matters.

DOE's National Laboratories

DOE's multiprogram national laboratories, plus the Kansas City Plant,[3] play a major role in the day-to-day operations of IPP. IPP projects are assigned to national laboratory scientists, known as principal investigators, who (1) develop the projects with Russian scientists, (2) provide technical oversight for the projects, and (3) provide testing and technical confirmation of projects' results when required by U.S. industry. Each laboratory also has an IPP program manager who monitors the laboratory's IPP projects. An interlaboratory board was established in 1994 to coordinate, review, and facilitate the activities of the national laboratories and provide recommendations to DOE headquarters on the execution of the IPP program. Program managers from each national laboratory make up the interlaboratory board. An interlaboratory chairman is appointed for a

[1]For more information on ISTC, see Weapons of Mass Destruction: Reducing the Threat From the Former Soviet Union: An Update (GAO/NSIAD-95-165, June 9, 1995).

[2]DOE manages the largest laboratory system of its kind in the world. The mission of DOE's 23 laboratories has evolved over the last 55 years. Originally created to design and build atomic bombs under the Manhattan Project, these laboratories have since expanded to conduct research in many disciplines—from high-energy physics to advanced computing at facilities throughout the nation. Nine of DOE's laboratories are multiprogram national laboratories. The remaining laboratories are program- and mission-dedicated facilities.

[3]The Kansas City Plant produces and procures electronic, electromechanical, mechanical, plastic, and nonfissionable metal components for nuclear weapons.

1-year period. The current chairman is from the National Renewable Energy Laboratory.

Table 1.2 shows the distribution of IPP projects and associated funding among the national laboratories as of December 1998.

Table 1.2: Distribution of IPP Projects and Associated Funding Among DOE's National Laboratories and Kansas City Plant

Dollars in thousands

National laboratory	Number of projects	Percentage of total projects	Program funds allocated	Percentage of total funds
Sandia	91	22	$14,383	18
Lawrence Livermore	56	14	14,768	18
Los Alamos	51	12	12,534	15
Oak Ridge	39	9	9,719	12
Pacific Northwest	42	10	7,806	10
Brookhaven	36	9	5,222	6
Argonne	37	9	6,572	8
Lawrence Berkeley	25	6	5,135	6
National Renewable Energy	20	5	4,304	5
Idaho National Environmental Engineering	12	3	1,192	1
Kansas City Plant	4	1	310	[a]
Total	**413**	**100**	**$81,945**	**100**[b]

Note: The amount of funds allocated refers to the IPP funds designated for projects at each national laboratory and the Kansas City Plant, not the amount of funds spent.

[a]Less than 1 percent.

[b]Total does not equal 100 percent because of rounding.

Source: DOE/IPP database.

U.S. Industry's Role

A consortium of U.S. industry participants, called the United States Industry Coalition (USIC), was established in 1994 to promote commercialization with the NIS. USIC is a private nonprofit entity headed by a president and board of directors and includes U.S. companies and universities. (See app. I for a list of the USIC members as of Sept. 30, 1998). In order to participate in the IPP program, a company is required to become a member of USIC and pay dues based on its size. The dues structure is as follows: Small companies pay $1,000 for a 2-year period; consortiums and

universities pay $2,000 for a 1-year period; and large companies pay $5,000 for a 1-year period.

IPP Projects Are the Core of the Program

The IPP program comprises over 400 funded projects. These projects represent collaborative activities among DOE's national laboratories, U.S. industry partners, and NIS institutes. The purpose of the activities is to convert NIS defense industries to commercial civilian applications. NIS nuclear, biological, and chemical weapons facilities are supposed to be the recipients of IPP funding. Also eligible are facilities that were associated with the development and production of strategic delivery systems or strategic defense systems.

IPP projects are categorized in three phases—Thrust 1, Thrust 2, and Thrust 3. The first phase is geared toward technology identification and verification. Thrust 1 projects are funded by the U.S. government and focus on "lab to lab" collaboration, or direct contact between DOE's national laboratories and NIS institutes. The second phase involves a U.S. industry partner that agrees to share in the costs of the project with the U.S. government to further develop potential technologies. The principal instrument used by DOE to promote partnerships is the cooperative research and development agreement.[4] The U.S. industry partner is expected to match funds provided by DOE. Industry costs can include in-kind support, such as employee time and equipment. Projects that do not receive any financial support from the U.S. government, known as Thrust 3, are expected to be self-sustaining business ventures.

According to DOE, 413 IPP projects had received funding as of December 1998. About 170 NIS institutes and organizations have been involved in the IPP program. The distribution of the projects among the three phases—and the associated funding levels—is shown in table 1.3.

[4]Cooperative research and development agreements are contract instruments that allow for joint U.S. government and industry cost-sharing to develop technologies for commercial application.

Table 1.3: Distribution of Projects and Funding for the IPP Program

Dollars in thousands

Thrust level	Number of projects[a]	Percentage of total projects	Amount allocated[b]	Percentage of total funding
Thrust 1	332	80	$41,777	51
Thrust 2	79	19	38,885	47
Thrust 3[c]	2	1	1,283	2
Total	**413**	**100**	**$81,945**	**100**

[a]Includes projects categorized as funded, under way, and completed.

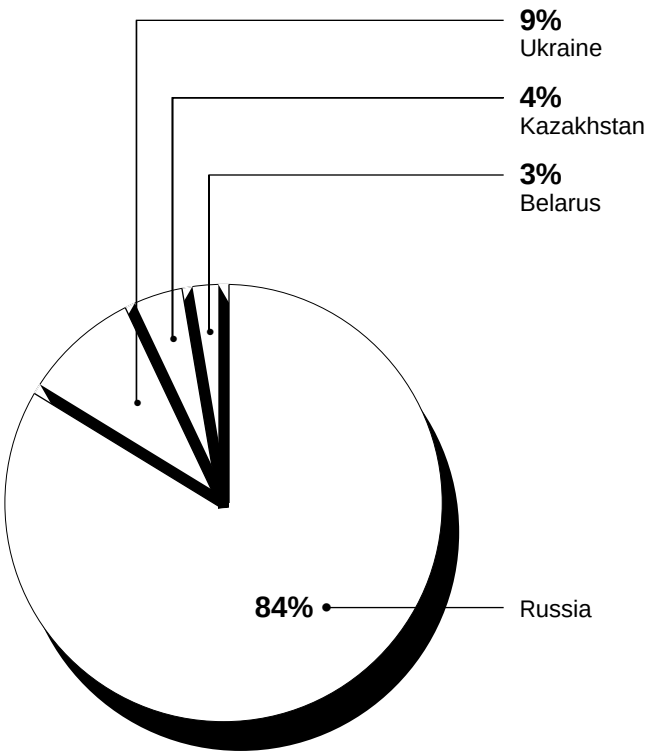
[b]These amounts refer to program funds designated for specific projects, not total funds spent.

[c]Although Thrust 3 projects are intended to be self-sufficient, one has received IPP funding.

Source: DOE/IPP database.

The IPP program is focused on four NIS countries—Russia, Ukraine, Belarus, and Kazakhstan. The bulk of the program's effort is concentrated on Russia. About 84 percent of the funded projects are related to Russia, as shown in figure 1.1.

Figure 1.1: Distribution of IPP Projects by Recipient Country as of December 1998



Note: Total based on 412 projects because 1 project was not associated with a country.

Source: DOE/IPP database.

IPP projects evolve from various sources. According to DOE and national laboratory officials, projects are proposed primarily by NIS scientists, laboratory officials, and U.S. industry. DOE, national laboratory, and State Department officials noted that many early IPP projects were "off the shelf" ideas of the national laboratories that heavily favored basic science with limited commercial potential. IPP's former program director told us the program's first priority was to initiate immediate projects at key NIS institutes to stabilize personnel who were facing the threat of economic dislocation. The idea was to get as many projects as possible under way in as short a time as possible. He noted that a key element in selecting early projects was to learn as much about the facilities and personnel as

possible to promote and increase transparency at the NIS weapons institutes. In mid-1995, less than a year after IPP received its first year's appropriation of $35 million, 175 Thrust 1 projects and 29 Thrust 2 projects had received almost $20 million.

Procedures for Reviewing Projects

Before they are approved for funding, all proposed IPP projects are reviewed by DOE's national laboratories, DOE headquarters, and a U.S. government interagency group comprising representatives of the departments of State and Defense and other agencies. A project is initially reviewed by the DOE national laboratory that proposed the project. After passing the initial review, the project is further analyzed by the interlaboratory board and its technical committees. The project is then forwarded to DOE headquarters for review. DOE, in turn, consults with the Department of State and other U.S. government agencies for policy, nonproliferation, and coordination considerations. DOE headquarters is responsible for making the final decision on all projects.

The IPP Program Faced Early Problems

According to its former director, the IPP program (1) faced continuous funding shortfalls, (2) was not adequately supported by DOE management, (3) faced confusion about the appropriate relationship between the national laboratories and U.S. industry over the commercialization of NIS technology, and (4) had poor relations with the State Department. Furthermore, the former program director noted that DOE management did not provide adequate support services, failed to recognize the program's successes, and was unwilling to support budget levels consistent with DOE's original commitments. He also noted that DOE management failed to address a series of problems with the State Department until irreparable damage had been done. These alleged problems ranged from broader policy-level issues to administrative matters, such as lack of support in processing country clearances for DOE visits to the NIS. The Department of State's Senior Coordinator for Nonproliferation Science Programs told us that constructive engagement between the two agencies ceased and employees of both became embroiled in personality conflicts. According to the former IPP program director, DOE did not adequately address these impediments in total, indicating that DOE did not consider the IPP program to be a high-priority nonproliferation activity.

Improvements in Program Management Since the Appointment of a New Director

DOE and State Department officials acknowledged that the IPP program had difficulties in the early years but maintained that the situation has improved markedly with the appointment of a new IPP program director in September 1997. The new program director told us that he has the full support of DOE management and the IPP program has improved relations with the Department of State.

In the midst of these problems, DOE commissioned two reviews of the program by private contractors. The first study, which cost $10,000, was completed in August 1997, and the second, which began shortly after the first review was completed in October 1997, cost $99,985. The studies identified many similar programmatic weaknesses, including flaws in program management, oversight, and failure to commercialize projects. Recommendations to improve the program included

- obtaining the support of DOE management for the IPP program,
- establishing commercialization priorities and developing a commercialization model,
- incorporating commercialization criteria in project approvals,
- repairing relationships with other U.S. government entities,
- reaching out aggressively to industrial and financial firms, and
- restructuring the USIC model to enhance commercialization potential.

According to the program director, since his appointment, he has implemented almost all of the recommendations. He further noted that program staff have been upgraded so that headquarters can assume control of financial and program management responsibilities from DOE's national laboratories and Albuquerque field office.

Objectives, Scope, and Methodology

The Chairman of the Senate Committee on Foreign Relations asked us to review (1) the costs to implement the IPP program for fiscal years 1994-98, including the amount of funds actually received by NIS scientists and institutes; (2) the extent to which IPP projects are meeting their nonproliferation and commercialization objectives; and (3) DOE's Nuclear Cities Initiative.

To determine the purpose and scope of the IPP program, we reviewed DOE and State Department program files, discussed the program with various DOE officials, and met with U.S. industry officials. We met with the former director of the IPP program to obtain information about its history and also had numerous discussions with the current IPP director and members of

his staff. We also met with the directors of DOE's Office of Nonproliferation and National Security and Office of Arms Control and Nonproliferation. We obtained information on the IPP program from Sandia National Laboratory, Los Alamos National Laboratory, and Argonne National Laboratory. At the Department of State, we met with the Special Adviser to the President and the Secretary of State on Assistance to the Newly Independent States and his staff. We also met with State's Senior Coordinator for Nonproliferation, Science Programs, and with various officials from the U.S. Embassy, Moscow. In addition, we interviewed several U.S. industry representatives who have been associated with the IPP program, including the former presidents of the U.S. Industry Coalition and officials from the University of New Mexico who provided administrative support to the coalition.

To identify the IPP program's costs for fiscal years 1994-98, we obtained data from DOE's IPP program office and national laboratories. We discussed these data with budget and program analysts from DOE's Office of Nonproliferation and National Security.

To assess the extent to which the IPP program was meeting its nonproliferation and commercialization objectives, we judgmentally selected 79 IPP projects valued at $23 million. Of the 79 projects, 70 were with Russia, 7 were with Ukraine, and 2 were with Belarus. Of the projects reviewed, 46 were Thrust 1, 30 were Thrust 2, and 2 were Thrust 3. One project was described as program directed and did not have an associated thrust level. The projects were managed by five DOE laboratories—Argonne National Laboratory, Los Alamos National Laboratory, the National Renewable Energy Laboratory, Oak Ridge National Laboratory, and Sandia National Laboratory. (See app. II for a list of the projects.)

We based our selection of projects on a number of factors. For example, we chose our projects from five DOE national laboratories that accounted for 57 percent of all funded IPP projects. The dollar size of projects was also a consideration. We chose projects whose allocations ranged from $30,000 to $1.4 million. In addition, we included the number of NIS scientists employed on the projects among our selection criteria. Furthermore, we asked DOE to provide us with a list of IPP projects that would be useful to review. DOE queried several national laboratories and provided that list to us. Whenever possible, we included these projects in our sample. We also provided DOE with a list of proposed projects that

identified the Russian institutes we planned to visit. DOE officials said that the projects we chose represented a fair sample of IPP projects.

We used the IPP information system to identify IPP projects. The database was developed and maintained by Los Alamos National Laboratory. The system holds data on all funded IPP projects as well as draft proposals. Members from the national laboratories and the Kansas City Plant, DOE headquarters, the Department of State, and many U.S. companies that are members of USIC have access to the system. For the projects we selected for our sample, we did find some inconsistencies, inaccuracies, and incomplete data. However, we did, whenever possible, obtain corrected data through follow-up discussions with the principal investigators at each U.S. laboratory and with Russian officials.

To assess the impact on U.S. nonproliferation goals of the IPP program, we met or spoke with the principal investigator for each IPP project. We used information contained in DOE's IPP information system to determine the extent to which each project focused on critical nonproliferation objectives, such as the number of weapons scientists engaged in the project and its potential commercialization benefits. We discussed with the principal investigator how the project was meeting these objectives and what role the investigator played in monitoring the project. We met or spoke with principal investigators from Los Alamos National Laboratory, Sandia National Laboratory, Argonne National Laboratory, Oak Ridge National Laboratory, the National Renewable Energy Laboratory, and the Kansas City Plant.

In several instances, we contacted U.S. industry officials to follow up on the status of commercialization activities. For example, we discussed selected projects and related commercial activities with U.S. industry officials from RUSTEC, Inc. (Camden, New Jersey); Energy Conversion Devices, Inc. (Troy, Michigan); Bio-Nucleonics (Miami, Florida); TCI, Inc. (Albuquerque, New Mexico); and Raton Technology Research, Inc. (Raton, New Mexico).

We visited Moscow and St. Petersburg, Russia, in September 1998 to meet with government and institute officials about the program and selected IPP projects. We focused our visit on Russia because over 80 percent of all funded IPP projects are there. We met or communicated with representatives from the Russian Ministry of Atomic Energy and 18 institutes and organizations that receive IPP funds. We met with the following organizations in the Moscow area: Entek (Research and

Development Institute of Power Engineering), the Kurchatov Institute, the Research Institute of Pulse Technique, KVANT/Sovlux, the All-Russian Scientific Research Institute of Natural Gases and Gas Technologies (VNIIGAZ), the Gamaleya Institute of Epidemiology and Microbiology, the Institute of Nuclear Research, the All-Russian Scientific Research Institute of Inorganic Materials (VNIINM), the Engelhardt Institute of Molecular Biology, and the Institute of Biochemistry and Physiology of Microorganisms. In St. Petersburg, we met with the following organizations: the St. Petersburg State Electro Technical Institute, the V.G. Khlopin Radium Institute, the Ioffe Physico Technical Institute, and the Association of Centers for Engineering and Automation (St. Petersburg State Technical University). We also met with officials from the All-Russian Scientific Research Institute of Experimental Physics (Sarov). In addition, we met in the United States with officials visiting from two other Russian institutes—the N.N. Andreyev Acoustics Institute and the Landau Institute of Theoretical Physics. We also had discussions with the director general of the State Research Center of Virology and Biotechnology (VECTOR). See appendix III for more information about each institute we visited.

One problem we encountered in doing our work was that we were denied access to Sarov, a closed nuclear city in Russia. We had planned to visit the city to learn more about its economic conditions and review several IPP projects. We had been granted access to visit the city, including obtaining the required entry and visa documents. Furthermore, IPP contracts with NIS institutes have a provision that allows for audits by GAO. After we had arrived in Russia, however, we were informed that the visit had not been cleared by Russia's Federal Security Bureau (formerly known as the KGB) and we would not be permitted to enter Sarov. Representatives from Sarov, however, traveled to Moscow to meet with us. They told us that they wanted us to visit their city but did not have the final approval authority.

We performed our work from February 1998 through February 1999 in accordance with generally accepted government auditing standards.

About 37 Percent of the IPP Program's Funds Reach Institutes in the Newly Independent States

As of June 1998, institutes in the Newly Independent States (NIS) had received about 37 percent of all IPP funding. About 51 percent of the program's funds have gone to DOE's national laboratories, and 12 percent have supported U.S. industry's participation in the program. The portion allocated to DOE's laboratories goes for the salaries of scientists engaged in the IPP projects, as well as for laboratory overhead charges. In Russia, scientists and others working on IPP projects received less than 37 percent of IPP funds because of various Russian taxes and administrative overhead charges on IPP funds at their institutes. DOE officials told us that they view the Russian taxes as costs over which they have no control and consider administrative charges an acceptable program cost.

