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Report to the Chairman, Committee on Governmental Affairs, U.S. Senate

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NUCLEAR POWER SAFETY

Chernobyl Accident Prompted Worldwide Actions but Further Efforts Needed

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National Security and
International Affairs Division

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The Honorable John Glenn
Chairman, Committee on Governmental
Affairs
United States Senate

Dear Mr. Chairman:

As you requested, we are providing information on (1) various international organizations' efforts to strengthen their responses to nuclear emergencies; (2) the current efforts of the U.S. government and international organizations to address nuclear safety problems, particularly with Soviet-designed reactors; and (3) what further actions could be taken to achieve greater international nuclear power plant safety.

We plan no further distribution of this report until 30 days from the date of this letter unless you publicly announce its contents earlier. At that time, we will send copies to the Secretaries of State and Energy, the Chairman of the Nuclear Regulatory Commission, and other interested congressional committees. We will also make copies available to others on request.

This report was prepared under the direction of Allan I. Mendelowitz, Director, International Trade, Energy, and Finance Issues, who may be reached on (202) 275-4812 if you or your staff have any questions. Other major contributors are listed in appendix III.

Sincerely yours,

Frank C. Conahan

Frank C. Conahan
Assistant Comptroller General

Executive Summary

Purpose

The widespread radiological contamination from the Soviet Union's Chernobyl nuclear power plant accident in 1986 raised global concerns about nuclear power plant safety. As a result, a variety of efforts were initiated to improve worldwide nuclear safety and establish emergency response procedures.

The Chairman of the Senate Committee on Governmental Affairs asked GAO to provide information on (1) the nature and extent of international organizations' efforts to strengthen their responses to nuclear emergencies; (2) the current efforts of the U.S. government and international organizations to address nuclear safety problems, particularly with Soviet-designed reactors; and (3) efforts to achieve greater international nuclear power plant safety.

Background

Eleven international governmental and private organizations currently have some role in helping to respond to nuclear power emergencies or to improve the safety of nuclear power plants. However, the International Atomic Energy Agency (IAEA) has primary responsibility and is to take the lead role in coordinating the activities of the others. About 6 percent of IAEA's regular budget for 1991 was for nuclear safety and radiation protection. The World Association of Nuclear Operators is a private sector organization established after the Chernobyl accident to enhance the exchange of operating personnel and information among participating nuclear utilities. Within the U.S. government, the Departments of State and Energy and the Nuclear Regulatory Commission are involved in U.S. efforts to improve international nuclear safety.

Results in Brief

Since the Chernobyl accident, over 70 of IAEA's 112 member states have adopted two conventions to enhance international cooperation by providing (1) timely notification of an accident and (2) emergency assistance. IAEA and other international organizations also developed programs to improve nuclear power plant safety and minimize dangers from radioactive contamination.

Despite the meaningful improvements that have been made, some of the measures have limitations, and serious nuclear safety problems remain in the design and operation of the older, Soviet-designed nuclear power plants. IAEA's ability to select reactors under its operational safety review program is limited. Also, information on the extent and seriousness of safety-related incidents at reactors in foreign countries is not publicly available. No agreement exists among nuclear power countries

to make compliance with any nuclear safety standards or principles mandatory. Currently, adherence to international safety standards or principles is voluntary and nonbinding. Some states support the concept of mandatory compliance, but others, including the United States, believe that mandatory compliance infringes on national sovereignty and that responsibility for the safety of nuclear reactors remains with each nation.

Principal Findings

International Emergency Response Initiatives After Chernobyl

Shortly after the Chernobyl accident, IAEA member states adopted two conventions to enhance international cooperation following a nuclear accident. These conventions covered early notification and emergency assistance. International organizations have also taken other steps designed to improve preparedness for and responses to an accident. These improvements have included IAEA's establishment of an interagency committee to coordinate emergency assistance and the publication of documents to implement its emergency response system, development of plans by United Nations' agencies on how the international community will respond to a nuclear accident, and development by the World Health Organization and Food and Agriculture Organizations of guidelines for controlling radioactively contaminated food in international trade.

International Nuclear Safety Efforts Continue, but Problems Remain

Since the Chernobyl accident, IAEA and many of its member states have increasingly emphasized improving nuclear power plant safety as an international as well as a national concern. Although significant improvements have been made, safety problems remain.

IAEA has continued to provide operational safety review team visits to countries with nuclear power plants. However, these reviews occur only at the request of the host country, and the host country selects the reactor. Sixty-one, or about 15 percent of the 412 operating power reactors in the world, have had such a review. Typically, about six or seven reactors are reviewed a year.

No IAEA operational safety review team visits have been made in seven countries. Such safety reviews have been made on only 13, or about 21 percent, of the 61 operating Soviet-designed nuclear power reactors. In

addition, little follow up is made to assess whether corrective actions are taken on IAEA review findings and recommendations.

There are information exchange programs on nuclear power plant incidents, but the host country or individual utility decides what gets reported or if they want to report some event. Incidents reported to the IAEA and the Nuclear Energy Agency are not made public by them.

There is growing international concern about older, Soviet-designed nuclear power reactors operating without basic safety features such as emergency core cooling systems, protective structures to contain radioactive releases in the event of an accident, and skilled personnel. According to the Nuclear Regulatory Commission, the extent of the problems with the reactors is well known. However, in the wake of major political and economic problems in Eastern Europe and the Soviet Union, the schedule for needed improvements is uncertain.

International Consensus Lacking on Nuclear Power Plant Safety Standards

The Chernobyl accident renewed debate about making IAEA's nuclear safety standards mandatory and providing some guarantees of power plant safety worldwide. IAEA updated the standards and has encouraged member states to integrate the standards into national licensing programs. However, adoption has been limited.

IAEA experts also developed a separate set of safety principles to help achieve uniform and higher levels of safety at nuclear power plants. However, the use of either safety standards or principles is optional. Moreover, there is no clear consensus by IAEA member states about making compliance mandatory. Some states support the concept of mandatory compliance, but others, including the United States, believe that mandatory compliance infringes on national sovereignty and that responsibility for the safety of nuclear reactors remains with each nation. However, the United States believes that each country has an international obligation to operate its reactors safely.

Although there is international concern about the need to cooperate in achieving uniform and higher levels of safety, there is no formal agreement among nuclear power countries to adhere to verifiable, generally accepted safety standards or principles. Without such agreements, the public cannot be confident that nuclear power countries are achieving higher levels of safety.

Recently, in an IAEA Conference on the Safety of Nuclear Power, member states recommended that IAEA prepare an outline of the possible elements of a safety convention that would allow IAEA member states to legally commit to observe certain safety standards. If an agreement on nuclear safety is adopted, the options for implementing it are either through IAEA or creating a new international body.

Recommendations

GAO recommends that the Secretary of State propose to other IAEA member states that (1) IAEA be given more discretion in selecting reactors for review under the Operational Safety Review Team program, (2) more of these reviews be made, and (3) IAEA routinely follow up on its operational safety review recommendations to ascertain if they have been implemented.

GAO also recommends that the Secretary of State, in cooperation with IAEA member states, promote the adoption of uniform and higher levels of safety standards for nuclear power plants. The present international climate may propel IAEA member states into adopting binding standards. GAO, therefore, recommends that the Secretary of State reassess the U.S. position against mandatory compliance with safety standards.

Agency Comments

As requested, GAO did not obtain official agency comments on this report. However, GAO discussed the information contained in a draft of this report with program officials at the Departments of State and Energy, the U.S. Nuclear Regulatory Commission, and IAEA. Their comments have been incorporated in the report where appropriate.

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Abbreviations

DOE	Department of Energy
GAO	General Accounting Office
IAEA	International Atomic Energy Agency
NEA	Nuclear Energy Agency
NRC	Nuclear Regulatory Commission
OECD	Organization for Economic Cooperation and Development
OSART	Operational Safety Review Team
U.N.	United Nations

Introduction

Since the Chernobyl accident in the Soviet Union on April 26, 1986, there has been a growing concern over the safety of nuclear power plants worldwide. Questions remain as to the likelihood of another Chernobyl-type accident and the ability of nations to reduce the dangers.

