AD-A124 109 RECOVER: A POTENTIALLY USEFUL TECHNOLOGY FOR NUCLEAR SAFEGUARDS BUT GREAT..(U) GENERAL ACCOUNTING OFFICE WASHINGTON DC INTERNATIONAL DIV 25 JAN 83 GAO/ID-83-9 1/1

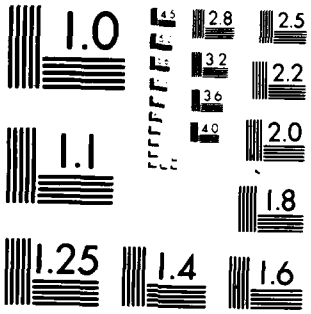
UNCLASSIFIED F/G 15/6 NL

END

DATE FILMED

6-83

DTIC



MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS-1963-A

AD A121109

BY THE COMPTROLLER GENERAL

Report To The Director, U.S. Arms Control And Disarmament Agency

OF THE UNITED STATES

Recover: A Potentially Useful Technology For Nuclear Safeguards, But Greater International Commitment Is Needed

Since 1976 the U.S. Arms Control and Disarmament Agency has been developing the REmote COntinual VERification (RECOVER) system for use by the International Atomic Energy Agency (IAEA). RECOVER is intended to remotely monitor the operational status of surveillance cameras and other devices. A small prototype RECOVER system has been undergoing testing at IAEA since December 1979.

RECOVER's potential benefits for international nuclear safeguards are uncertain and questions have been raised concerning its cost-effectiveness. IAEA has neither agreed to accept RECOVER for routine safeguards use nor specified the criteria RECOVER would have to satisfy to ensure its acceptance. Also, the RECOVER development program has fallen behind schedule and further technical development will be required before the system could be used operationally.

GAO recommends that the Arms Control and Disarmament Agency

--comprehensively assess the RECOVER program;

--take steps to clarify the commitment of IAEA to using a RECOVER system;

--determine, with interagency assistance, the priority and responsibilities for completing RECOVER's testing; and

--estimate the cost of an operational RECOVER system.

DTIC FILE COPY

DTIC ELECTE FEB 4 1983 S D

This document has been approved for public release and sale; its distribution is unlimited.

GAO/ID-83-9
JANUARY 25, 1983

83 02 04 026

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

INTERNATIONAL DIVISION

B-209935

The Honorable James L. George
Acting Director, U.S. Arms Control and
Disarmament Agency

Dear Mr. George:

This report discusses the Arms Control and Disarmament Agency's RECOVER project, including management problems in its development and the uncertainty of its use to improve international nuclear safeguards.

We recognize that the executive branch is currently engaged in a reassessment of the relationship between the United States and the International Atomic Energy Agency. The report assumes the resumption of normal relations with the Agency.

The report contains recommendations to you on pages 16 and 33. As you know, 31 U.S.C. §720 requires the head of a Federal Agency to submit a written statement on actions taken on our recommendations to the Senate Committee on Governmental Affairs and the House Committee on Government Operations not later than 60 days after the date of the report and the House and Senate Committees on Appropriations with the agency's first request for appropriations made more than 60 days after the date of report.

We are sending copies of this report to the Secretaries of State and Energy; the Chairman of the Nuclear Regulatory Commission; the Director of the Office of Management and Budget; and to others as requested.

Sincerely yours,

Frank C Conahan

Frank C. Conahan
Director

GENERAL ACCOUNTING OFFICE
REPORT TO THE DIRECTOR, U.S.
ARMS CONTROL AND DISARMAMENT
AGENCY

RECOVER: A POTENTIALLY USEFUL TECHNOLOGY FOR NUCLEAR SAFEGUARDS, BUT GREATER INTERNATIONAL COMMITMENT IS NEEDED

D I G E S T

In recent years the International Atomic Energy Agency has been faced with increasing challenges in safeguarding nuclear materials against diversion for use in nuclear weapons. It now safeguards over 840 facilities with about 130 inspectors. In 1976 the U.S. Arms Control and Disarmament Agency initiated development of the REmote COntinual VERification (RECOVER) system to eventually help the International Atomic Energy Agency better use its inspectors. RECOVER, as envisioned by its designers, would remotely monitor the operational status of the International Atomic Energy Agency's surveillance cameras and containment devices. To date, the U.S. Government has allocated over $4 million to RECOVER's development. A prototype model of RECOVER has been undergoing testing at the International Atomic Energy Agency headquarters since December 1979.