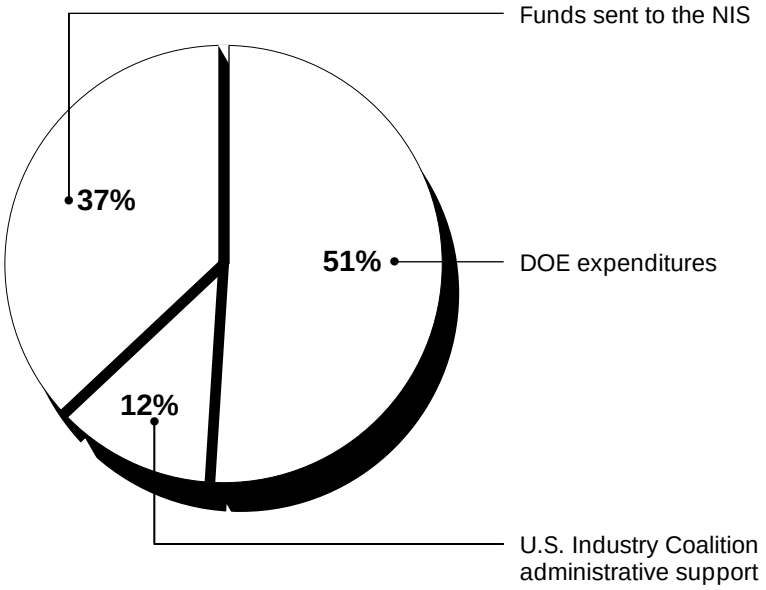
For the IPP program to achieve its goals, DOE officials told us it should be funded at about $50 million per year. At that level, they believe the program could be phased out by 2007. However, the program has never received that much funding in any one year. For example, in fiscal year 1994, the IPP program received its largest amount—$35 million. DOE is developing a strategic plan to establish goals for the IPP program and a means of measuring its accomplishments.

Most IPP Program Funds Go to DOE's National Laboratories

Most IPP funds have gone to DOE's national laboratories to cover (1) the costs of scientific research related to IPP projects (2) the costs of developing or monitoring the projects, and (3) various kinds of administrative and overhead charges. As indicated in figure 2.1, an analysis of the program's expenditures from fiscal year 1994 through June 1998 shows that 51 percent, or $32.2 million, of the $63.5 million spent on the IPP program has gone to reimburse DOE laboratories.[1]

[1]The administrative costs for DOE headquarters staff and the contractors who assist those who manage the program are not included in any of these amounts.

Figure 2.1: Percentage of IPP Expenditures for DOE Laboratories, Industry Coalition, and Newly Independent States, From Fiscal Year 1994 Through June 1998.



$23.7 million = NIS expenditures.

$10.8 million = DOE laboratories' direct project cost.

$21.4 million = DOE laboratories' administrative and overhead cost.

$7.6 million = U.S. Industry Coalitiion's administrative cost.

Source: DOE.

The direct costs of DOE laboratories for projects ($10.8 million, or 17 percent of all program expenditures) include funds used for the salaries and travel costs of DOE laboratory researchers during the time they worked on specific IPP projects. Principal investigators at the DOE laboratories told us they and their staff spent time conducting research related to the projects or monitoring the NIS contracts. IPP projects were usually not the main responsibility of the principal investigators. In several cases, they told us they spent about 5 to 10 percent of their time monitoring an IPP project. Furthermore, they said they spent most of this time during the early stages of the project, developing the paperwork necessary to get the project started.

Besides the funds attributable to the principal investigators and their research staff at DOE laboratories, a small portion of IPP funds was allocated for equipment and materials. However, the bulk of the expenditures for DOE laboratories went for administrative support fees. Totaling $21.4 million, these expenditures represented 33.7 percent of total program expenditures. The support fees include

- a portion of laboratory overhead, including the salaries and travel expenses of the IPP program managers, who coordinate the program among scientists at each laboratory;
- various standard administrative and support costs, paid to the contractor that operates the laboratory;
- another administrative charge, specifically for this program, taken from the funds earmarked for institutes in the Newly Independent States; and
- materials and subcontracts purchased in the United States and valued at $2 million.

The director of the IPP program told us he was concerned about the laboratories' costs for operating the program and the length of time to receive financial information from some of the labs. The director of the Office of Nonproliferation and National Security and other DOE officials told us that they believe laboratory overhead should be reduced to maximize the amount of money received by NIS weapons institutes. The director also told us that although her office supported funding the principal investigators, IPP should not be a jobs program for DOE's national laboratories. The Department of State's special adviser on assistance to the NIS told us that while he supported the goal of IPP, he questioned how valuable the laboratories are in promoting the goals and objectives of the program and said that questions should be raised about the extent and duration of the laboratories' involvement.

Industry Support Services Accounted for Expenditures of Over $7 Million

Until the end of fiscal year 1998, the University of New Mexico provided administrative services to the U.S. Industry Coalition (USIC), the consortium of industry partners interested in cooperating with DOE on IPP projects with the Newly Independent States. DOE's costs for the University of New Mexico's participation totaled about $7.6 million through June 1998. DOE anticipated that the consortium would become self-sustaining after 5 years, following strategic investments in successful IPP projects. According to DOE officials, the university never fulfilled the role envisioned for it, and its staff generally did not possess the required expertise. DOE decided to terminate funding for the university as of

September 30, 1998. DOE and the University of New Mexico agreed that the university's resources were not well suited to support IPP's increased emphasis on commercializing projects. The university may, however, provide some support services to IPP in the future.

IPP program officials and industry members of USIC, the chartered corporation, told us that USIC should still play a role in promoting the commercialization of NIS technologies. On October 1, 1998, DOE entered into an agreement with USIC to pursue commercial efforts with the NIS. USIC is currently organizing an office in Washington, D.C., to carry out its responsibilities. DOE has agreed to support USIC's operations through September 30, 1999, at a cost of $1.6 million.

NIS Institutes Receive About 37 Percent of IPP Funds

As of June 1998, about 37 percent, or $23.7 million, of the program's expenditures had been used to pay for work at NIS institutes; however, not all of these funds are reaching weapons scientists, engineers, and technicians who work on IPP projects. After a DOE laboratory wires a payment of funds to a bank designated by a Russian institute[2]—a step DOE takes when a principal investigator is satisfied that a segment of work on a project is complete—the bank may charge a fee, some taxes may be paid, and the institute may take some of the funds for general overhead expenses. When a Russian scientist finally receives a payment, the individual may have to pay additional taxes on that income. Although DOE has sometimes tried to help the institutes avoid or postpone tax payments, it is unclear how successful such efforts have been.

During our review, we found that principal investigators at DOE laboratories often did not know how much IPP funding their Russian counterparts received. Neither DOE nor its laboratories require any receipts or other explanation from the Russian institutes to show how the funds sent to Russia are allocated. Financial officials and others at the DOE laboratories are satisfied if they have documentation that the funds went to the designated bank account for the NIS institute. Principal investigators told us that their role in monitoring the contracts was mainly to establish the contracts or monitor the technical work products of the NIS researchers.

[2]We focused on Russia because it received 84 percent of the IPP projects.

Amount of IPP Funding Received by Russian Scientists and Engineers Varies

DOE does not have detailed records of the amounts of IPP funding received by individual scientists, engineers, and technicians in the NIS, and therefore it is uncertain how much of the funding supplements their salaries. However, at Russian institutes, according to a March 1998 DOE report to the Congress, the average IPP recipient receives about 47 percent of the funds provided to the institute. The remainder typically goes for various payroll taxes—pensions, medical insurance, and the equivalent of Social Security—along with 7 to 18 percent for the institute's overhead costs.[3] In addition, the IPP recipient's salary may be subject to an income tax of 12 to 35 percent. The director of the IPP program said that overhead payments to the institutes were justified as long as they were reasonable because they helped to stabilize the institutes. Even if all of the funds destined for the Newly Independent States are not allotted for salaries, DOE officials said the funds are being used mostly to achieve the goal of stabilizing the institutes.

At several of the 15 institutes we visited in Russia, we attempted to determine how much IPP funding each institute received and how the funding was allocated at each institute. Although we were not usually provided with documentation to review, in general, Russian officials told us that the funds received by the institutes went for taxes, administrative and overhead costs, and salaries. An analysis of the information provided to us indicated that the amount of IPP funding reaching weapons scientists and technicians at the institutes varied. For example, we were told at one institute that none of the IPP funds went for salaries; instead, the funds were used for overhead, travel, computers, and Internet access. (See app. IV for additional information on how funding was allocated at Russian scientific institutes).

We also met with the director of a Russian institute who was visiting the United States and participated in the IPP program. He told us that he did not receive the amount of funding that DOE's information showed going to his institute. Our review of the project found that (1) DOE's information was inaccurate, (2) laboratory officials responsible for the project did not know how much went to the institute, and (3) half of the funds allocated to the Russian institute went to a U.S. company instead. We discussed this project with DOE officials. They told us that they investigated the case, with the assistance of their General Counsel, because of the concerns we raised. DOE found that a number of actions occurred during the course of

[3]The DOE report is entitled Taxation of the DOE Initiatives for Proliferation Prevention Activities in the Russian Federation (Mar. 1998). The report is based on information that Sandia National Laboratory officials gathered from their Russian counterparts on 28 IPP projects.

the project that were contrary to IPP policies and practices and said that they will not be allowed to recur. A discussion of this IPP project follows:

DOE's IPP database showed that the N.N. Andreyev Acoustics Institute, in Moscow, received $68,200 of the $99,700 spent for the demonstration of an acoustic nozzle developed at the institute.[4] However, the director of the institute told us that the institute actually received $27,000. According to the director, about 40 percent of the $27,000 was allocated for the salaries of scientists and others participating in the project. For example, the Russian inventor of the nozzle received $5,000 (equal to about 50 months' salary), or about 5 percent of all IPP funds spent on the project. The remainder of the $27,000 went for taxes in Russia and the institute's overhead.

Records supplied by Argonne National Laboratory show that it paid out $60,000 rather than $68,200 in February 1998. The IPP program director at Argonne said that the IPP database showed $68,200 was spent for the NIS institute, but $8,200 of that amount was part of a $39,700 payment to Argonne, not to the Russian institute. According to the DOE laboratory's records, about $60,000 went to a bank account designated by the Russian institute. However, the manager of Argonne's IPP program said he suspected that the Russians received less than half of the $60,000. This is because Argonne transferred the $60,000 to a U.S. company that represented the Russian institute. Argonne officials, including the internal audit manager who reviewed the laboratory's records on our behalf, told us it was unclear how much of the $60,000 went to the Russian institute or its personnel.

The U.S. company became the institute's exclusive agent for acoustic activities in North America the same week in February that the agreement with the DOE lab was finalized. The company provided us with documents stating that the Russian institute would receive $30,000 and the U.S. company would receive the remaining $30,000. According to a letter the company sent the Russian institute on April 20, 1998, the Russian share included (1) $4,368 for equipment and travel costs for two institute officials visiting the United States, (2) $2,500 for the institute's share of program and demonstration set-up costs, and (3) $23,131 for the Russian institute's costs.

[4]The nozzle, which uses sound vibrations to break up water molecules and create a fine mist, might have several commercial applications. For example, it might be used as a fire suppressant.

Some IPP Funds Are Used for Russian Taxes

In general, representatives of the Russian institutes we visited said it was typical for a portion of the IPP funds to be used for taxes. The March 1998 DOE report to the Congress on Russian taxation of the IPP program described the tax situation for IPP as a problem, but not as debilitating.[5] According to the report, there was no comprehensive mechanism that guaranteed tax exemption for U.S. nonproliferation programs, but a temporary agreement between the United States and Russia, known as the Panskov-Pickering Agreement, provided for deferring taxes.[6] In many instances, however, Russians involved with the IPP program were not aware of the temporary agreement on income tax deferment and therefore did not contact the U.S. embassy to obtain it. In other cases, local authorities ignored the agreement, according to the DOE report. By July 1998, according to a DOE official, the Russian State Tax Service said that the agreement was no longer valid and all postponed taxes were due; however, the agreement was reinstituted in November 1998. A DOE official said that if the Russian Duma ratifies and the Russian President approves a bilateral agreement, signed by the United States and Russia in 1992 and providing exemptions from some Russian taxes for U.S. aid, then the tax deferments under the Panskov-Pickering Agreement may become permanent.

Unlike the IPP program, some aid programs to Russia, such as the ISTC program, provide assistance that is exempt from Russian taxes because of an intergovernmental agreement. DOE officials said that while the ISTC program does not pay taxes because of an intergovernmental agreement, all projects, including those of the ISTC, may still involve some customs duties, bank fees, and taxes at the local if not at the national level.

[5]The DOE report is called Taxation of the DOE Initiatives for Proliferation Prevention Activities in the Russian Federation (Mar. 1998).

[6]In 1996, the Panskov-Pickering Agreement or "Agreement on the Implementation of Tax Postponements under Gratuitous Assistance Rendered to the Russian Federation by the United States of America" was signed, providing temporary tax deferment of some taxes, including income taxes, value-added tax, excise tax, customs duties, and property tax.

DOE Officials See Need for Consistent Program Funding and Strategic Plan

As shown in table 2.1, funding levels for the IPP program have varied. In fiscal year 1994, the program's initial year, IPP received its highest annual level of funding, $35 million. In the following year, it was not funded.[7] DOE officials believe the program needs more consistent funding and say they see a need for a program plan with adequate performance measures.

Table 2.1: Annual Funding for the IPP Program

Dollars in millions

Fiscal year	Funding
1994	$35
1995	0
1996	20[a]
1997	29.6
1998	29.6
1999	22.5
Total	**$136.7**

[a]The fiscal year 1996 funds include $10 million in no-year funding that the Department of Defense transferred to IPP from the Cooperative Threat Reduction Program, with the understanding that $2.5 million would be spent at chemical and biological institutes.

Source: DOE.

DOE officials hold a variety of views on when to end the IPP program. In part, their views depend on the program's receiving adequate funding and accomplishing its mission. The former director of the program told us he believed the program could have ended after 5 years if it had received adequate funding. Originally, he anticipated that it would receive $50 million per year and become self-sustaining after 5 years.

The current director of the program also told us in February 1998 that the program could end by 2006 if it was adequately funded at about $50 million per year. However, in June 1998 he said that funding the program and then terminating it after 5 years was artificial. He said the program should be continued as long as it is useful and meets a need.

The director of DOE's Office of National Security and Nonproliferation said that she would like to see the IPP budget increased to $50 million per year. She believes that amount would be sufficient for DOE to make a significant

[7]According to DOE, not only federal funds are involved in assisting the NIS under the IPP. IPP tries to leverage $1 or $2 of private support for every $1 provided in federal funds. For some projects we reviewed, the private support was not in dollars sent to institutes of the former Soviet Union; instead it was more likely to be in-kind support that was used by the U.S.commercial partner to pay its U.S. staff to evaluate the work of researchers in the former Soviet Union.

impact on nonproliferation and commercialization and to end the program. She believes that adequate funding could lead to a phaseout by 2007. She noted that as DOE closes in on the 2000 time frame, it will be time to take a hard look at IPP, just as DOE will take a look at its other nonproliferation programs.

The successful completion of the program depends on identifying the goals of the program and determining when they have been achieved. The director of the program is developing program goals and a strategic plan. In February 1998, the director said the program was changing how it planned to measure performance. He noted that the program has to be results oriented if it is to succeed. In the past, the most commonly used measures of the program's success included the number of projects, the amount of funds a project provided to the NIS, and the number of institutes engaged. These measures would continue to have some use, according to the director, but IPP must employ more meaningful measures that show results. Consequently, he was looking at measures such as the number of patents issued for projects or the number of companies created. The director said the strategic plan will include about a dozen ways to measure performance. As of January 1999, the IPP program had developed a draft strategic plan, which includes some performance measures. Possible program measures include, among other things, (1) the amount of funds spent, (2) the number of NIS employees engaged in the IPP program, and (3) the number of job opportunities created. Possible commercialization measures include (1) the number of Thrust 3 projects, (2) the amount of private-sector funding for Thrust 2 and Thrust 3 projects, and (3) the number of commercial patent applications.

Impact of the IPP Program on U.S. Nonproliferation Goals Is Uncertain

Russian officials participating in the IPP program told us that IPP program funds are helping to prevent some institutes from closing and are supplementing the salaries of some scientists. However, numerous obstacles, such as a lack of capital and markets, are preventing the program from achieving its long-term goal of successfully commercializing IPP projects.

DOE's implementation and oversight of the IPP program raises concerns. For example, program officials are using inconsistent and imprecise methods to identify the number and background of NIS scientists and institutes receiving IPP funding. As a result, some institutes receive IPP funds, even though they are not associated with weapons research and development programs. In addition, IPP projects are not just directed to former weapons scientists. In some cases, scientists currently working on Russia's weapons of mass destruction program are receiving IPP program funds to supplement their salaries. Some of the projects we reviewed also had "dual-use" implications that could yield unintended, yet useful, defense-related information. Furthermore, some U.S. officials responsible for reviewing proposed IPP projects related to chemical and biological research told us that they did not always receive enough information from DOE to adequately review the projects.