Of greatest concern are the 40 Soviet-designed nuclear reactors operating in Eastern Europe and the Soviet Union. They represent about 10 percent of the world's operating reactors. (See fig. 3.1.) Four of these reactors in the former East Germany and two in the Soviet Union have been shut down for safety reasons. In September 1991, Bulgaria made plans to shut down two of its oldest reactors on the Danube River.

The public's awareness of previously unknown problems with these Soviet reactors further contributes to public anxiety about the safety of nuclear power everywhere. The lack of convincing evidence or independent assurances from credible authorities that nuclear reactors are operated safely adversely affects public confidence in nuclear power.

Global Impact of the Chernobyl Accident

The Chernobyl accident began when power suddenly increased during a scheduled shutdown of reactor number 4 at the nuclear power station located in the Ukraine. Explosions and fire released into the atmosphere partially melted and fragmented uranium fuel containing intensely radioactive materials such as Iodine-131, Cesium 137, Strontium-90, and Plutonium-239. During a 10-day period, these materials were carried by winds and rain to wide areas of the Soviet Union and across its boundaries to East and West European countries.

The Soviet government estimated that about 50-million curies was released as a result of the Chernobyl accident. By comparison, the 1979 Three Mile Island accident released about 15 curies of radioactivity.

According to Soviet officials, 30 people died fighting the fire and from the effects of radiation exposure. Over 116,000 persons were evacuated from the contaminated area and permanently resettled. Over 100,000 square kilometers were contaminated. About $5.5 billion[1] had been spent as of the end of 1989 for decontamination, relocation, evacuation, and the construction of a sarcophagus over the destroyed reactor.

[1]We used an exchange rate extrapolated from the Soviet commercial exchange rate, which was introduced in November 1990. The commercial rate was then set at about 60 cents per ruble.

Additional billions of dollars will be spent by the year 2000 for decontamination, relocation, and the construction of a permanent sarcophagus to prevent further radioactive contamination.

The economic costs outside the Soviet Union in losses to farmers because of radiological contamination to crops were substantial. For example, Hungary and the United Kingdom each paid about $10 million compensation to their farmers. The Austrian government paid nearly $70 million, and the West German government paid more than $100 million to farmers in their countries.

World Status of Nuclear Power Reactors

As of June 30, 1991, there were 412 operating nuclear power plants worldwide and 101 under construction, as shown in table 1.1.

Table 1.1: Nuclear Power Reactors (30 Megawatts or Above) **Operating or Under Construction Worldwide as of June 30, 1991**

Country	Number of operating reactors	Number of reactors under construction
Argentina	2	1
Belgium	7	0
Brazil	1	2
Bulgaria	5	3
Canada	19	3
China	0	3
Cuba	0	2
Czechoslovakia	8	6
Finland	4	0
France	55	7
Germany	21	0
Hungary	4	0
India	7	13
Japan	41	14
Mexico	1	1
Netherlands	2	0
Pakistan	1	0
Philippines	0	1
Romania	0	5
South Africa	2	0
South Korea	9	3
Soviet Union	42	22
Spain	9	6
Sweden	12	0
Switzerland	5	0
Taiwan	6	0
United Kingdom	37	1
United States	111	8
Yugoslavia	1	0
Total	**412**	**101**

Source: American Nuclear Society.

The International Atomic Energy Agency

When nuclear power first began to be used for peaceful purposes, nations saw a need for an international coordinating agency. On July 29, 1957, the International Atomic Energy Agency was created as an independent intergovernmental organization within the United Nations (U.N.) system. Headquartered in Vienna, Austria, IAEA currently has 112 member states. (See app. I.) IAEA's objectives are to (1) accelerate

and enlarge the contribution of atomic energy to peace, health, and prosperity throughout the world and (2) ensure so far as it is able that any assistance it provides, is requested to provide, or is under its supervision or control is not used to further any military purpose.

The policy-making bodies of IAEA are the Board of Governors and the General Conference. The Board of Governors has 35 members, of which 13 are designated by the Board itself and 22 are elected by the General Conference.

The estimated regular budget for 1991 was about $168 million, of which about $10 million, or about 6 percent, was for nuclear safety and radiation protection.

Other Involved Organizations

Nuclear Energy Agency

The Nuclear Energy Agency (NEA) operates as a specialized agency within the framework of the Organization for Economic Cooperation and Development (OECD). Formed in 1958, NEA has a main objective to enhance cooperation between OECD countries, except New Zealand, in promoting nuclear power.[2] It evaluates the technical and economic aspects of nuclear power growth and encourages harmonization of member states' safety and regulatory policies and practices.

According to NEA, the main portion of NEA's safety work is devoted to light water reactors, which contribute 85 percent of the energy generated by nuclear power in OECD countries. The NEA's nuclear safety programs include exchanges among regulatory authorities; the feedback of operational experience in the areas of human factors, protection of plant workers, and risk assessment; and the prevention and mitigation of severe accidents. Following the Three Mile Island and Chernobyl accidents, NEA increased its research into severe accidents and methods for limiting their consequences.

[2]The OECD countries include Australia, Austria, Belgium, Canada, Denmark, Finland, France, Germany, Greece, Iceland, Ireland, Italy, Japan, Luxembourg, the Netherlands, Norway, Portugal, Spain, Sweden, Switzerland, Turkey, the United Kingdom, and the United States.

Other International Organizations

Several specialized agencies of the United Nations have been active in promoting emergency response and preparedness in case of a nuclear accident. The World Meteorological Organization has a global telecommunication component that can transmit information on radiological releases into the atmosphere.

The World Health Organization and the United Nations Environmental Program are developing a global environmental radiation monitoring network. In 1988, the World Health Organization, in consultation with other international organizations, developed guidelines for countries to control exposure to radiation from contaminated food and drinking water. According to a U.N. Disaster Relief Organization official, his agency has emergency planning activities to mitigate the consequences of disasters and reduce requirements for relief.

U.S. Government Agencies

The Departments of State and Energy and the U.S. Nuclear Regulatory Commission (NRC) are responsible for U.S. efforts to improve international nuclear safety. According to a Department of State official, State is responsible for overall U.S. participation in IAEA, NEA, and other international organizations and is assisted with technical input from other federal agencies, such as NRC and the Department of Energy (DOE). The technical assistance includes training courses and equipment as well as cost-free experts who also participate in IAEA technical advisory group meetings.

Private Sector Organizations

The Institute of Nuclear Power Operations and the World Association of Nuclear Operators represent the nuclear utility industry in the United States and worldwide, respectively.

The Institute was formed after the Three Mile Island accident in 1979 to promote the highest levels of safety and reliability in the operation of nuclear plants—by establishing performance-based standards of excellence and by conducting plant evaluations and peer reviews. All 54 U.S. nuclear utilities are members of the Institute. There are also 47 associate member utilities in the United States, 14 international participants, and 16 nuclear equipment suppliers and architect and engineering companies.

The World Association represents 144 operators of the 412 operating nuclear power units in 29 nations. It was established in 1989 after the Chernobyl accident made clear the need for worldwide cooperation by

nuclear utilities. It was patterned after the Institute of Nuclear Power Operations and focuses on the exchange of operating personnel and information.

Objectives, Scope, and Methodology

The Chairman of the Senate Committee on Governmental Affairs asked us to provide information on (1) the nature and extent of international organizations' efforts to strengthen their responses to nuclear power emergencies; (2) the current efforts of the U.S. government and international organizations to address safety problems, particularly with Soviet-designed reactors; and (3) what further actions could be taken to achieve greater international nuclear power plant safety.

We were asked by the Committee staff to consider what options might be available to implement an international agreement on nuclear safety. In this regard, we considered the programs, composition, and financial support of IAEA and of a new international nuclear safety organization that could be created.