RECOVER'S USE IN INTERNATIONAL SAFEGUARDS IS UNCLEAR

The International Atomic Energy Agency has not agreed to accept RECOVER for routine safeguards use and has indicated that its decision on acceptance can not be expected before 1984. Moreover, it has yet to specify the criteria RECOVER would have to satisfy to ensure the system's adoption by the International Atomic Energy Agency for routine safeguards use. It has strictly limited its support for the project and has been dissatisfied with RECOVER's progress, although International Atomic Energy Agency officials' attitudes towards RECOVER have become more favorable. (See p. 5.)

Distribution/
Availability Codes
Avail and/or
Dist Special
A
DTIC COPY INSPECTED

RECOVER's potential benefits for international safeguards are still uncertain. Although it is intended to improve International Atomic Energy Agency efficiency and effectiveness, how and to what degree these goals would be achieved remains undetermined. The initial report of an ongoing study by a U.S. national laboratory has

indicated that RECOVER would be potentially cost-effective at only a small percentage of the installations under international safeguards in 1981. (See p. 7.)

Arms Control and Disarmament Agency officials believe RECOVER could provide valuable but unquantifiable benefits. The International Atomic Energy Agency believes RECOVER may enhance safeguards credibility but not reduce routine inspections. Other opinions are split on RECOVER's benefits. (See p. 7.)

At present, the involved parties do not appear to have the basic information needed to make an informed decision on RECOVER's global benefits. Also, potential legal and political obstacles to RECOVER's routine safeguards use remain unexamined. (See p. 12.)

MANAGEMENT PROBLEMS ALSO RAISE QUESTIONS ABOUT RECOVER'S FUTURE

The RECOVER project is having difficulty in making the transition from research and development to implementation. Although the Arms Control and Disarmament Agency has succeeded in developing a small prototype RECOVER system and in attracting important international interest, the program has fallen two to three years behind schedule. Milestones for RECOVER's integration into international nuclear safeguards procedures have been missed. (See p. 21.)

Arms Control and Disarmament Agency officials recognize that delays are partially due to their Agency's lack of resources found in more technically-oriented organizations. For example, a shortage of technical staff apparently contributed to the Agency's failure to identify a flaw in the initial design of a key component. (See p. 22.)

Arms Control and Disarmament Agency officials believe that the project should now be transferred to another agency. Other agencies, however, have had a small role in RECOVER's development and do not now appear likely to assume control of the project in the near future. All generally believe that RECOVER is not urgently needed. (See pp. 28 and 29.)

Although there is general agreement that no insurmountable technical barriers block RECOVER's use, significant additional technical development is necessary before RECOVER could be used routinely for international safeguards. (See pp. 25 and 28.)

Uncertainties also continue concerning the likely cost of actually implementing a RECOVER system. System cost estimates vary because the eventual size of such a system is unknown and because existing cost estimates for components are out-of-date and incomplete. (See p. 33.)

RECOMMENDATIONS

GAO recommends that the Director of the Arms Control and Disarmament Agency request the International Atomic Energy Agency to specify the criteria for its eventual acceptance of an operational RECOVER system. (See p. 16.)

Furthermore, GAO recommends that the Director assess the RECOVER program, taking into account the following factors:

--the International Atomic Energy Agency's criteria;

--results of any ongoing or completed facility studies and field tests;

--the nature and importance of RECOVER's unquantifiable benefits at various facility types;

--RECOVER's cost-effectiveness as described by the U.S. national laboratory study;

--the number and significance of facilities at which RECOVER could provide quantifiable and/or unquantifiable benefits;

--the suitability of RECOVER for worldwide, regional, and local applications; and

--legal and political issues bearing on RECOVER's international acceptance for routine safeguards use. (See p. 16.)

GAO also recommends that the Director present the results of the assessment to the International Atomic Energy Agency and request a decision regarding acceptance of RECOVER for routine safeguards use. If the International Atomic Energy Agency, following its review of the assessment, does not commit itself to eventually accepting a RECOVER system that fulfills its criteria, GAO recommends that the Director terminate all further development of RECOVER for the International Atomic Energy Agency and examine the feasibility of alternative uses for it. (See p. 17.)