IPP Program Funds Are Helping Some Institutes and Scientists

In general, officials at the 15 Russian institutes we visited were supportive of the program. Officials from three institutes told us that the IPP program had prevented their laboratory or institute from shutting down and reduced the likelihood that scientists would be forced to seek other employment. A representative from Sarov told us that without the IPP program, the situation at the institute would be a disaster. An official from the Research Institute of Pulse Technique said the IPP funding added $200 per month in salary and benefits for each employee assigned to the project, a significant amount for a Russian scientist. Some institute officials told us that the benefits of the IPP program went beyond financial support. For example, the general director of the St. Petersburg State Technical University said the IPP project on metal recycling has helped teach the university how to do business with the United States.

Given the dire financial and physical conditions at some of these locations, it is not surprising that institute officials were grateful for IPP funds. At several institutes we saw poorly lit, unheated work space and laboratories, aging equipment, crumbling floors, and peeling paint. Furthermore, some institute officials told us that their workers had not been paid in several

months and salaries had been eroded by the recent devaluation of the ruble, the Russian currency. For example, officials from the city of Sarov, which contains a major Russian nuclear weapons design facility, told us that the average monthly salary was about $200. The recent devaluation of the ruble, however, has reduced the actual value of the salary by about half.

Long-Term Commercialization Objective Has Met With Limited Success and Will Be Difficult to Achieve

To date, no IPP projects can be classified as long-term commercial successes, and only a few have met with limited success. Overall, of the over 400 funded projects, only two have achieved Thrust 3 status (as potential self-sustaining business ventures) and 79 are categorized as Thrust 2 (an intermediate step toward commercialization). Even the Thrust 3 projects that we reviewed have not achieved the type of commercial success envisioned by DOE. In fact, one of these projects, which is designed to help one of Russia's closed nuclear cities develop material used in the production of silicon chips, does not have a U.S. industrial partner and faces an uncertain future.

DOE and national laboratory officials told us that when the program was started, there was a general expectation that most projects would not graduate from Thrust 1 to Thrust 2 to Thrust 3. According to DOE data, 31 Thrust 1 projects have evolved to Thrust 2, and 1 project has evolved from Thrust 2 to Thrust 3. Plans for the IPP program envisioned, however, that projects would move from Thrust 2 to Thrust 3 in 3 years.

The IPP program director told us he was disappointed that more projects have not evolved more quickly. He indicated that there were too many ongoing Thrust 1 projects with little or no commercial potential. He said, however, that the limited commercial success of the IPP projects is not surprising in view of the difficulties involved in commercialization.[1] According to the director, commercializing science and engineering projects is very difficult in the United States and much more difficult in Russia. He noted that commercializing a new specialty chemical or polymer can take from 6 to 8 years in the United States. IPP projects do not have to start at the Thrust 1 phase. DOE officials are now stressing the commercialization of projects and told us that projects should have a U.S.

[1]In 1994, we reported that DOE's national laboratories faced challenges in commercializing products. Although the potential for commercial product development exists, the actual outcomes will not be known for several years. Over half of the national laboratory managers of programs with commercial product potential expected clear evidence of that potential to emerge within 5 years. For more information, see National Laboratories: Are Their R&D Activities Related to Commercial Product Development? (GAO/PEMD-95-2, Nov. 25, 1994).

industry partner identified at the conceptual stage. The director of DOE's Office of Arms Control and Nonproliferation told us that if a project does not have a clear commercial objective, he will not approve it unless there is an overriding national security consideration.

We found that many factors affected commercialization, including a lack of capital, the lack of a clearly defined goal for achieving commercial success, the inadequate training of NIS scientists in business-related skills, limited markets, and concerns about intellectual property rights. The difficulties of commercializing IPP projects have increased with the recent economic crisis in Russia. We found some IPP projects with limited commercial success—that is, a product has been developed and appears marketable, but customer demand for the products has generally not been established. A few projects we reviewed showed commercial potential and had interested U.S. industry partners. These included (1) a metals recycling partnership between U.S. industry and a Russian entity, (2) a photovoltaic cell renewable energy production project, and (3) a technology to eliminate insects from Russian lumber. For the first two projects, the U.S. industry-NIS partnerships were established before the partners began to participate in the IPP program. (See app. V for more information on these and other IPP projects.)

Several institute officials told us that current economic conditions in Russia discourage commercialization and investment. Some institute officials told us that Russian banks had frozen their assets and they were unable to be paid for work being done under IPP projects. Worsening economic conditions compound the difficulties associated with investing in Russia. According to the director general of the Khlopin Institute, it is unrealistic to expect that nuclear scientists trained under the Soviet system can easily make the transition to a market-based economy. He also believed that DOE's national laboratories were not well equipped to promote commercialization in Russia.

A couple of DOE national laboratory officials told us that they did not have the background and skills needed to fully implement commercialization programs in the NIS. The IPP program director at Sandia National Laboratory told us that the laboratories have done a good job of identifying potential projects and U.S. industrial partners. However, a laboratory is not the place to raise venture capital and develop markets for products because a laboratory does not have that kind of expertise. The actual commercial development must come from U.S. industry. According to the general director of the St. Petersburg State Technical Institute,

Russia needs an infrastructure in place before it can undertake significant commercialization activities. He said that, in the long-term, Russia needs to develop a cadre of managers who know how to deal in a market economy. Without such managers, commercialization will not take place on a broad scale in Russia.

Despite the limited success in commercializing IPP projects, DOE officials told us that the program has been successful because it has at least temporarily employed thousands of weapons scientists at about 170 institutes and organizations throughout Russia and other Newly Independent States.

DOE's Implementation and Oversight of the IPP Program Raise Concerns

Our review raised several concerns about DOE's implementation and oversight of the IPP program including

- the adequacy of DOE's efforts to obtain information on the background and number of NIS scientists and institutes engaged in IPP projects;
- the appropriateness of DOE's supplementing the salaries of scientists currently working in Russia's weapons of mass destruction program;
- the advisability of DOE's funding projects that could unintentionally provide defense-related information to Russian and other NIS scientists; and
- the adequacy of DOE's reviews of IPP projects dealing with chemical and biological research.

Background Information of NIS Scientists and Institutes Was Not Consistently Obtained

DOE's program guidance specifies that each project proposal should include a discussion of the background and experience of the key NIS scientists and institutes to determine that they possess the appropriate weapons of mass destruction background. The guidance also specifies that the principal investigator at the DOE laboratory is responsible for providing this information for each project. Some principal investigators told us that information on the backgrounds of the NIS scientists and engineers was not relevant to the project's success. In two instances, they said it was "none of their business" to ask for such information, claiming that doing so would have been too intrusive or would have resulted in a breach of Russia's national security laws. One principal investigator told us that he does not want to know the roles of the scientists because this information could jeopardize relationships and put the NIS scientists at risk for revealing such information. At one national laboratory, the IPP program director said the laboratory does not generally ask about scientists'

background because of concerns about undermining the potential success of a project.

During our visit to Russia, we asked for and received background information on scientists from officials at some institutes. Representatives from Sarov told us that it was not a violation of Russia's laws to provide background information, provided that a request was limited to general information about the scientists' nuclear weapons-related activities.

DOE's IPP program director told us that the principal investigators monitor the projects very closely, helping to ensure accountability. However, we found that the degree of oversight varied among the U.S. laboratories. In general, the principal investigators told us that they monitor the projects through contract deliverables (end products) received from the institutes, such as technical reports. A principal investigator is satisfied that an institute has complied with the terms of the contract between the national laboratory and the NIS institute upon (1) receiving the required deliverable(s) and (2) ensuring that the institute has met other technical expectations. Generally, the principal investigators did not believe their role included verifying the number of scientists working on a project or trying to determine if the scientists were performing weapons-related work while receiving IPP funding. A Sandia National Laboratory principal investigator told us that he was not concerned about the number of NIS scientists who were involved in the project as long as the institute met the technical requirements of the contract.

From the projects we reviewed, it was not always clear how NIS institutes and scientists were selected for IPP funding. DOE and laboratory officials told us that at the beginning of the program, it was important to get as many projects as possible under way in as short a time as possible. They noted that part of the initial phase of the program was focused on learning about the NIS institutes. A State Department official told us that IPP has not focused consistently on the most critical weapons institutes. This official told us she is uncertain that IPP program officials always ask the right questions about reaching the highest-priority NIS scientists when screening projects for funding. The president of the Kurchatov Institute, in Moscow, told us that, in general, IPP projects have not targeted the most critical nuclear scientists. He noted that two IPP projects that DOE identified as being highly successful have not focused on important weapons scientists and that nonproliferation efforts to date have been ad hoc, with no real strategy in mind.

The IPP program director initially told us that there is no U.S.-government-wide comprehensive, consolidated list of critical institutes and scientists that the program seeks to engage. According to the director, a list of institutes of nonproliferation interest for Kazakhstan, Ukraine, and Belarus has been developed. An interim list of Russian institutes has also been issued and continues to be refined. The director said that DOE works primarily with the national laboratories, the State Department, and other agencies to try to ensure that it is focusing on the most important nuclear institutes. However, in some cases the principal investigators were uncertain about the institutes' roles in weapons activities. The Los Alamos National Laboratory's IPP program director told us that sometimes the definition of a weapons of mass destruction scientist is stretched to maximize the participation of NIS scientists and institutes in the IPP program.

For more than half of the projects we reviewed, we were able to determine that the institutes that performed the work had a clear affiliation to weapons of mass destruction or other defense-related activities. These institutes either had a direct connection to weapons research, design, or production or were affiliated with materials production or uranium enrichment. However, we found that in about 20 cases, the institutes that received IPP funding did not appear to have a direct association with weapons of mass destruction or defense-related activities. We were unable to determine the institutes' backgrounds for the remaining projects we reviewed. Some projects that were not focused on weapons-related institutes included the following:

- At the Institute of Nuclear Research, which has participated in three IPP projects, the work has always been academic in nature, according to institute officials. They said the institute never directly performed military work. According to DOE, although the institute is not a primary weapons institute, it has conducted considerable work on the effects of radiation on electrical systems. Currently, the institute has no significant military role and has probably not had one since the early 1990s.
- Russia's natural gas enterprise, VNIIGAZ, which participated in one IPP project, has performed no defense-related activities, according to officials.
- A national laboratory principal investigator told us that a project that focused on studying the effects of radiation contamination in Ukraine was not related to weapons of mass destruction.

In the course of our review, we also tried to determine if the 15 institutes we visited, plus the key biological warfare institute in Russia, are training

or have had contacts with representatives from countries of proliferation concern. We received responses from 12 of the institutes and found some evidence that contacts with countries of proliferation concern had occurred at four institutes. In one case, a researcher from an NIS biological institute, which had received IPP funds, told us that he had gone to Iran on a teaching contract. He said he did not provide any sensitive information to Iran. Another institute told us that it had provided training to Libya in 1994 on light water reactors but said that the training had taken place before the IPP project was awarded in 1996. On January 12, 1999, the Clinton administration imposed economic penalties on this institute after determining that it had provided sensitive missile or nuclear assistance to Iran. According to DOE officials, the IPP program had been withholding approval on additional projects for this institute for several months in anticipation of this recent U.S. government action.

We were also told that one institute trained students from India, Pakistan, and Iran about 10 years ago. Also in 1994, the institute provided a special training course in radiochemistry for a group of about 20 students from China. An institute official said that no sensitive information had ever been included in the training courses. Finally, officials from a technical university that received IPP funds told us they are currently training students from China, India, Libya, Pakistan, Sudan, and Syria.

Officials from several institutes we visited told us that they were not aware of any scientists emigrating to countries of concern to provide weapons-related services. Some institute officials told us that their employees are patriotic and would not jeopardize their own country's national security by providing information to a rogue state. Nevertheless, Russian institute officials did note that "brain drain" is a problem. For example, Russian scientists are leaving the institutes but are emigrating to countries like the United States, Israel, and Germany for better opportunities. In addition, scientists and technicians are seeking employment in Russia's banking and technology industries. One institute official said he is most concerned about scientists who leave the scientific field because their skills are lost forever. He said that when a scientist emigrates to another country, however, these skills are maintained.

The Number of NIS Scientists Engaged in IPP Projects Is Uncertain

IPP program guidance specifies that the number of people employed in the NIS on IPP projects is a primary measure of the program's success. According to program officials, the guidance clearly requires that accurate figures on the number of scientists and engineers be maintained. The

national laboratories we visited—Los Alamos, Sandia and Argonne—had different methods for determining the number of NIS scientists and engineers working on IPP projects. One of the laboratories relied primarily on estimating the number of scientists by applying a formula under which the total value of the contract was divided by the scientists' average monthly salary to arrive at the number of full-time equivalents. The other laboratories used a combination of formulas plus some form of verification, but no approach was applied systematically. In many cases, however, laboratory principal investigators knew the names of some key NIS participants as a result of prior meetings, correspondence, or reports submitted to the laboratories.

According to a Sandia official, accurately tracking the number of scientists employed on projects was not considered very important at the start of the program. As a result, efforts to develop these figures were not a priority. A former Sandia principal investigator who helped implement the IPP program told us that it was never the intent of the program to identify exactly how many NIS scientists were working on a project. In some instances, principal investigators provided us with resumes and/or lists of NIS scientists engaged in the projects. Argonne officials said that they tried to get this type of information for many earlier projects because the former Argonne administrator of the program viewed it as necessary to qualify an institute for IPP funding. In one case we reviewed, national laboratory information indicated that no scientists were employed on a project. However, according to officials from the Russian institute, about 50 people were involved in the project. In several instances, information provided by the U.S. national laboratories did not indicate how many scientists were employed on a project. According to program officials, as a result of our review, principal investigators at the national laboratories are becoming reacquainted with program guidance on the need to maintain accurate information on the number of scientists receiving IPP funds.

Some NIS Scientists Work on Weapons of Mass Destruction Research and Development Programs While Receiving IPP Funding

The September 1993 Report of the Senate Committee on Appropriations provides guidance on the types of NIS institutes the Congress expected would be included in the IPP program. The Committee recognized that the Russian institutes were "principally devoted to military activities" and that a loss of employment had affected "weapons scientists and engineers previously involved in the design and production of weapons of mass destruction." DOE's program guidance is unclear on whether funds should be going exclusively to former, or previously employed, weapons scientists or if scientists currently working on weapons of mass

destruction programs are eligible to receive funding. The director of the IPP program told us that although program guidance is unclear on this point, he believes that both current and previously employed weapons scientists are eligible for program funding.

We found that IPP projects are not directed solely to former weapons scientists. For example, scientists from Sarov who were participating in the IPP program and receiving salaries supplemented by IPP funds told us that they are working on weapons of mass destruction projects. Sarov's deputy director for international relations told us that about half of the institute's scientists and engineers who are involved in international collaboration, including the IPP program, spend part of their time working on nuclear weapons research activities.

For many of the projects we reviewed, the principal investigators did not know whether the NIS scientists and engineers were working on other projects while receiving IPP funds, but several speculated that they were quite possibly doing so. IPP program directors from Sandia, Los Alamos, and Argonne said their laboratories do not know how the NIS scientists are splitting their time among various institute activities. Laboratory officials speculated that it is very likely that the scientists could be working on various other projects, including their institute's weapons of mass destruction programs. Russian institute officials told us that in most cases, the scientists are working on the IPP projects part-time. They may also be involved in other collaborative projects with other countries and/or spending part of their time working on other projects at their institute. An official from Los Alamos National Laboratory told us that it would be unrealistic to think that Russian scientists receiving IPP funding were not also working on their own country's weapons program.

Some Projects Have Dual-Use Implications

According to DOE's program guidance, IPP projects must not, among other things, (1) include weapons and delivery system design activity and (2) provide assistance in the maintenance or improvement of military technology. Program officials said that since Russia's technology base has been developed in the weapons program and since the goal of the IPP program is the commercial development of these technologies, there is an inherently dual-use aspect of the program. Moreover, they said, many of the projects involve materials science and any improvement in materials have inherent dual-use potential. According to program officials, no projects were undertaken that provided significant enhancements to Russia's or other NIS' weapons of mass destruction capability.

Discussions with principal investigators and other information indicated to us that nine of the nuclear-related projects we reviewed could have dual-use implications—that is, information learned during the course of the project could unintentionally provide useful defense-related benefits to Russian and other NIS scientists. These projects, all of which were approved from 1994 through 1996, include the following:

- One project involved ways to improve a protective coating material. The national laboratory principal investigator told us that Los Alamos is developing the coating and is paying a Russian institute to do some of the testing. The coating has both military and civilian applications and could be used to make aircraft bodies more resistant to corrosion. He noted that the Russians could obtain information to develop a similar material by analyzing the samples that Los Alamos has provided for testing. According to DOE headquarters officials, the Russian Federation already has aircraft utilizing this technology and therefore this project does not increase that country's defense capabilities.
- According to a DOE laboratory official, two IPP projects have focused on Russian electromagnetic absorbing materials technologies. According to DOE's information, this dual-use technology presents a proliferation risk. Among other things, this technology could reduce electromagnetic noise in airports, thereby improving flight safety. In addition to potential commercial applications, these projects were designed to assess the state of the technology to determine its validity for possible application to U.S. defense systems. The projects have not gone beyond the Thrust 1 stage and were recently canceled for lack of commercial potential.
- IPP project funds have been used to enhance communications capabilities through high data rate electronic links among some of Russia's closed nuclear cities and DOE's national laboratories. While the project promotes better communications among the Russian nuclear institutions, it is possible that it could also indirectly support the collaboration of Russian weapons laboratories. Additional communications links are planned for other nuclear and biological facilities in Russia. DOE officials told us that the benefits of the project clearly outweigh any negative implications of dual-use.
- Los Alamos National Laboratory is funding two projects in Chelyabinsk, a closed nuclear city, to improve the durability and performance of metal. The principal investigator said the technology could be used, for example, to enhance the performance of both military and civilian aircraft engines. He noted that he had not given the possibility much thought but believed that the United States could benefit from the technological improvements as much as Russia. According to DOE headquarters officials, the

development of aircraft engine components clearly has dual-use implications. They point out that this work is highly developmental and represents one of the true nonproliferation success stories. Furthermore, they added, any Newly Independent State wanting to obtain this state-of-the-art engine technology could easily buy it.