We reviewed how IAEA, the World Health Organization, and the World Meteorological Organization had implemented the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency.

We also reviewed the role of other international organizations in helping to mitigate the consequences of a nuclear power plant accident. These organizations included the International Labor Organization, the League of Red Cross and Red Crescent Societies, the U.N. Economic Commission for Europe, the U.N. Disaster Relief Organization, the Regional Office of the World Health Organization in Copenhagen, and the Commission of the European Communities.

To determine how the U.S. government and international organizations addressed safety problems, we interviewed and obtained documentary information from officials at the U.S. Department of State, DOE, and NRC. We also interviewed government regulators and nuclear safety experts in the United Kingdom and Germany. We obtained data from nuclear safety officials from IAEA, NEA, and the Commission of the European Communities on efforts to promote international cooperation on power plant safety.

To obtain information on efforts to improve the safety of the older model Soviet reactors, we met with officials of the Permanent Representative of the Soviet Union to IAEA in Vienna, Austria. We also toured the Bohunice nuclear power plant in Czechoslovakia and obtained the views of plant officials concerning the safety of Soviet-designed reactors.

To obtain information on what further action is needed to improve nuclear safety, we met with officials of the Institute of Nuclear Power Operations and the World Association of Nuclear Operators. Also, we attended a number of nuclear energy conferences sponsored by U.S. nuclear industry groups, including the American Nuclear Society.

We performed our review between January 1990 and July 1991 in accordance with generally accepted government auditing standards.

As requested, we did not obtain official agency comments on this report. We discussed the information contained in a draft of this report with program officials at the Department of State, DOE, IAEA, and NRC. Their comments have been incorporated in the report where appropriate.

International Emergency Response Initiatives After Chernobyl

Shortly after the Chernobyl accident, IAEA member states adopted two conventions to enhance international cooperation following a nuclear accident. These conventions covered early notification and emergency assistance. International organizations have also taken other steps designed to improve preparedness for and responses to an accident, should one occur.

Conventions on International Cooperation

Under the Convention on Early Notification of a Nuclear Accident and the Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency, IAEA serves as the focal point for receiving accident information and coordinating assistance. As of June 1991, 26 of the 30 nuclear power countries, including the United States, had consented to be bound by the conventions on early notification and on emergency assistance.[1] (See app. II.) Belgium and the Netherlands had signed the conventions, but had not consented to be bound by them. The Philippines has not signed the conventions.

Early Notification Convention

The Convention on Early Notification of a Nuclear Accident requires member states to promptly notify IAEA and any affected countries whenever there is a nuclear reactor accident with actual or potential consequences for release of radiation across national boundaries. Concern about the Soviets' delay in notifying IAEA or neighboring countries about the Chernobyl accident was the impetus for this convention. In addition to prompt notification, the member state must provide IAEA with information to help other states minimize the accident's radiological consequences. IAEA serves as the focal point for disseminating this information.

Emergency Assistance Convention

The Convention on Assistance in the Case of a Nuclear Accident or Radiological Emergency provides an international framework for helping member states aid each other directly or through IAEA or other international organizations.

[1]Taiwan is a nuclear power country but is not a member of IAEA. Therefore, it did not sign the conventions.

Other Steps to Improve Accident Response

In 1986 IAEA established an interagency committee to coordinate emergency assistance in the event of a nuclear accident. The committee includes representatives from the World Health Organization, the World Meteorological Organization, the U.N. Disaster Relief Organization, the U.N. Environmental Program, the International Labor Organization, and the U.N. Scientific Committee on the Effects of Atomic Radiation. The interagency committee helps to promote international cooperation, exchange information, and avoid duplication, several committee members told us.

IAEA has developed an emergency response system to implement its responsibilities under the conventions. IAEA established an emergency response unit with communication and computer equipment and documents and data bases expected to be needed in the event of a radiological emergency. Moreover, senior nuclear safety professionals are on call 24 hours a day to assess the significance of messages and to decide what action IAEA should take.

IAEA has developed three documents to implement its emergency response system. According to IAEA, the Nuclear Accident/Radiological Emergency Assistance Plan is an internal IAEA plan that provides the framework for maintaining and activating the emergency response system. It describes how IAEA will carry out its tasks and how it will be organized while responding to a radiological emergency.

IAEA has also published the Emergency Notification and Assistance Technical Operations Manual, which describes the overall IAEA program and how IAEA, member states, and relevant international organizations cooperate under the conventions. It includes information on human and technical resources in the member states and IAEA.

IAEA also published the Handbook of Emergency Response Procedures, which describes how individuals will carry out tasks in areas such as notification, activation, message authentication and verification, recordkeeping, and communications.

Other Steps to Improve Emergency Preparedness

In the event of a nuclear reactor accident, IAEA plans to use the World Meteorological Organization's global telecommunications system to notify member states and transmit radiological and meteorological information. According to IAEA officials, the system can efficiently transmit large amounts of data but it has limitations. For example, relaying transmitted data from the system to national authorities could delay the

notification process, particularly if a country has poor communication networks. That is, IAEA is concerned about the capability of some countries to notify IAEA on a timely basis because of the lack of infrastructure and a communications capability.

In April 1990, IAEA tested the emergency response system and its capability to communicate with member states and other organizations. The exercise included participation of 40 IAEA staff members, representatives from member states, other U.N. organizations, and various missions to IAEA. According to an IAEA official, the test demonstrated that the IAEA's capability to respond to an accident is not yet complete and that the IAEA's emergency response system can be improved. A list of lessons learned was developed covering areas such as improving the emergency response system organization, modifying operational procedures, upgrading resources and facilities, and correcting communications problems. A second exercise is scheduled in January 1992 to assess the lessons learned that were incorporated into the system and to demonstrate the IAEA's capability to respond to a nuclear accident or radiological emergency.

Because the Commission of the European Communities officials were concerned that the Notification Convention does not cover all radiological accidents and that the Emergency Assistance Convention would not meet the informational needs of the European Community, they established an emergency response system to supplement the IAEA's. The system was established in 1987, and, compared to the IAEA system, the European Community system provides a broader scope of reportable emergencies, gives a more exact definition of significant incidents, widens the range of information supplied, and ensures dissemination of information received to all Community members.

The U.N. Disaster Relief Organization has developed a disaster mitigation plan in the event of a nuclear accident. The plan includes hazard evaluations, risk assessment, disaster prevention, emergency planning, and public information. The U.N. Disaster Relief officials told us that the Byelorussian and Ukrainian Soviet Socialist Republics had asked the Disaster Relief Organization for assistance in developing and testing emergency procedures at a Chernobyl-type reactor.

Food and Water Contamination Guidelines

In 1988 the World Health Organization published guidelines for controlling exposure to radiation from contaminated food and drinking water. These guidelines, based on generally accepted health protection principles, are designed to minimize the health risk to the population. They also recognize that quantities and types of foods consumed vary in different areas of the world. For example, the tolerance level of radiological contamination acceptable for rice will be higher in Europe than in Asia because of differing consumption patterns. The guidelines provide national authorities with a basis for developing their own intervention levels.

The World Health Organization and the Food and Agriculture Organization have developed guidelines for the control of radioactively contaminated food in international trade in the event of a nuclear reactor accident. These organizations' member states adopted the guidelines in July 1989. In addition, the Commission of the European Communities also adopted guidelines for controlling exposure to food contaminated by radiation and defined conditions governing imports of agricultural products from non-Commission countries.

Radiation Monitoring

To implement the conventions and respond to an accident, IAEA and affected countries must exchange accurate and standardized radiological data. The World Health Organization and the U.N. Environmental Program have improved their monitoring networks to provide data to IAEA in the event of an accident. The World Meteorological Organization will also send IAEA radiological data from its worldwide network of weather stations.

According to World Health Organization officials, countries differed both in how they measured radiation and how they reported the information following the Chernobyl accident. These differences underscored the need for international cooperation in harmonizing data collection methods and in allowing timely exchange of comparable information.