GAO recommends that, concurrent with the actions recommended above, the Director of the Arms Control and Disarmament Agency request assistance from the Secretaries of State and Energy, and the Chairman of the Nuclear Regulatory Commission in order to determine (1) RECOVER's priority among all U.S. safeguards equipment development efforts and (2) the appropriate division of responsibilities among U.S. Government agencies for expeditiously completing RECOVER tests and studies. (See p. 33.)

Finally, GAO recommends that the Director develop more reliable and up-to-date cost estimates for RECOVER components and use these estimates to make cost projections for an operational RECOVER system. (See p. 33.)

AGENCY COMMENTS

In commenting on the draft of this report, the Arms Control and Disarmament Agency, the Departments of Energy and State, and the Nuclear Regulatory Commission agreed with GAO that the RECOVER system is not yet ready for operational use by the International Atomic Energy Agency. They generally agreed with the thrust of GAO's conclusions, although the Department of State and the Arms Control and Disarmament Agency disagreed with some of the recommendations. (See pp. 17 and 33.)

The Arms Control and Disarmament Agency commented that the law and established practices make it inappropriate to seek criteria and a decision from an international organization regarding eventual acceptance of a research product. Also, the Arms Control and Disarmament Agency said that performing an assessment of the RECOVER program is not called for and that representatives of all the appropriate agencies have met and will continue to meet to discuss remote verification and to arrange an integrated approach for RECOVER efforts. GAO disagreed with the Agency's views in this matter. (See pp. 17 and 33.)

Contents

		Page
DIGEST		i
CHAPTER		
1	INTRODUCTION	1
	The role of IAEA	1
	RECOVER and IAEA	2
	Objectives, scope, and methodology	3
2	RECOVER'S EVENTUAL ROLE IN IAEA SAFEGUARDS IS UNCERTAIN	5
	IAEA has not adopted RECOVER	5
	RECOVER's potential benefits are unclear	6
	Political and legal questions remain to be addressed	13
	Non-IAEA alternative uses for RECOVER are being studied	15
	Conclusions	16
	Recommendations	16
	Agency comments and our analysis	17
3	MANAGEMENT PROBLEMS RAISE QUESTIONS ABOUT ACDA'S FUTURE ROLE IN RECOVER'S DEVELOPMENT	21
	RECOVER is behind schedule	21
	ACDA lacks in-house capability to develop RECOVER	22
	More technical work needs to be done	24
	Other agencies have had a small role in RECOVER	28
	The United States is paying for RECOVER's development	29
	Conclusions	32
	Recommendations	33
	Agency comments and our analysis	33

APPENDIX		Page
I	Sources of information	35
II	Proposed alternative uses for RECOVER	37
III	Letter dated November 26, 1982 from the Arms Control and Disarmament Agency	40
IV	Letter dated December 3, 1982 from the Department of Energy	46
V	Letter dated November 30, 1982 from the Nuclear Regulatory Commission	48
VI	Letter dated November 29, 1982 from the Department of State	50

ABBREVIATIONS

ACDA	Arms Control and Disarmament Agency
CANDU	Canadian Deuterium Reactor
C/S	Containment and Surveillance
DOE	Department of Energy
GAO	General Accounting Office
IAEA	International Atomic Energy Agency
LWR	Light Water Reactor
NRC	Nuclear Regulatory Commission
POTAS	Program of Technical Assistance to Safeguards
RECOVER	REmote COntinual VERification
RVU	Resident Verification Unit
TRANSEAVER	TRANsport-by-SEA-VERification

CHAPTER 1

INTRODUCTION

The U.S. Arms Control and Disarmament Agency (ACDA) has been developing a REmote COntinual VERification (RECOVER) system for possible use by the International Atomic Energy Agency (IAEA). Since 1976 the United States has allocated over $4 million to this effort to improve international safeguards against the proliferation of nuclear weapons.

THE ROLE OF IAEA

Both nuclear weapons and nuclear energy for peaceful purposes depend, in large measure, on the same technology and use similar materials and production facilities. In order to encourage peaceful contributions of nuclear energy without furthering military purposes, IAEA was created in 1957 as an autonomous body associated with the United Nations. One of its principal responsibilities is to administer a system of international safeguards. Such safeguards are intended to (1) detect in a timely manner diversions by countries of significant amounts of nuclear material from peaceful activities and (2) deter such diversions by the risk of early detection.