The Los Alamos IPP program director told us that nothing in the IPP program threatens U.S. national security interests because the United States and Russia are basically equal in terms of nuclear weapons development. Therefore, there are no advantages that Russia could gain from the technology of U.S. origin used in the IPP program. DOE's director of Arms Control and Nonproliferation disagreed and told us the policy concerning U.S. technology related to the IPP program is clear. First and foremost, IPP projects are reviewed to ensure that they will "do no harm" to U.S. national security interests. He said that since he assumed his position in November 1997, all projects are being reviewed for any potential military applications.

IPP Chemical and Biological Projects May Not Be Adequately Reviewed

According to IPP program guidance, cooperative research in biological and chemical activities could be redirected to support a biological and/or chemical weapons program. The program's guidelines call for coordination with the departments of State and Defense to ensure that IPP projects will not support another nation's biological or chemical weapons knowledge base and that IPP funds are not provided to any NIS institute currently engaged in work on offensive biological or chemical weapons.

Our review of 19 approved IPP chemical and biological projects (7 of which were part of our overall sample of projects), indicated that DOE's review process may be inadequate. According to DOE officials, all chemical and biological IPP projects are subject to reviews by several agencies, including the Department of State, the Department of Defense's Office of Cooperative Threat Reduction, the Department of the Army's Soldiers and Biological Chemical Command (Aberdeen, Maryland), and the U.S. Army Medical Research Institute of Infectious Diseases (Fort Detrick, Maryland). However, for 19 projects that had been approved as of July 31, 1998, there was not always sufficient evidence in IPP project files to determine whether the proposed projects had been reviewed by all of the agencies. Furthermore, the criteria for reviewing the projects are vague.

We found no evidence in the IPP program files to indicate that 7 of the 19 projects had been reviewed by DOE program offices. External project

reviews also appeared to be inconsistent and/or were not well documented. For example, we found that, of the 19 project files,

- 13 contained evidence of the State Department's review,
- none showed evidence of review by DOD's Office of Cooperative Threat Reduction, and
- 15 showed no evidence of review by other agencies.

DOE does not provide specific criteria for reviewing the proposed chemical and biological projects. Rather, DOE forwards the projects with a cover letter asking reviewers to indicate whether the project (1) raises no concerns, (2) raises some concerns that can be dealt with through close oversight by the national laboratory's principal investigator, or (3) should not be done in its present form. Agency officials provided varying views on what criteria should be applied. Two officials said that projects should constitute "good science" but also noted that all proposed projects must be consistent with U.S. national security interests. The former special coordinator of DOD's Office of Cooperative Threat Reduction told us that her office reviews projects to identify areas of research that could be of interest to DOD.

Officials from one or more of the agencies that provide or coordinate technical reviews of the chemical and biological projects told us that they (1) do not always have sufficient information about the projects, (2) are uncertain whether they receive all of the proposed projects, (3) do not always thoroughly review the projects they receive, and (4) do not know the overall outcomes of the project reviews. Reviewers from some agencies told us that many of the proposals they review contain limited information, making adequate evaluation difficult. The official from the U.S. Army's Medical Research Institute of Infectious Diseases, who is responsible for reviewing biological projects, said his review is informal and superficial. The review is intended primarily to (1) determine that the projects are not being duplicated by other U.S. government agencies and to (2) identify promising projects that might be more appropriately funded by other agencies. He assumed that the proposals received a more rigorous review at the IPP program office.

An official from the Army's Soldiers and Biological Chemical Command noted that IPP projects are also reviewed informally. The Command began reviewing IPP proposals in late 1997 and focuses on whether a project is based on good science. The official also said (1) it is uncertain whether the Command is seeing all of the projects, since it evaluates only project

proposals forwarded by DOE, and (2) there is no well established mechanism to find out which projects are approved or rejected. The Command expected, however, that DOE would reject any proposals to which serious objections were raised. Officials from DOD's Office of Cooperative Threat Reduction told us that the IPP review process is ad hoc and it is unclear how DOD's review fits in with other U.S. government reviews. These officials were uncertain how many projects they had reviewed but thought it was only a few.

We found that some reviewers had raised objections to projects. For example, the Soldiers and Biological Chemical Command raised concerns about two projects, one of which focused on the destruction of toxic material by means of ballistic missile rocket engines. DOD also objected to this project. Ultimately, the project was not approved, primarily because it lacked technical merit and commercial potential. National security considerations also entered into the disapproval. Additionally, the Command raised concerns about another project that dealt with cholesterol esterase activators. According to the Command's evaluation, the proposed work could be approved, but there were concerns because it had the potential to provide information that could be applied to enhance the effects of nerve agents on the nervous system. According to an IPP program official, the project was further scrutinized and found to have only peaceful applications. The Command researcher who raised objections to the project was never informed of its final disposition.

IPP program officials told us that despite what the documentation in the project files showed, project proposals were routinely being sent to the relevant federal agencies for review. IPP officials responsible for coordinating the reviews of the chemical and biological projects said they give reviewers a chance to provide input before decisions are made, but all agencies are not involved on a consistent basis. For example, IPP program officials were uncertain about the process for distributing project proposals and obtaining comments from DOD's Office of Cooperative Threat Reduction. An IPP official told us that the State Department was responsible for disseminating the proposals to DOD through an interagency mechanism. A State Department official said this information was not correct. DOE does, however, rely on the State Department to facilitate other U.S. government agencies' reviews of proposed IPP chemical and biological projects through the interagency mechanism. A State Department official said that this process, which has been in place for about a year, works well and that the results of the reviews are provided to DOE. According to program officials, as a result of our review, project

proposals are now being sent directly to the Cooperative Threat Reduction office for review.

DOE's New Initiative Will Focus More Aid on Russia's Nuclear Cities

In September 1998, the United States and Russia embarked on an ambitious effort, known as the Nuclear Cities Initiative, to expand commercial cooperation in Russia's 10 nuclear cities. The two governments signed an agreement to facilitate the provision of new civilian jobs for workers in those locations. The Nuclear Cities Initiative will complement the IPP program in that its purpose is also to create jobs in the civilian sector for displaced weapons scientists. Whereas IPP is focused on four countries, the initiative will focus only on Russia's 10 nuclear cities. Some IPP projects will furnish the initial assistance under the initiative, but the initiative is envisioned as a more ambitious commercialization effort for such cities than the IPP program or any other assistance program. DOE estimates that the Nuclear Cities Initiative may cost $600 million during the next 5 years, with the initial funding set at $15 to $20 million for fiscal year 1999. On December 10, 1998, DOE submitted a report to the Congress describing the objectives of the Nuclear Cities Initiative.

U.S. embassy officials in Moscow have questioned large funding commitments to the nuclear cities at this time. According to these officials, promoting investment in nuclear cities has poor short-term prospects because of Russia's current economic situation and the difficulties it poses to achieving commercial success in these isolated locations.

Role of Russia's 10 Nuclear Cities

The former Soviet Union concentrated most of its nuclear weapons program at 10 cities, shown in figure 4.1, that were so secret they did not appear on any publicly available maps until 1992.

Figure 4.1: Russia's Nuclear Cities

Source: GAO's presentation of information from DOE and MINATOM.

The 10 nuclear cities were among the most secret facilities in the former Soviet Union. Behind their walls, thousands of scientists and engineers labored on the design, assembly, and production of the Soviet nuclear arsenal. Today, the cities remain high-security areas, and access to them is

limited. The 10 cities and their roles in developing nuclear weapons are shown in table 4.1.

Table 4.1: Role of Russia's Nuclear Cities in Weapons Design and Development

New name	Old name	Nuclear role
Sarov	Arzamas-16	Nuclear weapons design and assembly; plutonium storage
Zarechnyy	Penza-19	Nuclear weapons assembly and disassembly; plutonium and highly enriched uranium storage
Novouralsk	Sverdlovsk-44	Uranium enrichment, highly enriched uranium storage and blending
Lesnoy	Sverdlovsk-45	Nuclear weapons assembly and disassembly; plutonium storage
Ozersk	Chelyabinsk-65	Mayak Fuel Storage Site, fuel fabrication, mixed oxide fuel, plutonium production reactors, reprocessing, waste management
Snezhinsk	Chelyabinsk-70	Nuclear weapons design; plutonium and highly enriched uranium storage
Trekhgornyy	Zlatoust-36	Nuclear weapons assembly and disassembly; plutonium and highly enriched uranium storage
Seversk	Tomsk-7	Uranium enrichment and reprocessing, plutonium production reactors, waste management
Zheleznogorsk	Krasnoyarsk-26	Reprocessing, plutonium production reactors, waste management
Zelenogorsk	Krasnoyarsk-45	Fuel fabrication (military), uranium enrichment

Source: DOE.

Focus of the Nuclear Cities Initiative Will Differ From That of the IPP Program

The IPP program has provided funds to various kinds of institutes with nuclear and other disciplines throughout Russia, including many in Moscow, St. Petersburg, and the nuclear cities. However, the Nuclear Cities Initiative will provide assistance only to Russia's 10 nuclear cities. In addition, unlike the IPP program, the Nuclear Cities Initiative is based on a government- to-government agreement rather than on agreements between U.S. and Russian laboratories and institutes. The program is an outgrowth of a meeting between the Vice President of the United States and the Prime Minister of Russia at the Tenth Session of the United States-Russian Federation Commission for Economic and Technical Cooperation in March 1998. After additional meetings between high-ranking officials, the U.S. Secretary of Energy and Russia's Minister of Atomic Energy signed an agreement on September 22, 1998. The purpose of the agreement is to facilitate the provision of new civilian jobs for Russian workers in the nuclear complex, which is controlled by the Ministry of the Russian Federation for Atomic Energy (MINATOM). Russian officials have identified a need to create 30,000 to 50,000 new jobs in these cities.

According to DOE, the Nuclear Cities Initiative will create jobs faster than the IPP program. It will include the redirection of skills not only in the high-technology arena, as is being done in the IPP program, but also in the service, information, education, and small business sectors. Unlike the IPP program, the Nuclear Cities Initiative has a social component involving other federal agencies, such as the Agency for International Development and the Department of Commerce, to build good will in the scientific and general communities within these cities. The initiative will provide among other things, support systems for depression, women's rights, language training, and job retraining. Furthermore, unlike the IPP program, which is driven by DOE's national laboratories, DOE expects that the initiative will have working groups comprising not only scientists but also business and community leaders. DOE expects that the role of DOE's national laboratories will be reduced as the initiative evolves.

According to DOE, the Nuclear Cities Initiative will draw on the experience of the United States in restructuring the former nuclear weapons laboratories and production complexes. DOE will share the experience in restructuring that has occurred at U.S. nuclear sites such as Hanford, Washington and Oak Ridge, Tennessee, and will provide business training and support for development at nuclear cities and institutes in Russia affected by downsizing. The U.S. technical assistance will include training

in business planning, methods to attract business to the area, and ways to get new businesses started.

Objectives of the Nuclear Cities Initiative

According to DOE's report to the Congress on the program, the goals of the initiative are to

- assist the Russian Federation in reducing the size of its nuclear weapons establishment to correspond with its post-Cold War budget realities and smaller nuclear arsenal and
- promote nonproliferation goals by redirecting the work of nuclear weapons scientists, engineers, and technicians in the 10 Russian nuclear cities to alternative scientific or commercial activities.

In its report to the Congress, DOE said the program serves U.S. national security objectives by

- assisting the Russian Federation in reducing its nuclear weapons establishment, which is still significantly larger than that of the United States;
- facilitating the transition of Russian scientists, engineers, technicians, and other specialists from weapons development or production to civilian work, thereby deterring the transmission of weapons knowledge to criminal elements, rogue states, or other undesirable customers;
- extending into the 10 nuclear cities U.S. efforts to assist Russian science in moving from weapons development to civilian uses; and
- helping to promote stability in Russia at a time when that country is undergoing extreme financial and political crisis.

The program has other benefits, too, according to the DOE report, such as

- making the benefits of Russian science available to U.S. commercial enterprises,
- leveraging and developing existing success in bilateral and multilateral "brain drain" programs to advance Russia's new goal of downsizing its nuclear weapons complex, and
- providing new understanding of the conditions in the nuclear cities.

The agreement lists several cooperative activities. One such activity is developing entrepreneurial skills in employees displaced from enterprises of the nuclear complex, training them to write business plans, and

facilitating the development of such plans. Other possible activities include facilitating

- the creation of conditions necessary for attracting investment in the nuclear cities to implement the projects within the framework of the agreement;
- the search for investors for production diversification projects, market analysis, and the marketing of products and services resulting from the implementation of those projects; and
- access to existing investment mechanisms, including investment funds.

As a first step, DOE sent two working group missions, including members of the scientific, business, and financial communities, to Russia. DOE plans to send a third mission later this year. The initiative will start in three cities—(1) Sarov, formerly Arzamas-16, (2) Snezhinsk, formerly Chelyabinsk-70, and (3) Zheleznogorsk, formerly Krasnoyarsk-26,—and expand later. DOE's report to the Congress said it is critical that projects be selected, reviewed, and launched expeditiously because of the financial crisis in Russia. The report also outlines the objectives of the Nuclear Cities Initiatives and provides milestones or goals for fiscal years 1999 and 2000. Program milestones for fiscal year 1999 include developing

- a strategic program plan,
- budgetary needs,
- methods to track program implementation,
- program guidance and management policies and procedures,
- program success measurements,
- workshops based on lessons learned from U.S. nuclear weapons downsizing and military base closure experiences,
- briefings for industry and nongovernmental organizations interested in the program,
- commercialization centers or high technology incubators to develop new businesses, and
- a first year's progress report on the program.

In the second year, according to DOE's report, DOE expects that the program will expand to additional cities.

The New Initiative Will Not Replace the IPP Program

The director of the IPP program, who is also the director of the Nuclear Cities Initiative, said that the new program will not replace the IPP program's efforts for several reasons. First, the IPP program will provide

the initial projects for the Nuclear Cities Initiative. (See app. VI for a list of IPP projects scheduled to become part of the initiative.) Second, the IPP program will continue at other locations throughout the NIS, as well as the nuclear cities. Third, IPP projects will continue to give DOE lab personnel access to scientific institutes in the nuclear cities. By contrast, the Nuclear Cities Initiative is limited to a certain geographic region of each city and does not include the weapons institutes.

According to the Director of the Nuclear Cities Initiative, the new initiative will provide access only to the municipal area, or civilian core, of the city, which may be surrounded by a fence. Beyond the perimeter of the municipal area are various secret nuclear institutes or technical areas that will remain off limits to U.S. personnel involved with the Nuclear Cities Initiative. According to the director, DOE is hoping that the initiative will provide new commercial opportunities in the city that will not necessarily have a scientific and research focus, as IPP projects do. The intent is that this new source of employment will serve individuals who are working or have worked in the weapons laboratories. Examples of projects proposed for the Nuclear Cities Initiative include

- a business copy center,
- a nonalcoholic brewery,
- a confectionery, automobile or pharmaceutical plant,
- a software development company, and
- a telecommunications project.

DOE officials suggested that if commercial efforts are successful, not only will those employed in weapons manufacturing but also their relatives and friends will remain at the city and there will be less reason for weapons scientists, technicians, and engineers to leave the area. Also, according to the director, individuals working in the more secret technical areas may become involved with commercial enterprises in a municipal area by working in the municipal area part-time or eventually full-time.

The New Initiative Will Draw on a Variety of Resources

According to the director, the State Department is also considering including some ISTC projects in the Nuclear Cities Initiative. Other federal agencies, such as the Department of Defense or the Department of Commerce, may also provide assistance because the Nuclear Cities Initiative is considered more of an interagency effort than the IPP program. DOE will also coordinate with nongovernmental and commercial organizations.

Since the initiative draws on the experience of the United States in restructuring its former nuclear weapons laboratories and production complexes, most of the federal funding will be appropriated to DOE. The DOE laboratories are expected to play a role in facilitating relationships, identifying projects, and helping bring projects to commercial fruition. While DOE expects to receive $15 million to $20 million for the initiative for fiscal year 1999, the director said that the total funding could reach up to $600 million in 5 years.[1] In addition, DOE would like to receive funds from other sources, including U.S. industry and venture capitalists, but the program director said that the initiative may be a U.S. assistance program in the first years because of current economic conditions in Russia and its vast needs.

Unlike the IPP program, the initiative is intended to be a shared program, as the Russian Federation has maintained from the outset. According to the DOE director, the Russians said at one point that they would provide a total of about $30 million. DOE officials recognize that such funding from Russia is uncertain because of that country's current economic conditions. According to DOE officials, any Russian government assistance may be in the form of buildings, equipment, and other in-kind services. Also, the DOE director said that the Russians may consider revenue from the sale of highly enriched uranium to the United States as a possible source of funds for the Nuclear Cities Initiative.