Also, the World Health Organization and the U.N. Environmental Program have combined their efforts to improve radiation monitoring in the environment through a joint program called the "Global Environmental Radiation Monitoring Network." If there is a major radiological release, countries are expected to use the network to generate and circulate

information worldwide. According to World Health officials, the program is designed to improve about 40 participating countries' monitoring systems and their ability to evaluate radiation in food and the environment.

International Measures to Improve Nuclear Power Plant Safety; Limitations and Problems Remain

In the aftermath of the Chernobyl accident, the international nuclear power community emphasized nuclear safety and advice to improve the design, construction, and operation of nuclear facilities. Despite the meaningful improvements that have been made, some of the measures have limitations, and serious nuclear safety problems still exist with older, Soviet-designed nuclear power reactors that operate without basic safety features and, in some cases, skilled personnel.

IAEA continues to conduct Operational Safety Review Team (OSART) missions to inspect and assess the safety of nuclear power plants and offer suggestions for improvement. However, these reviews occur only at the request of the host country, and the host country selects the reactor. As a result, reactors of safety concern to IAEA officials or other member states are not always reviewed. Sixty-one, or about 15 percent of the 412 operating power reactors in the world, have been subjected to an OSART review. Typically, about six or seven reactors are reviewed a year.

IAEA offers pre-OSART inspections of reactors under construction to those member states that request them. In addition, IAEA has established the Assessment of Significant Safety Events Team program to review, at the request of the member state, specific events at nuclear power reactors.

IAEA, its member states, NEA, and private nuclear industry organizations exchange operational safety information to help prevent accidents. However, information on safety-related incidents in foreign countries is not made available to the public.

The older, Soviet-designed pressurized water reactors and the graphite-moderated Chernobyl-type reactors operating in Eastern Europe and the Soviet Union represent a major safety problem. These reactors represent about 10 percent of all the power reactors worldwide. IAEA, its member states, other international organizations, and private companies have begun to review these problems. According to NRC, the extent of the problems with the reactors is well known. However, in the wake of major political and economic problems in Eastern Europe and the Soviet Union, the schedule for any needed improvements is uncertain.

Operational Safety Review Team Program

In 1982 IAEA created the OSART program to advise nuclear power plant managers on enhancing the safety of their plants. The teams are composed of 10 to 12 experienced individuals, often managers from other nuclear power plants, who travel to a plant site at the request of a member state. They perform an approximately 3-week, in-depth review

of the local operating practices such as maintenance, operations, technical support, radiation protection, training, and emergency planning. Each OSART mission costs about $50,000.

The review compares a plant's operational safety practices to those used by other successful plants. It also provides ideas on how to improve safety at the working level. Afterwards, a confidential report recommending improved safety procedures is submitted to the host country government. Like most IAEA safety services, an OSART visit is advisory and recommendations are nonbinding.

IAEA officials expect that nuclear power plant operators will benefit from OSART reviews and implement improvements in a timely manner. Without follow-up on all the OSART missions, IAEA does not have detailed first-hand knowledge about the implementation of OSART recommendations for the improvement of the safety of the reactors. As of September 1991, there have been only 11 follow-up reviews to assess the nature or extent of any changes that may have been made.

As of September 1991, IAEA had sent 34 OSART missions to 19 countries to review 61 nuclear reactors. (See table 3.1.)

Table 3.1: OSART Missions to Review Nuclear Reactors as of September 1991

Year	Country	Plant	Number of reactors
1983	South Korea	KO-RI, unit	1
1984	Yugoslavia	Krsko	1
1985	Pakistan	Kanupp	1
	Brazil	Angra, unit 1	1
	France	Tricastin, units 1-4	4
1986	Finland	Olkiluoto, units 1,2	2
	Sweden	Barsebaeck, units 1,2	2
	Netherlands	Borssele	1
	Germany	Biblis, unit A	1
	South Korea	KO-RI, units 3,4	2
1987	Germany	Krummel	1
	Italy	Caorso	1
	Netherlands	Dodewaard	1
	Canada	Pickering, units 1-8	8
	United States	Calvert Cliffs, units 1,2	2
	Germany	Philippsburg, unit 2	1
	Spain	Almaraz, units 1,2	2
1988	Sweden	Forsmark, unit 3	1
	Japan	Takahama, units 3,4	2
	France	St. Alban, units 1,2	2
	Hungary	Paks, unit 3	1
	Soviet Union	Rovenskaya, unit 3	1
1989	Pakistan	Kanupp	1
	Brazil	Angra, unit 1	1
	United States	Byron, units 1,2	2
	United Kingdom	Oldbury, units 1,2	2
	South Korea	Wolsong	1
	Czechoslovakia	Dukovany, units 1-4	4
	Sweden	Oskarshamn, unit 1	1
1990	Spain	Cofrentes	1
	Bulgaria	Kozloduy, units 1-4	4
	Finland	Loviisa, units 1,2	2
1991	Sweden	Ringhals, units 3,4	2
	Bulgaria	Kozloduy, unit 5	1
Total	**34 missions (19 countries)**		**61**

Source: IAEA.

There are 42 older, Soviet-designed reactors, including 16 Chernobyl-type reactors, operating in the Soviet Union, Eastern Europe and Finland. With the exception of the 2 reactors in Finland that have western-style safety features, the remaining 40 reactors lack basic safety features. Until 1988 an OSART had not visited any of these reactors. Since 1988 one reactor has been visited in Hungary and one in the Soviet Union, five in Bulgaria, and two in Finland. However, none of the 16 Chernobyl-type reactors operating in the Soviet Union has had an OSART visit.

Of the 61 Soviet-designed nuclear reactors operating in the Soviet Union, Eastern Europe and Finland, 13, or about 21 percent, have been reviewed by an OSART. Of the 111 nuclear reactors operating in the United States as of June 30, 1991, 4 have been reviewed by an OSART mission. Overall, of 412 nuclear power reactors operating worldwide at that time, 61, or about 15 percent, have been reviewed by an OSART mission.

Several factors limit the OSART program.

- An OSART must be requested by the host country. Moreover, the requesting country selects the reactor to be reviewed. Therefore, there are no assurances that reactors with serious safety problems will be reviewed. According to an NEA official, under the OSART program nuclear power countries can select their "best" reactors for review or choose not to request an OSART visit.
- The program does not systematically review nuclear facilities worldwide. For example, as of September 1991, an OSART mission had not been conducted in seven nuclear power countries. These countries have a total of 33 nuclear reactors. (See table 3.2.)

Table 3.2: Countries Without an OSART Mission as of September 1991

Country	Number of reactors
Argentina	2
Belgium	7
East Germany (formerly)	4[a]
India	7
South Africa	2
Switzerland	5
Taiwan[b]	6
Total	**33**

[a]Reactors determined to be unsafe by German officials and shut down in 1990.

[b]Not a member of IAEA and cannot participate in OSART program.

Source: IAEA.

Pre-Operational Safety Review Team Program

A pre-operational safety review team visits a nuclear power plant under construction to review project management; quality assurance; civil construction; mechanical, electrical, and instrumentation and control equipment; preparations for start-up and operation; training and qualification; and radiation protection and emergency response planning. Before the Chernobyl accident only three pre-OSART visits were made to two countries with one reactor each. Since the accident, 10 pre-OSARTs were made to 8 countries with 21 reactors. (See table 3.3.)

Table 3.3: Pre-OSART Missions to Review Nuclear Reactors as of September 1991

Year	Country	Plant
1984	Philippines	PNPP, unit 1
1985	Philippines	PNPP, unit 1
1986	Mexico	Laguna Verde, unit 1
1987	Mexico	Laguna Verde, unit 1
	Mexico	Laguna Verde, unit 1
1988	Italy	Alto Lazio, units 1,2
1989	China	Qinshan
	Soviet Union	Gorky
	Poland	Zarnowiec, units 1,2
1990	Czechoslovakia	Temelin, units 1-4
1991	Bulgaria	Belene, units 1,2
	Romania	Cernavoda, units 1-5
	China	Guangdong, units 1,2
Total	**13 missions (9 countries)**	

Source: IAEA.