In recent years, the challenges to IAEA's safeguards mission have increased. There has been a great increase in the number of facilities to be safeguarded. IAEA, currently comprised of 110 nations, safeguards material in over 840 installations with a staff of about 130 inspectors. U.S. and IAEA officials generally agree that IAEA's limited number of inspectors has been one of several factors adversely influencing the general effectiveness of IAEA safeguards. In 1981, IAEA accomplished only 50 percent of the agreed amount of inspection effort at facilities under safeguards. Moreover, IAEA is now responsible for safeguarding material at new types and sizes of facilities that could play a central role in the proliferation of nuclear weapons. These include plants for uranium enrichment, spent fuel reprocessing, and mixed uranium-plutonium oxide fuel fabrication.

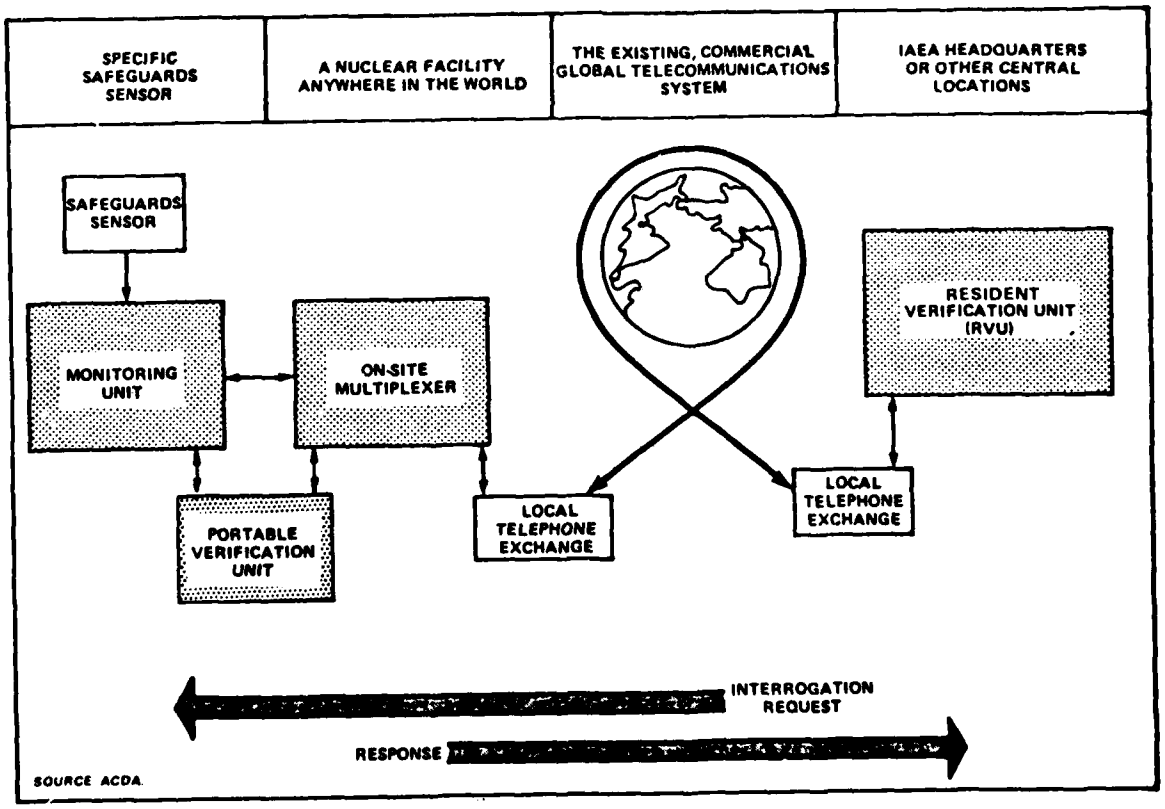
Although IAEA's safeguards system depends primarily on material accountancy and on-site inspections, IAEA now complements these tools with the use of various containment and surveillance (C/S) devices. In 1981, 160 IAEA surveillance systems took about 8 million pictures, and over 4,000 containment seals were applied and later verified. Such devices are prone to mechanical problems. Camera failures and film jamming have not been uncommon and IAEA officials have conceded that the overall performance level has been lower than desired. Loss of surveillance at a nuclear facility between an inspector's visits can result in an IAEA reinventory of that facility's material--an expensive and time-consuming process.