Some U.S. Officials Raised Concerns About the Challenges Facing the Nuclear Cities Initiative

In October 1998, U.S. embassy officials in Moscow raised concerns about the challenges facing the Nuclear Cities Initiative, particularly in the context of Russia's economic deterioration. With the devaluation of the ruble in August 1998 and the partial government default, developing a U.S. program to assist in commercializing the nuclear cities will require adjustment. U.S. officials said that the outlook for foreign investment, whether from Western companies or international financial institutions, is not favorable in the short and medium term.

According to embassy officials, the initial concept of the initiative was to increase investment opportunities and promote technological commercialization in the nuclear cities. Three major components of the initiative are (1) training, (2) refocusing the existing IPP program, and (3) facilitating access for multilateral lending institutions and private capital markets. The officials said the strategy was on target in mid-1998,

[1]Russian officials identified a need to create 30,000 to 50,000 new jobs in the nuclear cities. DOE has found that it costs $11,000 to create a new job in its nuclear complex. Hence, it would cost $550 million to create 50,000 new jobs in Russia, assuming comparable costs and business skills.

but with the changes in the economic and political landscape, "the reality is that a program based primarily on promoting investment in Russia's closed cities has very poor short-term prospects and needs a bridging strategy until the situation improves."

According to these officials, one important element in planning the initiative has been the assumption that Russian banks would support projects by providing small to medium-sized loans. However, the entire Russian banking system has collapsed, and there is no indication the situation will return to normal in the short term. The ability of Russian banks to support job creation in the nuclear cities by creating lending opportunities and investing has thus been severely curtailed. A number of banks are in financial difficulty and will likely not survive without a government bailout. U.S. officials have cautioned that "care should be taken in transferring funds to any project in Russia lest the money be swallowed up in a bankrupt financial institution." U.S. officials also referred to problems with the Russian tax structure. "Tax and customs problems have been especially detrimental to U.S. assistance programs and [the initiative] could be another casualty of Russia's dysfunctional tax structure" if the Russian government does not make improvements. Another concern is limited access to the nuclear cities. Without sufficient access, accountability, and transparency, there is a danger that the assistance will never go to the targeted areas. Access problems may continue because Russia's Federal Security Bureau may view this program as an intelligence-gathering effort. Officials from Sarov's All-Russian Scientific Research Institute of Experimental Physics told us that the Nuclear Cities Initiative can help, but it will be difficult to attract commercial partners to a city located behind a fence. The city has been isolated for over 40 years and it is not practical to think that conditions can be changed overnight; transition must occur on a step-by-step basis.

Still another challenge to implementing the initiative is the limit on intellectual property rights accorded to Russian researchers, according to DOE officials. As the IPP program is structured, the United States has worldwide intellectual property rights except in the NIS; however, the Russian collaborators may find their intellectual property rights to be of dubious value in a country that does not have the entrepreneurial capital to commercialize their ideas. Therefore, if the Russian intellectual property rights under the Nuclear Cities Initiative are also limited to the NIS, they may not be considered very valuable.

According to U.S. embassy officials, the banking issues, the poor prospects for foreign investment, the taxes on U.S. assistance, the potential restrictions on access to the nuclear cities, and concerns about intellectual property rights are some of the reasons that the program should be redirected in the short term from promoting investment to establishing the building blocks to attract financial resources when the Russian economy stabilizes. They recommended that more immediate aid could include working with Russians on developing business plans, providing leadership training, and working with local and regional governments to improve the business environment.

Conclusions and Recommendations

DOE's effort to supplement the salaries of former weapons scientists so that they do not sell their services to terrorists, criminal organizations, or countries of proliferation concern is laudable and, we believe, in our national security interests. However, we have concerns about the implementation and oversight of the IPP program. The program appears to be at a crossroads, requiring DOE to determine whether it will simply provide short-term financial assistance or will serve the longer-term nonproliferation goal of directing former weapons scientists into sustainable commercial activities. The program's long-term goal presents a much more difficult challenge than providing short-term assistance. Furthermore, given the economic situation in Russia, this goal may never be realized for the majority of IPP projects. As we noted earlier, over 80 percent of IPP projects are still in the Thrust 1 stage.

While the program has needed—and benefited from—the support provided by DOE's national laboratories, we believe that it is time to reassess the laboratories' future role, particularly if the focus of the program is to commercialize projects and thereby provide for the long-term employment of NIS weapons scientists. While the national laboratories possess technical skills and have made great strides in helping to "open up" NIS institutes, they have, by their own admission, limited expertise in commercial market activities. In addition, the high proportion of funding—about 63 percent—going to the U.S. national laboratories and to support U.S. industry's participation in the program—does not seem consistent with the program's goal of supplementing the salaries of NIS former weapons scientists.

The IPP program has established hundreds of projects at many institutes throughout the NIS. It is uncertain, however, to what extent IPP funds have focused on the most critical scientific institutes and targeted the most important weapons scientists. Our review showed that the national laboratory officials who monitor the projects were frequently uncertain about the number of weapons scientists employed and their background. In fact, some of the institutes we visited did not work on weapons of mass destruction or have any clear defense orientation. We believe that program officials could conduct a more thorough review of these institutes to better ensure that program funds are being focused on the most important facilities and personnel. In addition, more careful monitoring of funds disbursed to Russian and other NIS institutes would ensure greater accountability for these funds. Furthermore, IPP's program guidance is unclear as to whether assistance should focus on previously employed weapons scientists and/or scientists currently working on weapons

programs. As a result, U.S. funds are supplementing the salaries of scientists working on Russia's weapons of mass destruction programs.

Ensuring that IPP projects are consistent with U.S. national security interests is essential to safeguarding sensitive technologies. Some of the projects related to weapons, particularly the chemical and biological projects, could have dual-use implications. Although the projects were reviewed by U.S. government officials, the emphasis of their reviews appeared to be to ensure that they were "good science." Furthermore, some IPP chemical and biological projects were apparently given cursory reviews by some key reviewing officials. More rigorous and systematic reviews of all IPP projects would provide greater assurance that U.S. national security concerns are being carefully considered.

The IPP program has not demonstrated significant progress toward its longer-term nonproliferation goal of directing NIS weapons scientists from defense work to self-sustaining commercial employment. This goal would be difficult to achieve under any circumstances but is made more difficult by the deteriorating economic conditions in Russia. The program has evolved into a longer-term effort than was initially envisioned, and it is unclear when the program is scheduled to end. While DOE has claimed from the outset that the program has an exit strategy, or end point, it is unclear how that strategy is being implemented. DOE officials provided differing time frames for phasing out the program, and measures of the program's success are lacking. Given the unique nature of the program, a strategic plan is needed that, to the extent possible, links its goals, costs, performance measures, and time frames. Program officials told us that they are finalizing such a plan.

Successfully implementing the Nuclear Cities Initiative, a major economic development effort, is a daunting challenge considering the dire economic conditions in Russia, including the all but complete collapse of its banking system. The 10 nuclear cities are in remote locations and access to them is restricted. Attracting investors to these locations and finding customers to purchase whatever products or services are produced will prove to be major challenges. Given these problems and the limited commercial success evidenced in the IPP program, we believe that the Nuclear Cities Initiative is likely to be a subsidy program for many years, rather than a stimulus for economic development. In addition, we question whether DOE possesses the expertise needed to develop market-based economies in a formerly closed society. At a minimum, DOE will have to work in partnership with other federal and international economic development

agencies and private industry. Furthermore, DOE's initial estimate of the program's costs—$600 million over 5 years—may be just a down payment on a financially larger and longer-term program.

Recommendations to the Secretary of Energy

To maximize the impact of the Initiatives for Proliferation Prevention program's funding and improve DOE's oversight of the program, we recommend that the Secretary of Energy

- reexamine the role and costs of the national laboratories' involvement with a view toward maximizing the amount of program funds going to the NIS institutes;
- obtain information on how program funds are being spent by the NIS recipients;
- seek assurances from the Russian government, either through a government-to-government agreement or through other means, that program funds are exempt from Russian taxes;
- require that program officials, to the extent possible, obtain accurate data on the number and background of the scientists participating in program projects and eliminate funding for institutes that did not formerly work on weapons of mass destruction;
- clarify program guidance as to whether scientists currently employed in weapons of mass destruction programs are eligible for program funding;
- require that project reviewers consider all military applications of projects to ensure that useful defense-related information is not unintentionally transferred;
- strengthen and formalize DOE's process for reviewing proposed chemical and biological projects by (1) providing complete project information to all reviewing U.S. government agencies and organizations, (2) developing criteria to help frame the evaluation process, and (3) providing feedback to all of the reviewing agencies about the final disposition of the projects.

In addition, given that one of the purposes of the program is to sustain the employment of weapons scientists through projects that can be commercialized, we recommend that the Secretary

- reevaluate the large number of Thrust 1 projects, particularly those that have been funded for several years, and eliminate those that do not have commercial potential and
- develop criteria and time frames for determining when Thrust 1 projects should be terminated if they do not meet the criteria for graduation to the program's next phase.

Because DOE plans to implement the Nuclear Cities Initiative in a relatively short amount of time (5 years) at a cost of about $600 million during uncertain economic times in Russia, we believe it is critical that the program's implementation be based on solid thinking and planning that considers the problems experienced under the IPP program. Therefore, we recommend that the Secretary

- develop a strategic plan for the initiative before large-scale funding begins and include goals, costs, time frames, performance measures, and expected outcomes, such as the number of jobs to be created for each city; and
- not expand the initiative beyond the three nuclear cities until DOE has demonstrated that its efforts are achieving the program's objectives, that is, that jobs are being created in the civilian sector for displaced weapons scientists, engineers, and technicians.

Agency Comments

The Department of Energy, in commenting on a draft of this report, concurred with the report's findings and recommendations and said that our evaluation will assist the Department in significantly strengthening the program. The Department provided clarifying comments on three issues raised in the report, including (1) the dual-use potential of some projects, (2) the provision of program funding to Russian weapons scientists currently working on their own nuclear weapons programs, and (3) the lack of progress in commercializing program projects. The Department agreed with our recommendations on these issues, and its comments are presented in appendix VII. The Department also provided technical comments that were incorporated into the report as appropriate. Regarding the Initiatives for Proliferation Prevention program, the Department stated that, among other actions responding to our recommendations, it will (1) examine the role of the national laboratories, (2) work with the State Department to develop an agreement with Russia to exempt program funds from Russian taxes, (3) instruct program officials to obtain data on the number and background of Newly Independent State scientists in the program, and (4) reevaluate the large number of projects to eliminate those without commercial potential. Regarding our recommendations related to the Nuclear Cities Initiative, the Department said that it will publish a strategic plan within 90 days. The Department also concurred with our recommendation that it not expand the initiative beyond the first three nuclear cities until the initiative demonstrates that jobs are being created in the civilian sector for

unemployed weapons scientists. However, the Department stated that it did not want to preclude the possibility of reducing weapons-related activities through the initiative in another nuclear city if the opportunity arises.

U.S. Industry Coalition Membership as of September 30, 1998

Name of organization	Location
ACSPECT Corporation	Reno, Nevada
Air Products and Chemicals	Allentown, Pennsylvania
American Cyanamid	Princeton, New Jersey
Amoco Research Center	Naperville, Illinois
Aquila Technologies Group	Albuquerque, New Mexico
Argonide Corporation	Sanford, Florida
Ashurst Government Services, Inc.	Baltimore, Maryland
Battelle Memorial Institute	Columbus, Ohio
Beam Tech Corporation	San Antonio, Texas
Bio-Nucleonics	Miami, Florida
Bryant College	Smithfield, Rhode Island
Burle Industries, Inc.	Lancaster, Pennsylvania
Defense Enterprise Fund	Richmond, Virginia
Digirad Corporation	San Diego, California
Dycor Industrial Research, Ltd.	Burlington, Washington
Dye Seed Ranch, Inc.	Pomeroy, Washington
Eagle-Picher Industries, L.L.C.	Quapaw, Oklahoma
Earth Search Sciences, Inc.	McCall, Idaho
EG&G ORTEC	Oak Ridge, Tennessee
Ensign Bickford Company	Simsbury, Connecticut
Failure Analysis Associates, Inc.	Menlo Park, California
Fenix Technology International, Inc.	Washington, D.C.
General Atomics	San Diego, California
Global One	Reston, Virginia
Henis Technologies, Inc.	Creve Coeur, Missouri
Intel Corporation	Santa Clara, California
International Technologies	Albuquerque, New Mexico
LaSen, Inc.	Las Cruces, New Mexico
Laser Fare, Inc.	Warwick, Rhode Island
M & K Associates, Inc.	Boulder, Colorado
M-C Power Corporation	Burr Ridge, Illinois
McDonnell Douglas	Huntington Beach, California
Mine Safety Appliances	Pittsburgh, Pennsylvania
Mobil Technology Corporation	Dallas, Texas
National Center for Manufacturing Sciences	Ann Arbor, Michigan
New Horizons Diagnostics Corporation	Columbia, Maryland
O-Tech International, Ltd.	McLean, Virginia
Oakton International Corporation	Oakton, Virginia

(continued)

Name of organization	Location
Paratek, Inc.	Aberdeen, Maryland
Phygen, Inc.	Minneapolis, Minnesota
PPG Industries, Inc.	Pittsburgh, Pennsylvania
Radiation Monitoring Devices	Watertown, Massachusetts
Radkowsky Thorium Power Company	Washington, D.C.
RAIES International Corporation	Palm Harbor, Florida
Raton Technology Research, Inc.	Raton, New Mexico
RedZone Robotics, Inc.	Pittsburgh, Pennsylvania
Reynolds Metals Co.	Chester, Virginia
Rhode Island Technology Transfer	Providence, Rhode Island
RUSTEC, Inc.	Camden, New Jersey
Scientific Utilization, Inc.	Huntsville, Alabama
Soiltech Environmental Systems	New York, New York
Stable Earth Technology, L.L.C.	Louisville, Kentucky
Superconducting Core Technologies	Golden, Colorado
Sweet Analysis Services	Alexandria, Virginia
Symetrix International, Inc.	Colorado Springs, Colorado
Synmatix Corporation	Southfield, Michigan
Technology Commercialization International	Albuquerque, New Mexico
Texaco Inc.	Houston, Texas
Thermacore, Inc.	Lancaster, Pennsylvania
TRACE Photonics	Tijeras, New Mexico
TRASPACE International Corporation	San Jose, California
Triox Technologies, Inc.	Murray, Utah
TSI Research	Solano Beach, California
United Technologies	West Palm Beach, Florida
University of Missouri-Columbia	Columbia, Missouri
Westinghouse Electric Corporation	Pittsburgh, Pennsylvania

Source: U.S. Industry Coalition.

Initiatives for Proliferation Prevention Projects Reviewed by GAO

Responsible U.S. national laboratory	Country	Thrust level	Project's title (abbreviated)	Project's funding
Argonne	Russia	1	Radwaste encapsulation	$80,000
Argonne	Russia	1	Redirection of nuclear safety	182,000
Argonne	Russia	1	Millimeter and submillimeter waves	200,000
Argonne	Russia	1	Atomic clusters	130,000
Argonne	Russia	1	Laser instruments	120,000
Argonne	Russia	1	Polymer membranes for separation technologies	100,000
Argonne	Russia	1	High-temperature superconductors	50,000
Argonne	Ukraine	1	Milk decontamination	80,000
Argonne	Russia	1	Detection of landmines and explosives	60,000
Argonne	Russia	1	Neutronic enhancement of explosives detection	90,000
Argonne	Belarus	1	Ceramic coating	80,000
Argonne	Russia	1	Electrolyte impurities on molten carbonate fuel cells	130,000
Argonne	Russia	1	Acoustic nozzle	100,000
Argonne	Russia	1	Cover gas on molten carbonate fuel cells	130,000
Argonne	Russia	1	Zeolite guest compounds	100,000
Argonne	Russia	2	Bipolar plate material for molten carbonate fuel cells	500,000

(continued)

Responsible U.S. national laboratory	Country	Thrust level	Project's title (abbreviated)	Project's funding
Argonne	Ukraine	2	Magnetic separation for milk	960,000
Argonne	Russia	2	Radioprotectors	200,000
Argonne	Russia	2	Diamond thin film cathodes	350,000
Argonne	Russia	2	Wave sweeper and gas analyzer	250,000
Argonne	Russia	2	Soil remediation	50,000
Argonne	Russia	2	Soil remediation	50,000
Argonne	Russia	2	Soil washing remediation	400,000
Los Alamos	Russia	1	Material control and accountability infrastructure	140,000
Los Alamos	Russia	1	Reactor safety	145,000
Los Alamos	Russia	1	Optical sorter	146,000
Los Alamos	Russia	1	Microbiologically influenced corrosion	144,000
Los Alamos	Russia	1	Microbiologically influenced corrosion	160,000
Los Alamos	Russia	1	Polymer membranes	321,000
Los Alamos	Russia	1	Ion beam materials processing	110,000
Los Alamos	Russia	1	Materials coatings	400,000
Los Alamos	Russia	1	Nanophase powders	185,000
Los Alamos	Ukraine	1	Materials processing	100,000
Los Alamos	Russia	1	Conductivity of high-strength metals	284,000
Los Alamos	Russia	1	Bimolecular modeling	234,000
Los Alamos	Russia	1	Materials for manufacturing	251,000
Los Alamos	Russia	1	Materials for manufacturing	350,000

(continued)