Assessment of Safety Significant Events Teams

In late 1986 IAEA established the Assessment of Safety Significant Events Teams to identify root causes of nuclear power reactor safety-related events and offer recommendations to plant operators on preventive measures. The assessment team concentrates on quality assurance, management for prevention of incidents, and operation and design. As of September 1991, IAEA conducted 22 assessments in 14 countries. (See table 3.4.)

Table 3.4: Assessment of Safety Significant Events Teams' Missions Requested by Member States as of September 1991

Year	Country	Location
1986	Yugoslavia	Krsko
1988	Brazil	Angra
1989	Pakistan	Karachi
	Pakistan	Karachi
1990	Soviet Union	Ignalina, units 1,2
	Germany	Greifswald, units 1-4
	Germany	Greifswald, units 1-4
	Germany	Greifswald
	France	Gravelines, unit 1
	Hungary	Budapest
	Czechoslovakia	Bohunice, units 1,2
	Bulgaria	Kozloduy, units 1-4
	Spain	Vandellos I
1991	Pakistan	Karachi
	Pakistan	Karachi
	Belgium	Tihange-Doel
	Spain	Trillo
	Mexico	Laguna Verde
	Korea, Republic of	Seoul-Taejon
	Netherlands	The Hague
	Soviet Union	Kola, units 1,2
	Soviet Union	Novovoronezh, units 3,4
Total	**22 missions (14 countries)**	

Safety Problems of Older, Soviet-Designed Reactors

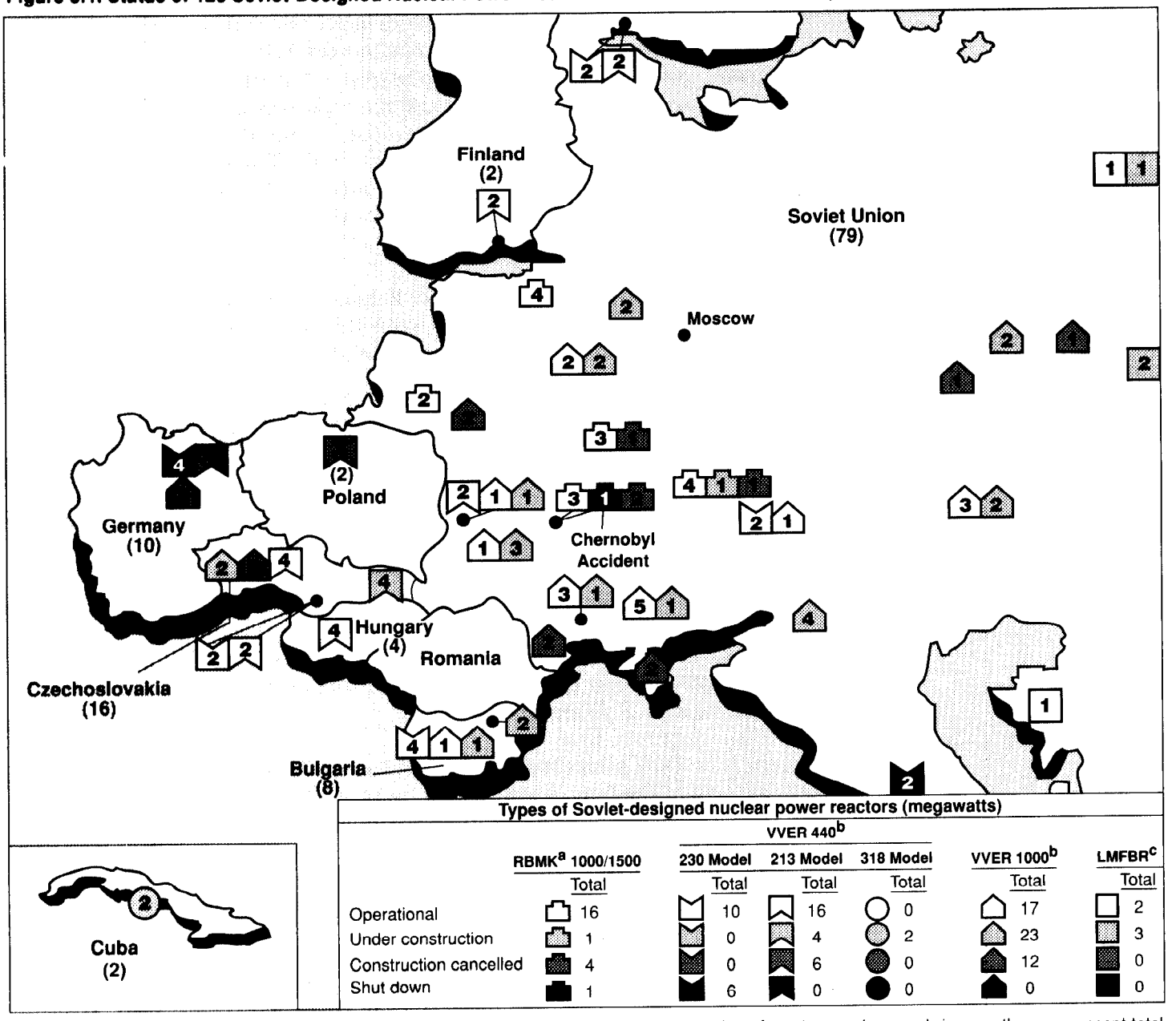
U.S. and other foreign government officials are particularly concerned about the safety of two different designs of older, Soviet-designed nuclear reactors. One reactor design is known as the VVER 440-megawatt;[1] this type of reactor is located in the Soviet Union and Eastern Europe. The other reactor design is known as the RBMK[2] (Chernobyl-type); this type is located only in the Soviet Union. The three models of the VVER-440s are denoted as V230, V213, and V318 (two reactors under construction in Cuba). The V230 is the oldest model in operation and lacks basic safety features. The V213 is the next oldest model and also lacks basic safety features.

In 1986 DOE published a study on the safety of the Soviet Union's Chernobyl-type RBMK reactors. In 1989 it reported on the safety of the VVER pressurized water reactors. These studies cited numerous safety problems with both types of operating reactors. Figure 3.1 shows the type, location, and status of these reactors.

[1]The VVER is a pressurized water-cooled, water-moderated nuclear power reactor.

[2]The RBMK is a graphite-moderated, boiling light-water-cooled nuclear power reactor.

Figure 3.1: Status of 123 Soviet-Designed Nuclear Power Reactors Worldwide as of June 30, 1991



Note: Numerals in symbols represent number of reactors, and numerals in parentheses represent total reactors by country.

[a]Graphite-moderated, boiling light-water-cooled reactor.

[b]Pressurized water-moderated and -cooled reactor.

[c]Liquid-metal-cooled fast breeder reactor.

Sources: American Nuclear Society, IAEA, and DOE.

According to DOE's studies, the older, Soviet-designed VVER 440-megawatt models V230 and V213 reactors lack basic safety features found in western-designed reactors. For example, the V230 model lacks emergency core cooling systems and protective structures to contain radioactive material and, therefore, would not meet western standards. The V213 model differs from the V230 model in that the V213 has an emergency core cooling system. According to NRC officials, these reactors would not be licensed in the United States. DOE has also pointed out that the VVER reactor pressure vessel embrittlement problem is a concern as well.

Table 3.5 shows the number of V230 model reactors by country. The V230 model was constructed between 1971 and 1980. In 1988 the Soviet Union canceled the Chernobyl-type RBMK reactor program because of many safety concerns.

Both the VVER models V230 and V213 as well as the RBMK reactors need expensive improvements to make them safer, according to NRC officials. However, there are limited resources available in the Soviet Union and Eastern Europe to do so. The European Community has pledged financial assistance to East European countries and the Soviet Union to make these reactors safer. In the meantime, the reactors continue to operate; however, some are working at a reduced power output. According to an NRC official, Bulgaria promised to shut down its two V230 plants because they are unsafe. Also, the Ukrainian parliament has voted to shut down the RBMK reactors at the Chernobyl power plant within 2 years.