RECOVER and IAEA

ACDA initiated the RECOVER program in 1976 to help IAEA make better use of its limited number of inspectors by addressing the problem of C/S device failures. RECOVER was intended to improve IAEA safeguards by remotely monitoring the status of C/S devices and transmitting status data to IAEA headquarters in Vienna, Austria. Although RECOVER has generally not been considered an urgently needed project by U.S. and IAEA officials, ACDA believes that RECOVER could be of long-term benefit for international safeguards. (U.S. officials have concluded that RECOVER has little utility to U.S. domestic safeguards.)

As conceived by ACDA, RECOVER would involve the use of a central component--the resident verification unit (RVU)--at IAEA headquarters. Through the international telephone system, the RVU would automatically contact smaller RECOVER components--on-site multiplexers--located at various nuclear facilities around the world. The multiplexer at each facility would have already collected and stored information obtained from monitoring units attached to that facility's devices.

RECOVER System Concept



For example, if a camera monitored by RECOVER were to fail, the monitoring unit would detect the failure and store that data until contacted by the on-site multiplexer. The monitoring unit would then transmit the data to the on-site multiplexer, which, in turn, would store the data until polled by the RVU. Once the RVU obtained the information describing the camera failure from the on-site multiplexer, an alert would be flashed on the RVU's display screen at IAEA headquarters. IAEA could then decide how to respond to the alert.

ACDA's concept also included a portable verification unit to enable an on-site inspector to tap into the multiplexer at a given facility and obtain up-to-date information. Moreover, once the basic RECOVER concept had been developed, ACDA added another component to allow IAEA inspectors to transmit their safeguards reports via RECOVER.

In 1978 ACDA awarded a contract to a private firm for the development and construction of a small prototype RECOVER system. Following the conclusion of an IAEA-ACDA research agreement in 1979, the prototype was accepted by ACDA and subsequently installed at IAEA headquarters.

IAEA has not accepted RECOVER for routine use in its safeguards operations, although it has been cooperating with ACDA since 1979 in testing and evaluating the RECOVER prototype. In November 1980 ACDA, IAEA, and representatives of six other IAEA member countries 1/ conducted an international test of RECOVER. Testing has continued and participants have met annually in Vienna to discuss the project. The most recent meeting, held in June 1982, centered around findings of a study on RECOVER by the Brookhaven National Laboratory.

The RECOVER program's primary direction is set by the Chief of the Nuclear Safeguards and Technology Division of the Nuclear and Weapons Control Bureau of ACDA. A single RECOVER project officer, working under the Chief's direction, has the responsibility for implementing the policy, managing the research program, and coordinating with other U.S. agencies and IAEA. ACDA continues to provide the bulk of RECOVER's funding.

OBJECTIVES, SCOPE, AND METHODOLOGY

~~Our~~ purpose was to (1) identify varying assessments of RECOVER's potential benefits to IAEA safeguards, (2) determine IAEA's position concerning RECOVER, (3) assess the planning, development, and programming of the RECOVER project, and (4) ascertain RECOVER's costs to the United States.

1/The six participating governments were those of Australia, Bulgaria, Canada, West Germany, Japan, and the United Kingdom. A facility located in Austria also contributed to the test.

This review was done in accordance with the "Standards for Audit of Government Organizations, Programs, Activities, and Functions." We applied these standards in gathering information from a variety of sources, including U.S. agencies and national laboratories, representatives of foreign governments, officials of an international organization, and private U.S. industry. Appendix I contains more detailed information concerning our sources.

CHAPTER 2

RECOVER'S EVENTUAL ROLE IN IAEA SAFEGUARDS IS UNCERTAIN

RECOVER has yet to win international acceptance as a useful addition to IAEA's arsenal of safeguards equipment. IAEA has not adopted RECOVER to date, and U.S., IAEA, and foreign officials have not reached a consensus regarding RECOVER's potential benefit to international safeguards. Important issues concerning RECOVER's possible implementation by IAEA remain unresolved. Although alternative applications for RECOVER are under consideration, none would benefit IAEA safeguards.

IAEA HAS NOT ADOPTED RECOVER

Although IAEA has expressed interest in the concept of remotely monitoring sensors, it has not accepted RECOVER for routine use in safeguards or for inclusion in IAEA's research and development program. Moreover, according to a key ACDA official, IAEA has never specified the definitive criteria RECOVER would have to meet in order to insure its acceptance and routine use by IAEA. The Director General of IAEA informed us that an IAEA decision concerning limited implementation of RECOVER could be expected by 1984 or 1985, if sufficient support is provided to the project and if testing goes well.