Responsible U.S. national laboratory	Country	Thrust level	Project's title (abbreviated)	Project's funding
Los Alamos	Russia	1	Optical systems	105,000
Los Alamos	Russia	1	Optical systems	250,000
Los Alamos	Russia	1	Telecommunications	200,000
Los Alamos	Russia	2	Gas separation membranes	130,000
Los Alamos	Russia	2	Gas separation membranes	1,070,000
Los Alamos	Russia	2	Ion technologies	345,000
Los Alamos	Russia	2	Parallel computing applications	430,000
Los Alamos	Russia	1	Medical radioisotope production	80,000
Los Alamos	Russia	2	Positive emission tomography	400,000
Los Alamos	Ukraine	2	Microwave materials processing	656,000
Los Alamos	Russia	2	Nanophase metal powders	250,000
Los Alamos	Russia	2	Nanophase metal powders	0
Los Alamos	Russia	2	Technical risk and reliability center	0
Los Alamos	Russia	3	Commercialization of positive emission tomography	no funds allocated
National Renewable Energy Laboratory	Russia	2	Photovoltaic products	988,750
National Renewable Energy Laboratory	Russia	2	Next-generation photovoltaic products	428,000
National Renewable Energy Laboratory	Russia	2	Photovoltaic gas recycling technology	184,000
Oak Ridge	Russia	1	Immunomodulatory of interferon and cells	200,000

(continued)

Responsible U.S. national laboratory	Country	Thrust level	Project's title (abbreviated)	Project's funding
Oak Ridge	Russia	2	Soil and water remediation	820,000
Oak Ridge	Russia	2	Advanced recycling of commingled metals	627,000
Oak Ridge	Russia	2	Battery technology	800,000
Oak Ridge	Russia	2	New methods for recycling commingled metals	468,000
Oak Ridge	Russia	2	Cockroach toxin	322,250
Sandia	Russia	[a]	Telecommunications with closed cities	1,285,000
Sandia	Russia	1	Medical radioisotope production in Russian reactors	90,000
Sandia	Russia	1	Silicon-based electronics	134,000
Sandia	Russia	1	Security tags and seals for hazardous material containers	100,000
Sandia	Russia	1	Security tags and seals for hazardous material containers	100,000
Sandia	Ukraine	1	Renewable energy sources	30,000
Sandia	Russia	1	Thin film characterization and analysis techniques for X-ray scattering	98,000
Sandia	Russia	1	Safety, reliability, and risk assessment training	150,000
Sandia	Belarus	1	Health effects from radionuclide contamination	106,000

(continued)

Responsible U.S. national laboratory	Country	Thrust level	Project's title (abbreviated)	Project's funding
Sandia	Ukraine	1	Lessons learned compendium	82,000
Sandia	Russia	1	Human relations workshop	120,000
Sandia	Russia	1	Development of separator plates for phosphoric acid fuel cells	400,000
Sandia	Russia	1	Medical prosthesis	250,000
Sandia	Russia	2	Log irradiation	1,021,000
Sandia	Russia	2	Microwave components	598,000
Sandia	Russia	2	Conversion of natural gas to liquid fuel	800,000
Sandia	Russia	2	Commercial application of cutting technologies for oil/gas platforms	200,000
Sandia	Ukraine	2	Brazing process for stainless steel tubes	225,000
Sandia	Russia	3	Silicon of Siberia	1,283,000
Total allocated costs $23,188,000				

[a]This project was identified as program directed and was not assigned a thrust level.

Profile of Institutes in Russia Visited by GAO

This appendix provides information on the 15 Russian institutes we visited that had received Initiatives for Proliferation Prevention (IPP) program funds. The information was obtained from written material provided to us by the institute and from interviews with institute officials. We asked the institutes to review what we had written about them. Comments from those that responded have been incorporated.

Entek, Research and Development Institute of Power Engineering (Moscow)

ENTEK, the Research and Development Institute of Power Engineering, was organized about 45 years ago and is one of Russia's largest research centers for nuclear engineering and technology. Among its varied responsibilities, ENTEK designs reactors for nuclear power plants, research reactors, and nuclear district heating plants. Current research is focused on advanced designs in nuclear power as well as existing plant life management. ENTEK is currently engaged in defense conversion activities.

Research Institute of Pulse Technique (Moscow)

The Research Institute of Pulse Technique is part of the Russian Ministry of Atomic Energy (MINATOM). The institute is a closed area that we were unable to visit. Instead, we met with institute representatives at an outside location. The institute was created primarily to design and develop methods for measuring fast pulses. This means it studies gamma X-ray emissions during nuclear tests. During the course of its work, the institute has developed routine measurement devices, such as electromagnetic detectors and oscilloscopes.

More recently, the institute's work has shifted to maintaining the safety of Russia's nuclear weapons, detecting underground explosions, and measuring low-level radiation. The institute now employs about 1,000 people, compared with about 3,000 10 years ago. Employment has been fairly stable in the last 2 years. Many of the institute's members have retired, but many have left science in response to banking and computer software opportunities in Russia. So far, according to institute officials, there has been no external brain drain—emigration to other countries. Employees at this institute are being paid regularly.

St. Petersburg State Electrotechnical University (St. Petersburg)

The St. Petersburg State Electrotechnical University was established in 1886. Among the oldest technical universities in Russia, it comprises seven schools: radio engineering; electronics; automation and computer science; industrial automation and electrical engineering; electrophysics; marine automation, electrical and radio engineering; and humanities.

In 1992, the school was granted university status and became the first electrotechnical university in Russia. More than 70,000 students have graduated from the university, including over 3,000 foreign students from 35 countries. The faculty numbers about 1,100, and the university currently has about 7,000 students at the seven schools.

Originally, the university was closely aligned with military research, focusing on creating special devices that worked against an array of pulses with high power. The purpose of this research was to prevent the jamming of communications equipment in the wake of a nuclear bomb. Since 1992, the demand for military research has declined, so the university is looking for international collaboration on peaceful activities. The university has also created the first fast-acting tunable microwave components and devices for wireless communications. These components are used in cell phones and satellite communications.

The Kurchatov Institute (Moscow)

Kurchatov is the leading nuclear research institute in Russia. Formerly part of MINATOM, Kurchatov is now an independent institute. Up through the mid-1950s, defense activities represented more than 80 percent of the institute's budget. By 1965, the defense portion had been reduced to about 50 percent, and today, less than 3 percent of the work is defense related. Kurchatov has virtually no defense-related contracts. Since the devaluation of the ruble, the average salary is now equal to about $30 per month. Senior scientists and researchers earn significantly more, although no figures were provided.

KVANT/Sovlux (Moscow)

Sovlux, a joint venture company, was created in the early 1990s. It is owned by KVANT, MINATOM, and a U.S. company, Energy Conversion Devices. Sovlux is located on KVANT's grounds but appears to be autonomous. Sovlux is a product of Russia's effort to shift from defense to civilian enterprises. The Sovlux enterprise was created as a means of commercializing activities in batteries and photovoltaic cells. Sovlux has about 40 employees, mainly former employees of KVANT. Some Sovlux employees are former employees of MINATOM enterprises and other defense

industries. Sovlux has hired some of the leading specialists from KVANT, including 7 PhDs and 28 graduates of Russian universities. Among these employees are machine cleaners, turners, and some specialists in machinery and production techniques.

KVANT was established during World War II and is an enormous state defense industry organization. It had 16 production facilities and plants spread across Russia, including research institutions. In the 1980s, it was removed from any state ministries and focused almost exclusively on Russia's space and military program. Many of the power sources used on Russian satellites were built by KVANT. The power panels on the Mir space station were developed by KVANT. In the mid-1980s, KVANT began converting technology to solar energy, using its experience from space/satellite applications. At that point KVANT started to look for other applications of its technology. KVANT began manufacturing photovoltaic modules for terrestrial applications. It believes that amorphous silicon technology is the most promising because it will lead to the goal of cheap production of photovoltaics.

In the early 1990s, KVANT and Energy Conversion Devices were introduced and began discussing the possibility of a joint venture. Sovlux was created with the idea of establishing a manufacturing base for photovoltaics in Russia that could be commercialized, with product distribution around the world. KVANT paid Energy Conversion Devices $10 million for equipment and expertise and established a small production facility at Sovlux. The agreement envisioned two parts—(1) a photovoltaic production facility in Moscow capable of producing 15 to 20 megawatts of photovoltaic capacity per year and (2) a nickel storage battery production facility at a remote defense production facility at Glazov, about 18 hours by train from Moscow. Energy Conversion Devices was paid an additional $1.5 million by the Chepetsk Mechanical Plant (which belongs to MINATOM) for technology. Also, according to the agreement, Energy Conversion Devices has 50 percent of the shares of the battery plant. Glazov is a MINATOM facility that focuses on metallurgy research and production. Currently, Glazov is providing Energy Conversion Devices with materials to build the negative electrode portion of the batteries. These batteries are to be used in small motor scooters. The most promising market is in Asia, where reliance on the scooters is very heavy. Glazov is supplying its own equipment and technology. More than 1/2 ton of material has been sent to Energy Conversion Devices. In 1999 the plant should deliver 100 tons of material to a U.S. company, Ovonics, which is a subsidiary of Energy Conversion Devices. In about 1 to 2 years, the plant hopes to begin selling

the material to General Motors and Ovonics for the manufacture of traction batteries for the production of electric vehicles.

All-Russian Scientific Research Institute of Experimental Physics (Sarov)

The All-Russian Scientific Research Institute of Experimental Physics, also known as VNIIEF, was founded by government decree in 1946. It is at the city of Sarov, where the first Soviet nuclear bomb was designed and assembled. The primary mission of VNIIEF is designing nuclear warheads. The institute fabricates experimental and prototype warheads. The institute employs approximately 20,000 people. In 1990, it reported that its staff included 3 academicians, 2 full-time and 3 corresponding members of the academy, 70 employees with doctorates in science, and 500 PhD candidates.

Weapons-related work has been declining since the early 1990s. The institute is moving many of its employees into other areas, such as nuclear safety, agriculture, and the environment. One of the main ways of shifting to nondefense work is through international collaboration. About 4,000 employees, or about 20 percent of the workforce, participate in international collaboration. Of these 4,000 employees, about 2,000 are scientists and the remainder are technical assistants, interpreters, and administrative assistants. Approximately half of the 4,000 spend about half of their time on international collaboration. About 10 percent of the people involved in international collaboration are associated with IPP projects.

Eighty percent of the institute's international collaboration is with the United States. VNIIEF/Sarov also collaborates with France, Germany, China, and the United Kingdom on projects for peaceful, civilian purposes.

All-Russian Scientific Research Institute of Natural Gases and Gas Technologies (VNIIGAZ) (Moscow)

VNIIGAZ was established in 1948 and is the main research and engineering arm of GAZPROM, Russia's supplier of natural gas. The institute's work in Russia's gas industry includes geology, the technology and engineering of gas production, transportation, and processing. Currently, VNIIGAZ cooperates with over 40 foreign companies. During the past years, major international projects have been jointly implemented with Amoco and Caterpillar (United States), Gaz de France (France), Ruhrgas (Germany), and ENI (Italy). VNIIGAZ's activities are also being supported by the European Community. Joint projects have been completed with Rolls Royce on energy efficiency and ENI on the reconstruction of the Unified Gas Supply System.

Khlopin Radium Institute (St. Petersburg)

The Khlopin Radium Institute, which is now part of the Russian Ministry for Atomic Energy, was founded in 1922 to investigate all aspects of radioactivity. The first Russian/European cyclotron was built at the institute. Khlopin produced the chemical technology that contributed to the production of weapons-grade plutonium. During the Soviet era, many Khlopin employees worked on weapons testing and production and radiation effects. After World War II, defense projects dominated the work at Khlopin. In the 1960s, reprocessing emerged as a key nuclear technology, and Khlopin became the sole designer and developer of the RT-2 reprocessing facility.

Khlopin's defense-sector work has declined and currently accounts for about 5 percent of the total budget. After the reactor accident at Chernobyl, many institute personnel went to there to work on remediation issues. In 1985, the institute started to become involved in international collaboration and international contracting work. The institute's environmental and waste remediation departments expanded greatly. Although the institute contracted with the United Kingdom, Japan, and France for reprocessing activities, reprocessing is now limited because of the problems at Krasnoyarsk-26 (work has virtually stopped for lack of money). Khlopin works closely with Krasnoyarsk-26 on many scientific matters.

Khlopin employs about 800 people, of whom one-third are scientists, one-third are engineers, and one-third are support staff. The number of employees has been reduced by about half over the last 10 years. The losses have come through retirements as well as career changes prompted by opportunities at Russian banks and other burgeoning Russian enterprises. The institute does not have enough money to attract and retain talented young people. Three scientists emigrated to Israel. Institute personnel are also working with in Finland, Sweden, the United Kingdom, France and the United States. These scientists remain Khlopin employees.

International contracts account for about 35 percent of the institute's budget. The remainder of the institute's funding comes from MINATOM, the Ministry of Science, and direct contracts with Russian nuclear industry plants.

Ioffe Physico Technical Institute (St. Petersburg)

The Ioffe Institute is one of Russia's largest institutions for research in physics and technology, operating a wide range of projects. It was founded in 1918 and run for several decades by Abram Ioffe. The institute is affiliated with the Russian Academy of Sciences and is Russia's major

institute for semiconductor physics and semiconductor devices. Departments include solid state physics, astrophysics, plasma physics, and the physics of dielectrics. The first Russian transistor was developed at the institute. During Soviet times, the institute was state supported and financed. It also had agreements with Soviet civilian and defense organizations, which provided a small amount of funding. It was primarily funded to do nonweapons work. However, defense research was conducted in the solid state physics department. Currently, the institute receives about 20 percent of its funding from abroad for collaborative work with the United States, Germany, Japan, South Korea, France, and China. Singapore has expressed interest in collaboration, but it has not yet occurred.

About 10 years ago, the institute employed about 3,500 people; today it employs about 2,500, including about 600 researchers with PhDs. Around 10 percent of the staff emigrated to the United States or Israel. Of the others who have left, many have gone into private business in Russia or have moved elsewhere in the West to pursue science.

The average age of the employees is 38. Ten years ago, the average age was 42. The institute is getting some younger people, but the middle-level employees are leaving.

Association of Centers for Engineering and Automation (St. Petersburg State Technical University) (St. Petersburg)

The Association of Centers for Engineering and Automation carries out the federal innovation program "Engineering Network of Russia" according to a decree by the Russian government. The network unites more than 100 engineering centers throughout Russia and the Newly Independent States (NIS). Its centers employ over 100 doctors of science and 200 PhDs. The centers seek to collaborate with partners all over the world, including the United States, Scotland, South Korea, Finland, Germany, France, Greece and Belgium. The association's head is called the Science-Intensive Engineering Center of St. Petersburg State Technical University.

Gamaleya Institute of Epidemiology and Microbiology (Moscow)

The Gamaleya Institute for Epidemiology and Microbiology of the Russian Academy of Medical Sciences has been active for over a century. In the course of its long existence, its activities have focused primarily on basic research and to a lesser extent on applied studies in three closely related areas:

- medical microbiology, particularly in the fields of genetics and the molecular biology of pathogenic bacteria;
- basic and applied infectious immunology; and
- epidemiology, including the problems of nosocomial infections and infections with natural foci.

The Gamaleya Institute has focused most of its attention on studying viruses, including lethal ones, and identifying cures for their effects. During the Cold War, the institute conducted research to defend the Soviet Union against lethal viruses that might be introduced by the West. The director noted, however, that this type of work can always be turned around into an offensive capability.

Since the breakup of the Soviet Union, the institute has transformed itself and its mission. During the Cold War, nearly all of its work was research, but now about 80 percent of its work is clinical and 20 percent is research. The institute is actively marketing products, such as testing kits for sexually transmitted diseases. Since the institute employs many medical doctors, it also performs hospital functions. In addition, it manufactures medicines for humans and animals. The institute is part of the Russian Academy of Medical Sciences. While some parts of the institute are in dire financial straits, the overall health of the institute is good, according to institute officials.

The institute has experienced minimal turnover in staff. According to institute officials, about 10 people have left and emigrated to the United States. Others have left the institute to work in Russia's private sector, in industries such as banking and computers. According to institute officials, no scientists/doctors have emigrated to rogue nations, and the institute does not have contracts with these countries. The deputy director said "the patriots" remain and the institute will survive whatever economic hardships come its way.

Institute of Nuclear Research (Moscow)

The institute does basic and applied research and specializes in nuclear, neutron, neutrino and particle physics. During the Soviet era, the institute conducted experimental nuclear research and was trying to investigate different processes related to nuclear research. About 5 to 6 years ago, the institute began changing its scope of activities and is now doing more applied research and less basic research. It began working in isotope production for medical purposes. It has been producing strontium-82 targets for positron emission tomography, which is used to diagnose

cancer. The institute is collaborating with many countries and is working with Los Alamos National Laboratory, Argonne National Laboratory, Fermi Laboratory, Brookhaven National Laboratory, and Canada-Triumph Laboratory in Vancouver.

The institute has 1,380 employees, including 800 who work in Troitsk. The laboratory we visited is the Moscow Meson Factory. The institute is now working primarily in applied sciences because it needs to supplement its budget. The institute is facing difficult economic conditions. During the period from July through September 1998, the institute had enough money to pay only 1 month's worth of salaries. About 10 years ago, the institute had over 2,500 employees, but many have retired or left because of the dire financial conditions. Currently, about 30 employees are working abroad on contracts, but they remain employed by the institute. About 30 employees have moved to other countries, including Germany and Canada. According to institute officials, no employees have emigrated to rogue countries.