In June 1991 IAEA experts completed a review of design and operational aspects of the four oldest reactor units at Kozloduy in Bulgaria. The experts found the reactors in poor condition, with two units shut down. Also, the experts were concerned over the shortage of skilled operating personnel. They believed that the most valuable assistance that could be provided in the short term would be skilled reactor operators.

The concern over the lack of skilled workers and adequate training of workers at nuclear power plants was voiced at the IAEA's International Conference on the Safety of Nuclear Power in September 1991. Nuclear safety experts stated that "[T]he status of training varies widely among operating organizations throughout the world and that the operators' basic understanding of plant characteristics needs to be improved." The experts also cited an additional problem in that there has been a reduction in enrollments in university courses for nuclear occupations and a

curtailment of suitable engineering programs, thereby reducing the supply of suitably educated personnel.

In 1990 the Chairman of the World Association of Nuclear Operators suggested that applying western safety standards to the older, Soviet-designed reactors would require shutting them down immediately. In particular, he noted the western countries' safety requirement for a containment structure. However, for many countries with these plants, a shutdown is not feasible because these countries have limited energy alternatives. Some countries are facing pressure to continue operating nuclear plants because of increasing energy demands.

Table 3.5: Countries With Older, Soviet-Designed Pressurized Water Reactors (VVER 440-Megawatts/Model 230)

Country	Number of reactors
Soviet Union	6[a]
Bulgaria	4
Germany	4[b]
Czechoslovakia	2
Total	**16**

[a]Includes two reactors shut down in March 1989 after the 1988 earthquake in Armenia.

[b]These reactors are located in the former East Germany and were shut down in 1990 after unification because they could not meet West German safety standards.

Sources: American Nuclear Society and IAEA.

According to NRC, the Chernobyl-type RBMKs have serious problems in their electrical systems, fire protection, and instrumentation. NRC considers them "worrisome" even with the safety improvements that have been made since the Chernobyl accident. The NRC Chairman believes that, in the interest of safety, the Soviets should shut down the RBMKs as quickly as possible.

NRC officials believe that the United States and other western countries should not provide safety assistance to the RBMK reactors since it will be ineffective in view of fundamental design and fire safety problems. The NRC Chairman believes that such assistance could be viewed as sanctioning the continued operation of these plants.

U.S.-Soviet Bilateral Efforts to Address Nuclear Safety Problems

Exactly 2 years after the 1986 Chernobyl accident, the United States and the Soviet Union signed a Memorandum of Cooperation to increase civilian nuclear reactor safety in both countries. The memorandum outlines 11 areas of cooperation, such as safety approaches and regulatory

practices, analysis of the safety of nuclear power plants in both countries, and exchanges of operational experience.

DOE officials stressed that the memorandum allows the United States to demonstrate how it practices nuclear safety while letting the Soviets decide whether such practices would be useful. In March 1990 both governments began addressing safety problems with the older model VVER 440-megawatt reactors in the Soviet Union.

In 1990 DOE contracted with the Institute of Nuclear Power Operations for $7.5 million to provide operational safety assistance to the Soviet Union.

Other Assistance to Improve Soviet-Designed Reactors

In March 1990 IAEA established a project to address safety problems with the older, Soviet-designed VVER 440-megawatt pressurized water reactors. The project consists of sending fact-finding missions led by internationally recognized experts to operating plants at Bohunice in Czechoslovakia, Kozloduy in Bulgaria, Greifswald in Germany, and Kola and Novovoronezh in the Soviet Union. The World Association of Nuclear Operators agreed to help provide assistance by sharing operating experience.

According to IAEA, this project complements rather than replaces other national, bilateral, or multilateral programs. The IAEA's project is designed to (1) advise member states on weaknesses in design, procedures, or operational limits; (2) comment on possible improvements to conform with current safety principles; and (3) assist in evaluating member states' proposed safety enhancements.

In September 1991 the heads of nuclear regulatory organizations from seven major OECD countries stated concern about the safety of nuclear power in Eastern Europe and recommended that the highest priority should be given to setting up effective nuclear regulatory authorities in these countries.

International Sharing of Nuclear Safety Information

After the Three Mile Island accident in 1979, more countries recognized that feedback of operational experience beyond national boundaries provided a unique opportunity to improve nuclear safety. In 1980 and 1983 NEA and IAEA each set up an international Incident Reporting System to share operational safety information among their member states, respectively.

The IAEA's and the NEA's Incident Reporting Systems gather, analyze, and exchange operational information on safety-related events at nuclear power plants worldwide. The goal is to reduce the frequency and severity of incidents related to safety at nuclear power plants. Incidents related to the storage of nuclear waste are not required to be reported in either the IAEA or NEA system. By the end of 1990 the IAEA's Incident Reporting System had 1,081 reports of incidents on file. As of April 1990 NEA had 1,466 incident reports in its system from its member countries and other countries participating in its reporting system. Neither IAEA nor NEA makes these reports available to the public.

Over the years the United States and other NEA countries have been reluctant to participate in both Incident Reporting Systems because of the potential for duplication. Therefore, to avoid duplication, the United States and other NEA countries participate in the IAEA system through the NEA's system by identifying which reported incidents can be shared with non-NEA countries. IAEA is working with NEA to create a single data base reporting system. The new system is expected to use a new classification method to overcome reporting inconsistencies between the two existing systems. Also, IAEA officials stated that improvements are needed in analyzing incident reports to make them more useful.

The Institute of Nuclear Power Operations and the World Association of Nuclear Operators also exchange operating safety information. The Institute represents U.S. industry, while the World Association is an international group. The Institute reviews and analyzes operating reports from all U.S. domestic and some foreign-operated reactors. The World Association also exchanges operational information with its members—nuclear operators worldwide. The World Association also exchanges operational information and technical personnel among utilities operating nuclear power plants in 29 countries.

Incidents at foreign nuclear power plants reported to IAEA, NEA, and the Institute of Nuclear Power Operations systems are kept confidential. NRC does not make foreign incident reports public because it believes that disclosure could compromise its ability to obtain worldwide information in the future. NRC officials told us that it has encouraged foreign countries to make their incident reports available to the public but to date has not been successful. In contrast, NRC makes incidents or unusual events in U.S. plants publicly available.

Conclusions

Since the Chernobyl accident, the international nuclear power community has placed greater emphasis on nuclear safety to help improve the design, construction, and operation of nuclear facilities. IAEA makes OSART and pre-OSART visits and provides other safety services such as the IAEA project on the safety of older reactors in Eastern Europe and the Soviet Union. However, the IAEA's ability to select reactors for review under the OSART program is limited because the program is voluntary and the requesting country selects the reactor. Consequently, there are no assurances that the reactors with serious safety problems will be reviewed.

IAEA, NEA, and private nuclear industry organizations have increased their exchanges of operational safety information. But information on the extent and seriousness of safety-related incidents in foreign countries is not publicly available.

Since the Chernobyl accident, international concerns about Soviet-designed reactors have focused on providing assistance to improve operational safety. As a result, IAEA, other international organizations, and member states have begun to help the Soviet Union and the East European countries address safety problems associated with the older model, pressurized water nuclear reactors.

Recommendation

We recommend that the Secretary of State propose to other IAEA member states that (1) IAEA be given more discretion in selecting reactors for review under the OSART program, (2) more of these reviews be made, and (3) IAEA routinely follow up on its operational safety review recommendations to ascertain if they have been implemented.

Lack of International Consensus on Nuclear Power Plant Safety Standards

As a result of the global consequences of the Chernobyl accident, nuclear power plant safety has been elevated to an international concern. Consequently, there have been calls to provide some guarantees of nuclear power plant safety worldwide as well as renewed debate on whether to make the IAEA's nuclear safety standards mandatory.