IAEA has been cooperating in ACDA's development of RECOVER under the terms of the 1979 IAEA-ACDA research agreement, but IAEA's support for the project has been limited and carefully qualified. The agreement exempts IAEA from bearing any costs connected with RECOVER's development, and IAEA's tangible assistance has been strictly limited (see pp. 30 through 31). ACDA's promotion of RECOVER at the 1982 United Nations Special Session on Disarmament was criticized by a key IAEA official, who insisted that ACDA not identify RECOVER as an IAEA system or project.

IAEA considers RECOVER a "long-term" development effort. According to ACDA, IAEA believes that it faces problems more urgent than those RECOVER is intended to address. Within IAEA, only the Division of Development and Technical Support has had much contact with RECOVER, while other sections, including those with actual safeguards responsibilities, have had relatively little to do with the project. Moreover, IAEA has not determined as yet how it would fit RECOVER into its daily safeguards routine.

Despite IAEA's official "wait-and-see" stance, U.S. and foreign observers believe that opinions within IAEA have been shifting towards RECOVER. In our most recent discussion with IAEA officials, we found more optimism about RECOVER's prospects than we had in discussions during 1980. A key IAEA official, less skeptical than before, informed us in mid-1982 that he was generally positive about RECOVER and called it a sound project that needed time.

Nevertheless, IAEA remains unwilling to accept RECOVER officially until more information is available. IAEA officials have stressed the need for field tests using actual IAEA sensors and have strongly criticized ACDA's failure to develop the RECOVER-compatible sensors needed for such tests. Moreover, as discussed below, IAEA has indicated that it needs a more comprehensive study of RECOVER's potential benefits for international safeguards.

RECOVER'S POTENTIAL BENEFITS ARE UNCLEAR

Although the RECOVER program has been in progress since 1976, involved U.S., IAEA, and foreign officials have yet to determine how and to what degree RECOVER would enhance IAEA safeguards. Most officials believe the RECOVER concept has at least some merit, but issues concerning the nature, significance, and global applicability of RECOVER's potential contribution remain unresolved. An ACDA official told us that ACDA may have initially "oversold" RECOVER's potential.

ACDA believes RECOVER will enhance efficiency and effectiveness

Although ACDA concedes that the existing RECOVER demonstration prototype has had no effect to date on IAEA safeguards, it believes that an operational 1/ RECOVER system could potentially enhance the efficiency and effectiveness of IAEA's safeguards operations around the world.

Efficiency

According to ACDA officials, RECOVER could eventually help IAEA enhance the efficiency with which it uses its inspectors by reducing the effort needed for routine monitoring of C/S devices and permitting inspectors to focus on situations identified by RECOVER as warranting their attention. For example, it has been suggested that IAEA could replace broken C/S devices before redundant sensors fail, reducing the need for reinventories. ACDA believes that RECOVER could allow IAEA to substitute remote monitoring for some degree of human inspection effort without

---

1/As used throughout this report, an "operational" RECOVER system means a system in routine IAEA safeguards use.

compromising the level of IAEA's assurances. RECOVER proponents also suggest that remote monitoring could enable IAEA to reduce the actual number of inspections at certain facilities.

Effectiveness

ACDA believes RECOVER may increase safeguards effectiveness by providing more complete and timely safeguards data to IAEA, thus enabling it to arrive at more reliable and timely decisions concerning possible diversions. According to ACDA, RECOVER could help (1) enhance the credibility of IAEA's safeguards and assurances and (2) increase deterrence of would-be diverters. ACDA officials believe that such benefits are valuable but unquantifiable.

Worldwide applicability

The global utility of a RECOVER system adopted for safeguards use has been a major theme in ACDA's descriptions of RECOVER. Originally, a worldwide network of up to 500 facilities was envisioned by RECOVER's developers. ACDA officials are now unsure of the number of facilities that would be included, and doubts exist within ACDA as to whether or not a network linking more than 100 facilities has any likelihood.