All-Russian Scientific Research Institute of Inorganic Materials (VNIINM) (Moscow)

This institute is named for Academician A.A. Bochvar, and is often referred to as the Bochvar Institute. Its work includes spent fuel reprocessing, the transportation of radioactive materials, work on spent fuel containers, radiation technology and research, radiochemistry, and nuclear waste management and disposal. It was founded in 1945 and was part of the "Soviet Manhattan project." Initially, its work focused on plutonium and uranium issues, but now it addresses fuel for nuclear power plants, structural materials, and fuel rods for thermal neutron reactors, fast reactors, research reactors, and nuclear powered icebreakers.

The institute performed comprehensive work on plutonium recovery and reprocessing and first reprocessed spent fuel in 1977. It also conducts work related to nuclear disarmament, the long-term storage of nuclear materials and products, and the conversion of weapons-grade plutonium and uranium into reactor fuel as well as the immobilization of plutonium. According to institute officials, these activities are supported by the Department of Energy.

The institute produced the equipment and methods for reprocessing nuclear waste and spent fuel, and it conducted research on nuclear fusion and superconductive materials. It also developed the materials for powerful magnets, blanket materials for fusion research, and processes for

tritium recovery, extraction, and purification. The institute also provides analytical support for verifying the results of inspection activities under certain nonproliferation treaties. In 1987, the first Russian plant was commissioned for the vitrification of high-level waste. The second one was commissioned in 1991, and 280 curies of nuclear waste were vitrified in Chelyabinsk.

Engelhardt Institute of Molecular Biology (Moscow)

The Engelhardt Institute was organized in 1959 to study the effects of radiation. It functions like a university and is part of the Russian Academy of Sciences. Engelhardt does work on DNA, chemistry, and genetic engineering. Engelhardt has about 450 employees and administrative staff, as well as about 200 undergraduate, graduate, and postgraduate students. About half of the staff scientists are biochemists and mathematicians. According to officials, the institute does no work on weapons of mass destruction and did not work on biological warfare during the Soviet era. About a quarter of the institute's budget comes from international collaboration, primarily with the United States, France, and Sweden. With the collapse of the Soviet Union, the institute determined that it would have to become more self-sufficient and rely less on government funding. It fostered a greater entrepreneurial mentality and created individual units that have assumed large responsibility for obtaining work with international collaborators.

Institute of Biochemistry and Physiology of Microorganisms (Moscow Region)

In the 1950s, Russia established science cities—one each for chemistry, biology, and physics. The Institute of Biochemistry and Physiology of Microorganisms is part of the city established for biology and was established around 1962. The institute was developed because Russia was far behind the rest of the world in the biological sciences. It was decided that the institute's work would not be defense related.

The institute started work on the genetic engineering of microorganisms and microbiology in 1972. Its scientists do biochemistry, physiology, and genetics and are interested in applications of basic research. For example, they developed a single-cell protein to be used as a food additive for livestock. This accomplishment was the basis for a microbiology industry in Russia. About 1 million tons of the livestock additive was produced each year.

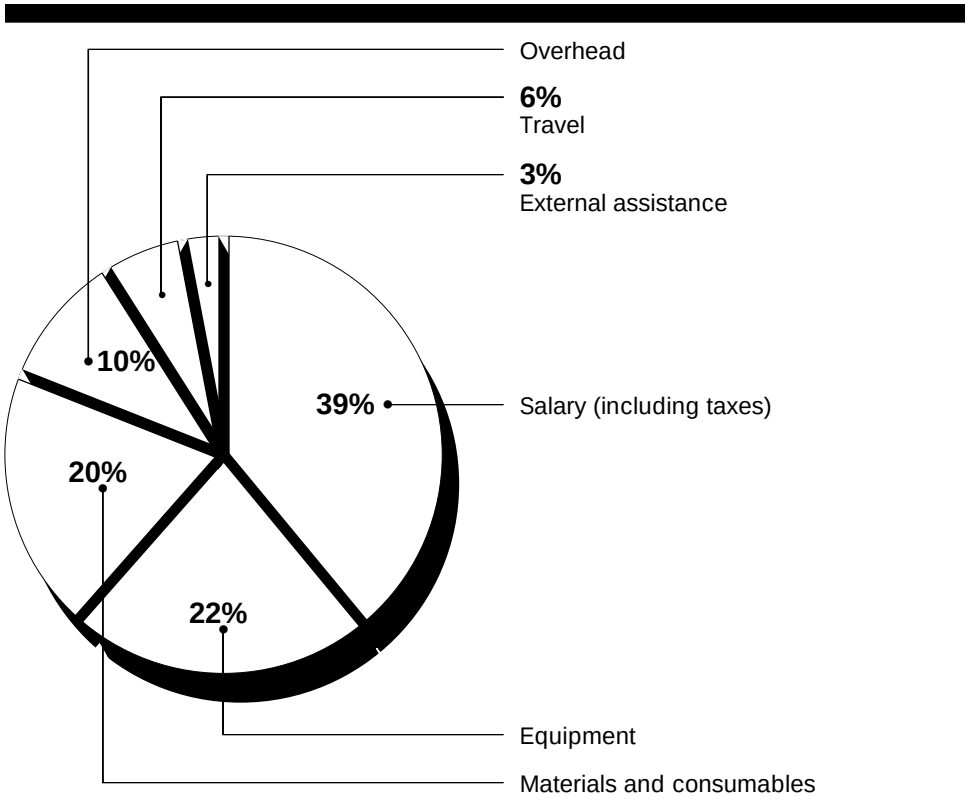
Another asset of the institute is its fermentation pilot plant. Although the institute has experienced staff to operate the plant, it does not have money

for the spare parts needed to sustain operation. Another department at the institute has cataloged 15,000 microorganisms and has 10,000 to 15,000 microorganisms remaining to be cataloged. The institute also focuses on biodiversity, applying these concepts to pollution control, ecology, environmental science, remediation research, and related fields.

Distribution of IPP Funds at Some Russian Institutes

We obtained some information on how IPP funds were allocated from officials at other institutes, mainly in St. Petersburg and Moscow. For example, the St. Petersburg Electrotechnical University received $300,000, but $117,000, or 39 percent of the total, went for salaries and taxes.[1] According to a university official, most of the funds were used for equipment, materials, overhead, travel, and other purposes, as shown in figure IV.1.

Figure IV.1: Allocation of Funds Received at the St. Petersburg Electrotechnical University for an IPP Project



Source: St. Petersburg Electrotechnical University.

[1]The project involved tunable microwave components for wireless communications, under contract No. AO-497 with Sandia National Laboratory.

An official at the Landau Institute for Theoretical Physics in Moscow told us that none of the funds received from an IPP project went for salaries. Twenty percent of the institute's reimbursement for efforts to improve fiber optical transmission systems went for overhead, and the remainder went for travel, computers, and Internet access. Elsewhere, at the Gamaleya Institute in Moscow, officials said that of the $80,000 received from the IPP program, $12,290, or 15.4 percent of the funds, went toward salaries, as shown in table IV.1. The rest of the money went for taxes, supplies, and other costs. The institute received the funds via Oak Ridge National Laboratory in an effort to find possible new pharmaceutical compounds.

Table IV.1: Expenditures From an IPP Payment to the Gamaleya Institute

Type of Expenditures	Amount	Percentage
Salaries	$12,290	15.4
Taxes	21,023	26.3
Supplies	45,618	57.0
Other costs	1,069	1.3
Total	**$80,000**	**100**

Source: Gamaleya Institute.

Taxes on the Gamaleya project funds included a value-added tax, which institute officials in Russia told us should not be paid on IPP projects.[2] Institute officials said they were perplexed that the funds were subject to such a tax, and they queried their partner at Oak Ridge National Laboratory, but the issue has not been resolved. The institute generally charges for overhead but has eliminated that assessment for now because of the high tax rate.

The director general of the State Research Center of Virology and Biotechnology (VECTOR), which has been involved in developing biological weapons in the Novosibirsk region, told us that 10 percent of the research center's portion of an IPP project's funding goes for overhead costs. The principal investigator, who has a doctoral degree, is paid no more than $25 a day. The other participants — scientists, who usually have doctoral degrees, and technicians — are paid $15 to $25 per day, depending on their expertise and involvement in the project. Taxes amount to about 40 percent of the salaries.

[2]The value-added tax is a sales tax on all goods and services acquired in Russia.

Commercialization of Selected IPP Projects

This appendix discusses the status of efforts to commercialize several IPP projects that we reviewed.

Some IPP Projects Have No Discernible Commercial Potential

In a few cases, the principal investigators at the Department of Energy's (DOE) national laboratories told us that the projects they were responsible for had little or no potential for commercial success. For example, the principal investigator for one Thrust 1 project dealing with engine materials said there was no recognized U.S. industry partner for the project, even though the project has been under way since 1994. Similarly, the principal investigator responsible for a Thrust 1 project on nuclear safety risk assessments, which began in 1995, said the project did not have commercial potential. Officials from Russia's Khlopin Radium Institute, who collaborated on the project, said the project had no commercial application because it was research oriented. The institute's director said that despite the lack of commercial potential, he was glad to have the project. In another instance, Sandia National Laboratory spent $120,000 on a seminar to provide a workshop for Russian officials to downsize the Russian nuclear weapons complex. The project, completed in August 1998, was led by a human resources employee from Sandia. According to the project leader, the project did not have a direct commercialization benefit but was intended to promote, among other things, strategies for meeting future human resources needs. We were told by a laboratory official that one of the intended benefits of the project was to encourage Russian school children to choose science- and technology-related disciplines to maintain the Russian nuclear complex.

A couple of projects that had U.S. industry partners did not come to fruition for various reasons. Part of the national laboratories' role is to review the claims made by Russian institutes about the potential commercial applications of their technologies. As a result, for projects such as the following, IPP program funds are used to try to substantiate the potential commercial viability of the Russian technology.

- $201,900 was spent for a Thrust 2 project involving Argonne National Laboratory and the Russian Institute of Biophysics. The Russian institute claimed that it had invented an agent that could reduce the effects of radiation. The Argonne principal investigator told us that the institute was unable to support its claims and was reluctant to provide sample agents to the laboratory for testing and evaluation. After many months, the institute finally sent a sample, which the principal investigator said appeared to have been sitting on a shelf for a long time and had no unique qualities.

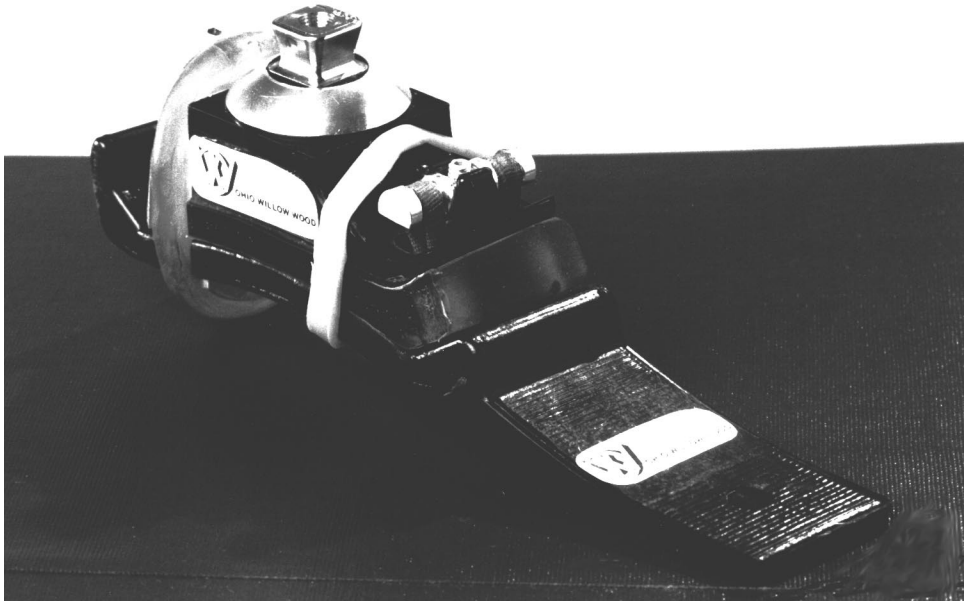
Argonne received $138,100 for the project, and the institute received $63,800.

- $294,000 was spent on a Thrust 2 project to study a cockroach toxin developed by Russian biological warfare institutes. According to the Oak Ridge National Laboratory principal investigator, the project was designed to validate claims by the Russians that they had developed a toxin to kill cockroaches that would be protein based and would not be applied in the form of a dust. As a result, the toxin could be used widely in sensitive machinery and equipment, such as computers and submarines. U.S. researchers were unable to replicate the toxin provided by the institute.

Other IPP Projects Have Greater Commercial Potential

Some projects appear to have greater commercial potential. For example, Sandia National Laboratory has a Thrust 1 project with Chelyabinsk-70, a Russian closed city, to help improve a prosthetic foot device developed by a U.S. company (see fig. V.1). The Russian scientists working on the project are expected to test the U.S.-manufactured prototype and offer design changes. According to the Sandia principal investigator, there is a market for the technology, and once it has been further improved and refined, it can be marketed. It is anticipated that the Russian scientists will assume more responsibility for manufacturing components—and perhaps the entire device—if the project becomes commercially viable.

Figure V.1: Prosthetic Foot Device That Is Being Engineered by NIS Scientists at Chelyabinsk-70



Source: Sandia National Laboratory.

Another Thrust 1 project that shows commercialization potential is a device known as an acoustic nozzle. The technology for this device was developed by a Russian institute about 25 years ago for submarine sound detection. The technology is now being used for other applications, such as fire suppression and fuel dispersal. In November 1998, the Federal Aviation Administration began testing the device for possible use in aircraft fire suppression. According to a Federal Aviation Administration official, the initial testing of the device was promising but the inventors have to modify the device so that it can pass further testing before it can be approved for use in U.S. aircraft.

We also reviewed a project involving the recycling of metals from old cars that has enjoyed some commercial success (see fig. V.2). A U.S. company that has recycled metals for many years is looking for more cost-efficient and effective ways to separate and recover the metals, such as brass, aluminum, and tungsten carbide. Once separated, the metals are sold to other companies. Currently, the separation is done manually and is very

expensive. Russian participants are providing equipment and developing new metals separation technology and expertise to improve the existing processes. According to the U.S. industry representative, he initiated contact with Russian defense-related institutes in the early 1990s to determine what technologies they might have for possible commercial application. As a result, he identified an enterprise in St. Petersburg and began working with them on this project. A joint venture company was formed in 1995 as the venue for the commercial relationship. IPP funds have been applied to the project since 1996 and used to support research and development.

Figure V.2: Metals Recycling Facility in St. Petersburg, Russia

The U.S. industry official said that the IPP program demonstrates the U.S. government's commitment to sustaining the project. He told us that the IPP program provides discipline and structure because the Russian partner is held accountable to time frames and deliverables. The program serves as a bridge between U.S. and Russian industry. The national laboratory principal investigator told us that the U.S. government is phasing out and should complete its role in the project by the summer 1999. He believes the collaboration between U.S. and Russian industry will continue and the project will move into a Thrust 3 phase.

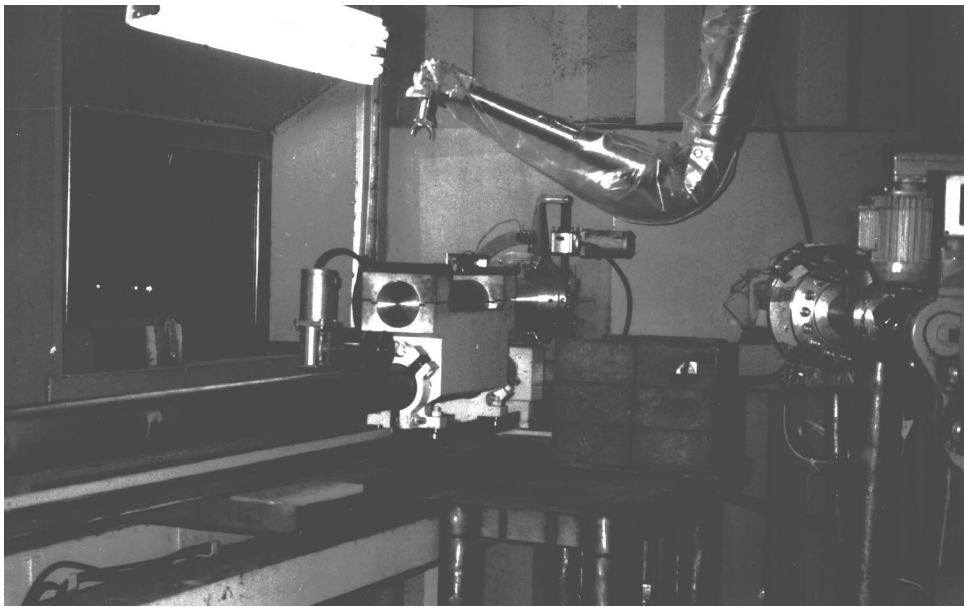
Russian officials participating in the project spoke positively about the IPP program because it introduced more accountability into the project. They told us that the project would continue without IPP funding but at a slower pace. The general director of the St. Petersburg State University, which established the association[1] that leads the project, told us that the project has also been valuable because it gives the Russian participants greater experience in doing business with the United States. In addition the project helps the center meet its strategic goal of finding self-financing projects that will no longer require future government support.