IAEA updated its nuclear safety standards to incorporate the lessons learned from the Chernobyl accident and developed a set of safety principles to help achieve higher levels of safety at nuclear power plants. However, the use of either safety standards or principles by member states is optional.

Although there is international concern about the need to cooperate in achieving higher levels of safety, there is no clear consensus by IAEA member states about making compliance with the safety standards mandatory. Some states support the concept of mandatory compliance, but others, including the United States, believe that such compliance infringes on national sovereignty.

Nuclear power countries have not signed any formal agreements to adhere to verifiable, generally accepted safety standards or principles. Without such agreements, the public cannot be confident that nuclear power countries are striving to achieve a uniform higher level of safety.

Recently, the IAEA's Conference on the Safety of Nuclear Power recognized the importance of promoting an international agreement on nuclear safety by recommending that IAEA prepare an outline of the possible elements for a safety convention for consideration by the IAEA's Board of Governors in February 1992. Also, nuclear regulators from major OECD countries agreed to work toward achieving a binding international safety framework convention.

If such an agreement was made, there are options for implementation either through an existing international organization, such as IAEA, or a new international body with independent oversight responsibilities.

No Consensus on Mandatory Safety Standards

Following the Chernobyl accident, IAEA revised and strengthened nuclear safety standards incorporating lessons learned. The global financial and environmental consequences of the accident as pointed out in chapter 1 directed attention to the need for some further enhancement of nuclear power safety and mandatory adherence to the IAEA's safety standards. However, there is no consensus among IAEA member

states on accepting mandatory safety standards for nuclear power countries. Moreover, the United States, among other member states, does not support mandatory safety standards because they infringe on national sovereignty. Furthermore, the United States believes that responsibility for the safety of nuclear reactors remains with each nation. Nonetheless, while the debate over mandatory standards continues, about 10 percent of nuclear power reactors are operating without basic safety features.

Use of the IAEA's Nuclear Safety Standards

According to IAEA, the five Nuclear Safety Standards Codes of Practice were updated in the light of lessons of the Chernobyl accident. These codes contain recommendations for nuclear power plant safety involving siting, design, operation, quality assurance, and governmental organization. IAEA encourages member states to integrate the standards into their national licensing programs. However, adoption of the guidelines by the IAEA's member states has been limited.

A 1983 IAEA survey of 30 member states with an operating or planned nuclear power program showed that only 9 of those responding had officially endorsed the standards or used them as a regulatory requirement. Nineteen countries indicated that they use the standards as a source of information for establishing national regulations or for training purposes, and 2 countries indicated that they do not use the standards.

In 1988 IAEA published the analysis or replies to an IAEA questionnaire on regulatory practices in 30 member states operating or planning to operate a nuclear power reactor. The IAEA's analysis of the questionnaire showed that respondents were generally in accordance with the Nuclear Safety Standards Code of Practice on governmental organization, while some practices varied widely. To reduce the likelihood of another nuclear accident, IAEA concluded that the international community and IAEA should focus on identifying areas where standards might be necessary to make regulatory practices uniform, and on defining and promoting good regulatory practices.

Pros and Cons of Mandatory Safety Standards

Some IAEA member states have asserted that, to dispel any question about nuclear power plant safety, it is necessary to establish international safety standards that can be verified by inspection. The Director General of IAEA in September 1991 stated that "the question is now being asked with increasing frequency whether the time has come to make some international standards mandatory."

Mandatory international safety standards have received support from several organizations, as well. A 1987 report to the U.N. General Assembly by the World Commission on Environment and Development stressed the need for an international agreement on codes of practice for reactor operation, including minimum safety standards.[1] The report also recommended an international regulatory function, including inspection of nuclear reactors worldwide.

A 1989 International Confederation of Free Trade Unions report[2] stated that all countries should demonstrate high levels of nuclear safety assurance because of widespread public skepticism concerning the safety of nuclear power following the Chernobyl accident. But the report pointed out that confidence in an effective nuclear safety regime can happen only if nuclear power plants are exposed to regular, detailed, and independent examination at an international level.

However, despite statements of concern over the need for mandatory international safety standards, the United States and some other members of IAEA do not support a mandatory standards and verification regime. According to a State Department official, the United States has resisted having mandatory standards prescribed in an international agreement to avoid the tendency toward settling upon the "lowest common denominator." The United States prefers instead to encourage voluntary association with good practice and internationally agreed guidelines, while retaining flexibility to promote established U.S. regulatory practice. Moreover, some IAEA member states, including the United States, believe that mandatory standards infringe on national sovereignty.

After the Chernobyl accident, President Reagan and other leaders of industrialized nations stated that each country engaged in nuclear power generation bears the full responsibility for the safety of its installations. At the same time, they noted that, for each country the maintenance of safety is an international responsibility. According to the IAEA's Director of Nuclear Safety, "more member states are becoming more positive to some type of international safety regime or presence."

[1]Our Common Future, World Commission on Environment and Development (Oxford, England: Oxford University Press, 1987).

[2]Nuclear Safety-Proposals for the International Control of the Nuclear Energy Industry, International Confederation of Free Trade Unions, March 20, 1989.

The IAEA's Basic Safety Principles

In 1988 the IAEA's International Nuclear Safety Advisory Group issued a report setting out basic safety principles that reflect their understanding of the safety policies and the best practices in the nuclear industry worldwide.[3]

The report is a concise statement of the objectives and principles of design and operation of nuclear plants. The safety principles are not part of the IAEA's safety standards, which are an internationally agreed set of recommendations on safety requirements adopted by the IAEA's Board of Governors.

According to the report, "These safety principles do not guarantee that nuclear power plants will be absolutely free of risk, but, when the principles are adequately implemented, the plants should be very safe." The principles address nuclear power plant siting, design, construction, commissioning, operation, maintenance, operator training, and all related activities.

In addition, IAEA evaluated comments from individuals and organizations in 25 countries and found that the report was well received and that the principles would contribute to safety if fully implemented. IAEA is also using the report's principles as guidance for safety assessments requested by East European countries and the Soviet Union of older, Soviet-designed pressurized water reactors.

Lack of International Agreement on Nuclear Safety

There is no agreement among nuclear power countries to abide by nuclear safety standards or principles that could improve nuclear power plant safety and facilitate maintaining a higher level of safety.

According to the IAEA's Director of Nuclear Safety, national approaches to nuclear safety developed over the years have resulted not only in differences in regulations, but also in variations in technical requirements from one country to another. He believes that this may have had an effect on the level of public confidence in nuclear safety. He also believes that the development of a clear and universally acceptable approach to safety guided by an international body might well alleviate national and international safety concerns and also positively influence public opinion.

[3]Basic Safety Principles for Nuclear Power Plants, A report by the International Nuclear Safety Advisory Group, International Atomic Energy Agency Safety Series No. 75-INSAG-3 (Vienna, Austria: 1988).

A member of the IAEA's Nuclear Safety Standards Advisory Group stated that the European Community would be receptive to an international agreement on nuclear safety since some European Community members have already proposed an agreement on common safety principles.

An agreement committing nuclear power countries to achieving higher levels of safety could also provide some assurances to the international community that plants are operating safely worldwide, thereby increasing public confidence.

Recent Efforts Toward an International Agreement on Nuclear Safety

IAEA has emphasized the need for a more thorough and transparent nuclear safety review process with the objective of achieving a high safety performance for all nuclear power reactors. At the IAEA's Conference on the Safety of Nuclear Power in September 1991, 350 experts from more than 40 countries and 10 international organizations agreed to explore ways of bolstering the international nuclear safety regime, including the creation of a convention on nuclear safety. The IAEA's Director General plans to prepare an outline of the possible elements for the safety convention for the February 1992 meeting of the IAEA's Board of Governors. According to Germany's Minister for the Environment, the convention would allow IAEA member states to legally commit themselves to observe certain safety standards.

At a September 1991 conference on the prospects for a wider international nuclear safety regime sponsored by NEA, the heads of nuclear regulatory agencies from seven OECD countries agreed to work toward a binding international framework convention, under the aegis of IAEA, with the objective of achieving a high and homogeneous level of safety.