Brookhaven study questions
RECOVER's cost-effectiveness

The initial report 1/ on an ongoing study by the Brookhaven National Laboratory indicates that RECOVER's cost-effectiveness and worldwide applicability may be limited. The study, performed by the Department of Energy (DOE) and Brookhaven at the request of ACDA and IAEA, focuses entirely on RECOVER's potential cost-effectiveness in a variety of nuclear facility types. 2/ The study's authors compared the costs of a RECOVER system (including those of an IAEA response to an alert) to those of alternative actions,

---

1/"An Evaluation of a Remote Continual Verification System, RECOVER, for International Safeguards," Technical Support Organization, Brookhaven National Laboratory, Jan. 12, 1982. These preliminary findings are being revised and extended as a result of subsequent discussions with IAEA.

2/Research reactors were not included in the study because IAEA does not have a single safeguards approach applicable to the different types of such facilities. ACDA is arranging for RECOVER to be evaluated at a U.S. research reactor. In 1981, about 150 of the 844 facilities safeguarded by IAEA were research reactors. However, according to DOE, only 40 of these research reactors had a sufficient quantity of nuclear material to construct a nuclear explosive device.

such as reinventories. They also considered alternative IAEA uses for RECOVER, notably transmission of inspector reports. The scope of the study was limited to quantifiable costs and benefits; it did not evaluate possible benefits from enhanced deterrence and safeguards credibility. The study's authors did not deny that such benefits may exist but they believed that evaluation of unquantifiable benefits was beyond the scope of their study. (ACDA officials--despite their stress on the importance of unquantifiable benefits--recognize that cost-effectiveness is a significant criterion.)

RECOVER cost-effectiveness

The study found that RECOVER could be "beneficial and cost-effective" in safeguarding only three of the seven facility types examined, as shown in the following table.

Cost-Effective	Not Cost-Effective
Fast critical facilities	Light water power reactors (LWR)
Canadian deuterium power reactors, 600-type (CANDU-600)	Mixed oxide fuel fabrication facilities
Inactive storage facilities for plutonium or highly enriched uranium	Reprocessing plants under continuous inspection
	Commercial size centrifuge enrichment plants

Of the 844 installations safeguarded by IAEA in 1981, less than 3 percent--18 CANDUs and as many as four fast critical assemblies--were of types at which Brookhaven found RECOVER to be

cost-effective. 1/ According to DOE, about 5 to 10 percent of IAEA's 1981 inspection effort may have been expended at such installations. IAEA officials do not know of the existence of any inactive plutonium/highly enriched uranium storage facilities.

Not all CANDUs and fast critical facilities could necessarily use RECOVER in a cost-effective manner. Only certain CANDUs located within two days travel from an IAEA office would be suitable, and RECOVER's cost-effectiveness at fast critical assemblies is premised on the use of a proposed C/S arrangement which IAEA may not accept. Moreover, RECOVER's cost-effectiveness has not been established for certain types of fast critical assemblies, according to DOE. The study's authors also informed us that facilities vary in physical characteristics, even within a given type, and various national situations could affect RECOVER's usefulness at particular locations.

ACDA and Brookhaven officials stated that not all of the 844 installations safeguarded by IAEA in 1981 contained a "significant quantity" of nuclear materials--i.e., the approximate amount needed to construct a nuclear explosive device. They believe that if only those facilities containing a significant quantity are considered, the percentage of installations at which RECOVER could be cost-effective would increase from the 3 percent cited above. We were also told that considering only those facilities with a significant quantity could roughly double DOE's estimate that 5 to 10 percent of IAEA's 1981 inspection effort was at facilities at which RECOVER could be cost-effective.

The study's finding that RECOVER would not be cost-effective at LWRs is of particular importance because LWRs, distributed throughout the world, are the most common type of power reactor safeguarded by IAEA: 78 percent of the 134 power reactors IAEA safeguarded in 1981 were LWRs. Moreover, the margin by which RECOVER failed to be cost-effective at LWRs was substantial.

1/According to DOE, the Brookhaven study dealt with the cost of a global RECOVER system by facility type. In the case of light water reactors, the cost of the RVU in Vienna was prorated over an assumed 200-facility network. Approximately the same RVU cost per facility was assumed for CANDUs. The cost analysis for the fast critical facility was performed after initial results had indicated that a global RECOVER system was not cost-effective for light water reactors. Because (1) the study included only one fast critical facility, (2) there seemed to be few or no other promising candidate facilities, and (3) the most favorable location for the RVU seemed to be near the fast critical facility, the authors felt justified in charging the entire cost of the RVU against the one fast critical facility they studied.