We reviewed a Thrust 3 project involving the production of medical isotopes used to diagnose heart disease. This project, which evolved from a Thrust 1 project, employs scientists from Russia's Institute of Nuclear Research. The institute uses its particle accelerator to irradiate a small block of rubidium metal, called a target. The target is exported to Los Alamos National Laboratory for further refinement and is eventually forwarded to a U.S. pharmaceutical company that prepares the medical isotope for sale to hospitals. Once in the hospital, it is administered for cardiological imaging (see figs. V.3 and V.4).

[1]The Association of Centers for Engineering and Automation carries out a Russian federal innovation program to promote commercialization. It unites more than 100 engineering centers throughout the NIS. The association's head is called the Science Engineering Center of St. Petersburg State Technical University.

Figure V.3: Institute of Nuclear Research

Figure V.4: Interior View of Medical Isotopes Production Area at the Institute of Nuclear Research



According to Los Alamos officials, the project was reclassified as a Thrust 3 project because it had shifted away from direct laboratory participation, although the laboratory will continue to provide some oversight and material processing functions. The U.S. industry partner, a small New Mexico firm, assists in transporting the material and takes care of various administrative functions. Institute officials told us that the project does not provide sustained employment. In addition, the manufacturing capacity of the institute is constrained because it cannot pay for the electricity to produce the material on a consistent basis and has only a limited share of the market. The U.S. industry partner has placed a purchase order for irradiated fuel targets in fiscal year 1999.

Lack of Capital Stalls Some Projects

Other projects we reviewed showed commercial potential, but their success is uncertain. For example, one project deals with the irradiation of Russian timber so it can be exported to the United States. The U.S. Food and Drug Administration and the U.S. Environmental Protection Agency require that logs be disinfested to remove insects before entering the United States. According to Sandia National Laboratory, complete implementation of the project will result in the creation of 100,000 jobs in the NIS. However, only about 100 of these jobs would be for weapons scientists. The project, which was started in 1996, is languishing because the U.S. industry partner has encountered serious financial difficulties. The director general of the Khlopin Radium Institute, the NIS partner, told us that the project has great potential but is now a paper exercise because it lacks funding. The national laboratory principal investigator also said the project is stagnant. He said that if the U.S. company is unable to provide the necessary funding, the project may be terminated in early 1999.

Another project we reviewed dealing with the fabrication of photovoltaic cells appears to hold promise but is stalled for lack of capital. The project envisions U.S.-Russian collaboration on the production and sale of solar cells (shingles), modules, and systems in Russia, with most of the products geared to developing countries that do not have ready access to electricity. A U.S. industry official told us that the technology, much of which was developed in the United States before the IPP program began, has commercial potential. Because of the technology's importance, the project received high-level attention by both the U.S. and the Russian governments. The Russian Ministry of Atomic Energy (MINATOM) agreed to provide several million dollars to enable the existing plant to begin full-scale production and to help construct a full production facility but

has been unable to meet its commitment. The U.S. industry official also told us that the IPP program was critical to sustaining the project, enabling the venture to do critical preproduction work and train personnel.

We visited the pilot photovoltaic cell facility in Moscow and talked to representatives from the plant. They confirmed that the technology is ready for commercial production but the project lacks financing. Pending the required financing, the plant has been limited to research and development activities. A new opportunity growing out of the collaboration is the production of solar cell panels for space. Some prototype modules employing the technology are currently being tested on Russia's Mir space station.

Figure V.5: Photovoltaic Cell Production

Another project that DOE believes may have enormous commercial potential—but has an uncertain future—is DOE's effort to help Krasnoyarsk-26 develop a production facility for electronics-grade

polycrystalline silicon, a precursor for the production of virtually all silicon for integrated circuits and other electronics. Krasnoyarsk-26 is one of Russia's 10 nuclear cities and has been responsible for plutonium production. The project has major visibility with the Russian government and was approved for funding by DOE in January 1997. In addition, the U.S. Defense Enterprise Fund has provided some assistance.

If this facility is built, it is expected to (1) provide Russia with a significant role in the world silicon marketplace and (2) employ as many as 800 scientists, engineers, and technicians. However, the Sandia National Laboratory principal investigator said that no Russians from Krasnoyarsk-26 have been employed by the project with DOE funds to date. The amount allocated for this project is $1.2 million, and $248,600 had been spent as of December 1998. A significant amount of the money spent to date has been for preliminary designs by a U.S. consultant. However, several million dollars will be required for the Russians to obtain a more detailed plant design, and overall investment costs of about $200 million are anticipated. Although DOE considers this one of its two Thrust 3 projects, there is no major commercial investor. In fact, no U.S. company has been an industrial partner. In May 1998, Sandia National Laboratory officials told us that the most promising investor was a German company. However, in December 1998, the Sandia principal investigator told us that the potential German partner's interest had declined because of the deteriorating Russian economy. According to the principal investigator, the project is going more slowly than anticipated, and the Russians have been looking for funding from other countries, such as Oman, and multilateral organizations. Continued U.S. funding depends on whether Russia can find an investor for the project.

IPP Projects Selected for Inclusion Under the Nuclear Cities Initiative

DOE selected 23 IPP projects as the initial activities under the Nuclear Cities Initiative. These projects had been approved between May 15 and July 21, 1998. Ten of the projects were announced when the U.S. Vice President visited Russia in the fall of 1998. Table VI:1 identifies the nuclear cities and DOE laboratories involved, as well as the purpose of and funding for the projects.

Table VI.1: IPP Projects Approved for the Nuclear Cities Initiative

Dollars in thousands

Russian nuclear city	DOE national laboratory	Purpose	Allocated funding
Seversk	Lawrence Berkeley	Use a plasma system to produce a diamondlike coating for materials	$100
Zhelelnogorsk Ozersk	Sandia	Design treatment for high-level radioactive tank waste	150
Sarov	Pacific Northwest	Host a workshop on economic diversification	75
Sarov	Lawrence Livermore	Develop a better well-casing perforator for oil and gas production	260
Sarov	Lawrence Livermore	Develop a pulsed pressure generator for oil and gas fields	220
Sarov	Lawrence Livermore	Develop a new explosives detonator for safer mining and oil exploration	260
Sarov	Brookhaven	Use electron beam technology to assess precious minerals in ore rubble	140
Sarov	Lawrence Berkeley	Develop a new magnetron for food sterilization and processing	950
Sarov	Sandia	Conduct a planning workshop for the development of a center to preserve the Russian infrastructure	100
Sarov	Sandia	Conduct a workshop to provide Russians with decontamination and decommissioning information	100
Sarov	Oak Ridge	Develop a new sensor to detect flaws in ceramics using acoustical measurements	143
Sarov	Pacific Northwest	Apply and demonstrate nuclear waste management techniques and technologies	135
Ozersk	Brookhaven	Develop a pulse neutron source for studying condensed matter and nuclear physics research	150

(continued)

Dollars in thousands

Russian nuclear city	DOE national laboratory	Purpose	Allocated funding
Snezhinsk	Lawrence Livermore	Develop new generation X-ray tubes for medical diagnosis and nondestructive evaluations	335
Snezhinsk	Lawrence Livermore	Improve cathode-anode X-ray tubes	320
Snezhinsk	Los Alamos	Establish a Russian center to focus on quality and standardization practices	1,200
Snezhinsk	Sandia	Develop a flexible explosive system for cutting steel-reinforced concrete structural sections for decontaminating and decommissioning DOE and Department of Defense structures	200
Zheleznogorsk, Snezhinsk	Pacific Northwest	Host economic diversification workshops at Pacific Northwest	200
Total allocation			**$5,038[a]**

[a]In addition, $50,000 in IPP funds was approved for a Lawrence Livermore project to fund travel for four people to Snezhinsk. This was considered an additional project.

Comments From the Department of Energy

Department of Energy
Washington, DC 20585

FEB 10 1999

Mr. Victor S. Rezendes
Director
Energy, Resources
and Science Issues
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Rezendes:

The Department of Energy appreciates the opportunity to review the draft General Accounting Office report, GAO/RCED-99-54, "Nuclear Nonproliferation: Concerns With DOE's Efforts to Reduce the Risks Posted by Russia's Unemployed Weapons Scientists." The report, as written, provides valuable insight into our Initiatives for Proliferation Prevention Program and will assist the Department to better manage this valuable program. Technical comments to this report have been provided separately. Our comments on the report's recommendations are attached.

Sincerely,

Leonard Spector
Director
Office of Arms Control
and Nonproliferation

Attachment

Comments on
Draft General Accounting Office Report
NUCLEAR NONPROLIFERATION: Concerns With DOE's Efforts to Reduce the Risks Posed by Russia's Unemployed Weapons Scientists
RCED-99-54, February, 1999

General Comments

The Department of Energy appreciates the effort that the General Accounting Office put into this report. We agree with the vast majority of its recommendations, and the IPP Program will be significantly strengthened as the result of this independent, in-depth evaluation. There are, however, a number of issues that we believe need further clarification.

First, the report expresses concern that certain IPP projects may have supported the development of dual-use technology that could inadvertently strengthen Russian military capabilities. We note that the specific projects identified in the report date from an earlier period of the program and, at worst, might have provided only incidental military benefits to Russia -- and not to its weapon of mass destruction or missile programs. We are firmly committed to ensuring that IPP projects do not support dual-use technologies and are directed exclusively to peaceful objectives. This is an explicit project requirement as noted in guidance. Over the past eighteen months, the new management of the IPP Program has intensified project reviews to reinforce implementation of this standard.

We have been particularly sensitive to the dual-use potential of projects in the NIS chemical and biological institutes. The Department recognized from the onset of the program that the dividing line between commercial and weapons technologies was subtle in this area of technology. As a result, DOE instituted a special review process, which included the U.S. interagency, the U.S. chemical and biological community, and the DOE National Laboratories. Although the GAO report states that some reviewers may have provided only cursory analysis of particular projects, we believe that *every* IPP project with a chemical and biological institute received extensive scrutiny from numerous participants in the review process and that this process deliberately erred on the side of disapproval when questions on potential dual-use applications were raised. Nonetheless, we recognize that improvements are needed to make the review process more consistent and, as noted below, we accept the GAO's recommendation on this issue.

The GAO report also raised the concern that some Russian weapon scientists are being paid by the IPP Program even though they remain employed at their respective weapons-related institutes. The implicit criticism of the program is that this practice is subsidizing Russian weapon-of-mass destruction activities. We believe this implication is misplaced. The fundamental goal of the IPP Program is to keep weapons specialists working in their home countries -- in the face of grim domestic employment prospects -- rather than selling their services to foreign states or organizations of proliferation concern. At virtually all Russian weapons institutes, salaries are going unpaid for months, even for those who are nominally "employed" there. These scientists, and those who have been dismissed, are the proper targets of the IPP Program, because these are the individuals who are most likely to be tempted to sell their services abroad. IPP policy clearly states that the Program does not pay scientists to perform weapons work, and we match the scale of payments to those of deliverables required by our contracts, so that we are not inadvertently subsidizing other work at the host institute. Moreover, time spent on IPP activities is time scientists cannot spend working on Russian military programs.

Finally, GAO notes that only two of the IPP projects have progressed to Thrust III. Commercialization of science and engineering requires time, and the IPP program has only recently shifted its emphasis to commercialization. In the United States, commercialization efforts normally take five to seven years. In just the past year, the IPP Program has placed increased emphasis on projects cost-shared with U.S. industry (Thrust II) and on moving such projects towards commercial viability (Thrust III). This progression is important, we believe, to create viable long-term employment opportunities for Russian scientists who are leaving weapons work. We recognize, however, that IPP cannot by itself create commercial entities; it can only set measures and procedures in place to maximize the likelihood of their creation by U.S. industry. If Russian economic conditions stabilize, we believe the coming eighteen months will see the fruits of these and earlier efforts.

Fortunately, as the GAO notes, even if IPP commercialization success remains limited, the fundamental objective of the IPP Program -- keeping former Soviet weapon-of-mass-destruction scientists at home -- is succeeding.

Responses to GAO Recommendations

A. Recommendations on the IPP Program

Recommendation 1

Re-examine the role and the costs of the national laboratories with a view towards maximizing the amount of program funds going to the NIS institutes.

DOE Management position

Concur.

The Department will continue its examination of laboratory roles to utilize their expertise more efficiently. In coming months, we expect to increase significantly the proportion of project dollars going to the NIS and to correspondingly reduce the proportion of funds spent at the national laboratories. An increased emphasis on Thrust II and Thrust III projects will help to promote this shift in funding. The Department notes that the enabling legislation for IPP calls for a "...program of cooperation between scientific and engineering institutes in the New Independent States of the former Soviet Union and national laboratories and other qualified academic institutions in the United States designed to stabilize the technology base in the cooperating states as each strives to convert defense industries to civilian applications..."

Recommendation 2

Obtain information on how program money is being spent by the NIS recipients of program funds.

Management position

Concur.

The IPP Program office will issue guidance to participating laboratories to ensure more complete tracking of the expenditure of funds by the NIS recipients. The program will establish quarterly reporting on funds spent in the NIS.

Recommendation 3

Seek assurances from the Russian government, either through a government-to-government agreement or through other means, that program funds are exempt from Russian taxes.

Management Position

Concur.

The Department of Energy agrees with this recommendation and will work with the Department of State to facilitate a government-to-government agreement. In the meantime, the Department will continue its efforts within the U.S. interagency structure to resolve this issue. This effort has led to discussions by the Vice President with his Russian counterparts on taxation issues and to the renewal of the Panskov-Pickering agreement as the basis for seeking case-by-case tax exemptions for IPP funds expended in Russia.

Recommendation 4

Require that program officials, to the extent possible, obtain accurate data on the number and backgrounds of scientists participating in program projects, and eliminate funding for institutes that did not formerly work on weapons of mass destruction.

Management Position

Concur.

The IPP Program has issued, and will reemphasize, program guidance instructing principal investigators to obtain accurate data regarding the number and backgrounds of scientists participating in program projects. Scientists with weapons knowledge now employed at nonweapons institutes will continue to be eligible to participate in the IPP Program, as they represent a continuing potential proliferation concern.

Recommendation 5

Clarify program guidance as to whether scientists currently employed in weapons of mass destruction programs are eligible for program funding.

Management Position

Concur.

The basic goal of the program is to retain former Soviet WMD scientists in their home countries; the key question is the expertise they possess and might offer to others, not whether they are currently on the roster of an NIS WMD institute. Through its increasing emphasis on commercialization, IPP will continue to develop long-term opportunities for scientists to leave WMD institutes. Explicit program guidance regarding scientists currently employed in weapons of mass destruction programs will be issued within 90 days.

Recommendation 6

Require that project reviewers consider all military applications of projects to ensure that useful defense related information is not unintentionally transferred.

Management Position

Concur.

The IPP Program has always been sensitive to the question of transfer of weapons-sensitive technology to the NIS. Based on the GAO's report, however, we recognize that our review process was not as complete as it should be. Accordingly, the program has revised its procedures to request a direct review of projects by the Department of Defense instead of forwarding projects through the Department of State.

Recommendation 7

Strengthen and formalize DOE's process for reviewing proposed chemical and biological projects by:

(1) providing complete project information to all reviewing U.S. Government agencies and organizations

Management Position

Concur.

Based on the GAO's report, the program has revised its procedures to ensure that all appropriate government agencies and organizations have complete project information.

(2) developing criteria to help frame the evaluation process

Management Position

Concur.

This recommendation was completed during the course of the GAO's audit.

(3) providing feedback to all of the reviewing agencies about the final disposition of the projects.

Management Position

Concur.

The Department will provide feedback to all reviewers regarding the status of final approval of IPP projects.

Recommendation 8

Re-evaluate the large number of Thrust 1 projects, particularly those that have been funded for several years, and eliminate those that do not have commercial potential.

Management Position

Concur.

The Department has implemented a reevaluation of Thrust 1 projects based on GAO's review.

Recommendation 9

Develop criteria and time frames for determining when Thrust 1 projects should be terminated if they do not meet the criteria for graduation to the program's next phase.

Management Position

Concur.

Based on GAO's review, this recommendation will be accomplished within 120 days.

B. Recommendations on Nuclear Cities Initiative:

Because DOE plans to implement the Nuclear Cities Initiative in a relatively short amount of time (5 to 7 years) at a potential cost of up to $600 million during uncertain economic times in Russia, we believe it is critical that program implementation be based on solid thinking and planning which considers the problems experienced under the IPP Program. Therefore, we recommend that DOE:

Recommendation 10

Develop a strategic plan for the Initiative before large scale funding begins and include in the plan–program goals, costs, time frames, performance measures, and expected outcomes, such as the number of jobs created for each city.

Management Position

Concur.

The Department is preparing a strategic plan that will be published within 90 days.

Recommendation 11

Not expand the Initiative beyond the three nuclear cities until DOE has demonstrated that its efforts are achieving program objectives, that is, that jobs are being created in the civilian sector for displaced weapons scientists, engineers, and technicians.

Management Position

Concur, with qualification.

Some existing IPP projects in other closed cities may naturally transition to work under the Nuclear Cities Initiative. Similarly, the Department does not want to preclude the possibility of accomplishing significant reductions in nuclear weapons related activities in another closed nuclear city should the opportunity arise to assist in the shutdown of facilities there. It is also the intent of the Department to structure the second year of the Nuclear Cities Initiative based upon lessons learned the first year. The Department has a process for reviewing program objectives to determine lessons learned and next steps.

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