To ensure effective implementation of a convention or agreement, a monitoring mechanism to verify compliance should be included. According to the IAEA's Director of Nuclear Safety, since there are possible differences in interpretation of applying standards, verification appears to be necessary. This could involve oversight by IAEA or another international organization. However, primary responsibility for enforcing the safety principles and recommendations would lie with national regulatory authorities but be backed up by international peer reviews.

Options for International Agreement on Achieving a Higher Level of Safety

Two options for implementing an international agreement on achieving a higher level of safety are (1) using the IAEA's existing framework and (2) creating a new international organization.

Using the IAEA's Framework

IAEA could be the focal point to carry out an international agreement on nuclear power plant safety. IAEA has an established organizational framework that could implement an international agreement. Its worldwide membership consists of 112 countries whose approval would be needed for an international consensus on safety. IAEA has played a key role in developing nuclear safety standards, and it has experience in building international consensus. According to the IAEA's Director of Nuclear Safety, IAEA could use the existing Operational Safety Review Team program to verify compliance with generally accepted safety standards.

There are consequences in applying these basic safety principles to some older model Soviet-designed reactors. Some reactors would have to be shut down; others would face costly repairs to bring them up to IAEA standards. Some of the reactors would have to be "grandfathered," that is, excused from meeting the current standards for adequate safety if they were to continue operation. A timetable of when these reactors would eventually be brought up to standard or closed down would be needed.

Creating a New International Organization

Another option would be to establish a new organization to implement an international nuclear safety agreement. This option has two advantages. First, it could avoid the IAEA's potential conflict of interest as both a promoter and regulator of nuclear power, thereby maintaining independence and objectivity. Second, membership could be restricted to countries with nuclear power programs, and obtaining consensus on issues could be easier since there could be potentially greater freedom from political pressure.

A new organization could have disadvantages, too. The cost of creating a new agency to carry out the agreement could be high. It would have to

develop its own financial, technical, and logistical support, thereby perhaps competing with the existing body for skilled personnel. The new organization also may not have immediate credibility in making recommendations, and it could take time to establish a reputation for technical competence.

Conclusions

The massive global consequences of the 1986 Chernobyl disaster renewed debate on mandatory, enforceable international safety standards. IAEA revised and strengthened nuclear safety standards, and the IAEA's safety experts also developed a set of safety principles which, if fully implemented, could help in raising the level of operational safety worldwide. However, the use of either safety standards or principles by member states is optional.

IAEA does not have the authority to enforce the use of the standards or principles, and some countries, including the United States, resist the concept of mandatory compliance. They believe that a mandatory standards and verification regime would infringe on national sovereignty.

Nuclear experts and organizations generally agree that the safety standards and principles developed by IAEA represent at least the foundation for creating and enhancing a safety "culture" at nuclear power plants worldwide. However, nuclear power countries have not signed any formal agreements to adhere to generally accepted standards or principles.

As a result of recommendations made at the IAEA's Conference on the Safety of Nuclear Power, the framework of a nuclear safety convention will be presented to the IAEA's governing body for its consideration in February 1992. This effort is supported by nuclear regulatory authorities from seven major OECD countries. If such an agreement were enacted by IAEA member states, there are options for implementing the agreement either through the existing framework of IAEA or the creation of an independent organization for nuclear safety.

Recommendation

We recommend that the Secretary of State, in cooperation with IAEA member states, promote the adoption of uniform and higher levels of safety standards for nuclear power plants. The present international climate may propel IAEA member states into adopting binding standards. We, therefore, recommend that the Secretary of State reassess the U.S position against mandatory compliance with safety standards.

The 112 Member States of the International Atomic Energy Agency

Afghanistan
Albania
Algeria
Argentina[a]
Australia
Austria

Bangladesh
Belgium[a]
Bolivia
Brazil[a]
Bulgaria[a]
Byelorussian Soviet Socialist Republic[a]

Cameroon
Canada[a]
Chile
China[b]
Colombia
Costa Rica
Cote d'Ivoire
Cuba[b]
Cyprus
Czechoslovakia[a]

Democratic People's Republic of Korea
Denmark
Dominican Republic

Ecuador
Egypt
El Salvador
Ethiopia

Finland[a]
France[a]

Gabon
Germany[a]
Ghana
Greece
Guatemala

Haiti
Holy See
Hungary[a]

Iceland
India[a]
Indonesia
Iran[b]
Iraq
Ireland
Israel
Italy

Jamaica
Japan[a]
Jordan

Kampuchea
Kenya
Korea, Rep. of[a]
Kuwait

Lebanon
Liberia
Libya
Liechtenstein
Luxembourg

Madagascar
Malaysia
Mali
Mauritius
Mexico[a]
Monaco
Mongolia
Morocco
Myanmar

Namibia
Netherlands[a]
New Zealand
Nicaragua
Niger
Nigeria
Norway

Pakistan[a]
Panama
Paraguay
Peru
Philippines
Poland
Portugal

Qatar

Romania[b]

Saudi Arabia
Senegal
Sierra Leone
Singapore
South Africa[a]
Spain[a]
Sri Lanka
Sudan
Sweden[a]
Switzerland[a]
Syria

Tanzania
Thailand
Tunisia
Turkey

Uganda
Ukrainian Soviet Socialist Republic[a]
Union of Soviet Socialist Republics[a]
United Arab Emirates
United Kingdom[a]
United States[a]
Uruguay

Venezuela
Vietnam

Yugoslavia[a]

Zaire
Zambia
Zimbabwe

[a]Denotes member state has operating nuclear power program.

[b]Denotes member state plans future nuclear power program.

Source: IAEA.

International Atomic Energy Agency Member States That Signed And/Or Consented to Conventions on Notification and Assistance (as of June 1991)

Countries with nuclear power program	Date conventions signed	Date of agreement to be bound
Argentina	[a]	Jan. 17, 1990
Belgium	Sept. 26, 1986	[b]
Brazil	Sept. 26, 1986	Dec. 4, 1990
Bulgaria	Sept. 26, 1986	Feb. 24, 1988
Canada	Sept. 26, 1986	Jan. 18, 1990
China	Sept. 26, 1986	Sept. 10, 1987
Cuba	Sept. 26, 1986	Jan. 8, 1991
Czechoslovakia	Sept. 26, 1986	Sept 26, 1986
Finland	Sept. 26, 1986	July 6, 1988
France	Sept. 26, 1986	Mar. 6, 1989
Germany	Sept. 26, 1986	Sept. 14, 1989
Hungary	Sept. 26, 1986	Mar. 10, 1987
India	Sept. 29, 1986	Jan. 28, 1988
Japan	Mar. 6, 1987	June 9, 1987
Mexico	Sept. 26, 1986	May 10, 1988
Netherlands	Sept. 26, 1986	[b]
Pakistan	[a]	Sept. 11, 1989
Philippines[c]	[a]	[b]
Poland[d]	Sept. 26, 1986	Mar. 24, 1988
Romania	[a]	June 12, 1990
South Africa	Aug. 10, 1987	Aug. 10, 1987
South Korea	[a]	June 8, 1990
Soviet Union	Sept. 26, 1986	Dec. 23, 1986
Spain	Sept. 26, 1986	Sept. 13, 1989
Sweden	Sept. 26, 1986	Feb. 27, 1987
Switzerland	Sept. 26, 1986	May 31, 1988
United Kingdom	Sept. 26, 1986	Feb. 9, 1990
United States	Sept. 26, 1986	Sept. 19, 1988
Yugoslavia	May 27, 1987	Feb. 8, 1989

Note: In 1986, over 70 IAEA member states adopted the two conventions after the Chernobyl accident.

[a]Where no date is shown, country has not signed conventions.

[b]Where no date is shown, country has not consented to be bound.

[c]Nuclear power program has been postponed indefinitely.

[d]Nuclear power program was canceled in September 1990.

Sources: IAEA and American Nuclear Society.

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