Brookhaven's conclusion that RECOVER would not be cost-effective at continously inspected reprocessing plants or at commercial enrichment facilities is also important; bulk handling facilities of these types pose substantial challenges to IAEA safeguards. RECOVER, Brookhaven found, could be cost-effective only in parts of reprocessing facilities that were not under continuous inspection or in non-commercial pilot enrichment facilities (which will be phased out eventually in favor of commercial facilities).

Global and local applications

Although the study did not assess the benefits of a global RECOVER system, its findings regarding various facility types appear to raise serious concerns about a global system's cost-effectiveness. According to DOE, if RECOVER is not installed at LWRs, the most widespread and numerous type of facility will be excluded and the RECOVER system will not be global in character.

However, executive branch officials believe that regional or local applications of RECOVER-like systems apparently could offer potential benefits. Brookhaven safeguards experts suggested to us that local or regional systems focused on a few facility types might be easier to justify in terms of cost-effectiveness than a single global network. For example, if IAEA accepts the proposed C/S arrangement, use of RECOVER at the one fast critical facility studied, alone could, according to Brookhaven, save IAEA $100,000-$280,000 annually. Moreover, DOE and NRC have indicated interest in further tests of localized remote monitoring systems within certain types of facilities. A local system could conceivably assist inspectors continuously present at large bulk handling facilities by alerting them to C/S device failures within such facilities.

Transmission of inspector reports

Brookhaven concluded that the benefits of transmitting inspector reports via RECOVER were not, in themselves, sufficient to justify installing RECOVER at a particular facility, such as an LWR. Also, according to a Brookhaven official, it is doubtful whether regional systems would enable IAEA to utilize RECOVER in this manner.

IAEA stresses RECOVER's impact on credibility over impact on inspections

The Director General of IAEA informed us that an upgraded RECOVER system (1) could enhance safeguards credibility and assurance, but (2) would not significantly reduce routine inspections.

According to the Director General, RECOVER would improve IAEA safeguards by increasing assurance and credibility through

timely warning of equipment malfunctions and would be of "great assistance" to IAEA inspectors. IAEA officials believe that the value of enhancing confidence in IAEA safeguards is important, if difficult to quantify.

In terms of quantifiable benefits, IAEA believes that "the implementation of RECOVER would hardly result in a significant reduction of routine inspections." In some cases, according to the Director General, a saving of inspection effort may result through RECOVER. IAEA informed us that RECOVER, in certain cases, would reduce the need for special inspections and/or reduce and simplify inspection activities.

IAEA generally praised the Brookhaven study. Nevertheless, it disagreed with the conclusions concerning LWRs and raised questions regarding the analysis of reprocessing facilities. Consequently, IAEA has asked the study's authors to further consider and extend their findings.

Other views are also mixed

Some foreign participants believe that the RECOVER system may provide a "real advantage" to IAEA and that a reliable IAEA RECOVER system could enhance IAEA safeguards "considerably." Other potential benefits foreseen by some foreign observers include

--enhanced safeguards credibility;

--improved inspector morale;

--possible utility at reprocessing plants;

--reduced costs in the design of C/S devices; and

--the introduction of modern data and computer concepts into IAEA's safeguards procedures.

However, one otherwise optimistic participant informed us that (1) the system would have no impact in reducing the number of inspections at facilities in his country and (2) RECOVER's usefulness to IAEA would be seriously limited if it were not cost-effective at plants for mixed oxide fuel fabrication or reprocessing. Others expressed concern regarding their perceptions of

--a "lack of continuity" between RECOVER and IAEA safeguards approaches;

--an unclear definition of RECOVER's objectives; and

--doubts about RECOVER's true cost-effectiveness.

They suggested that, until doubts regarding cost-effectiveness were resolved, further support of RECOVER's development should be limited.

Domestic observers also had differing views. Some U.S. safeguards officials not associated with ACDA believed that RECOVER could enhance IAEA safeguards effectiveness. Others warned against depending too heavily on mechanical systems to do the work of inspectors, or told us that ACDA

--had failed to clearly define RECOVER's likely application at an early stage of the project, and had developed a prototype system before sufficiently assessing what RECOVER could actually contribute;

--should have focused on specific uses and areas of interest to IAEA, rather than to have initially "oversold" RECOVER's potential (RECOVER, one expert concluded, is "a hardware solution looking for a problem"); and

--should have sought outside assessments of RECOVER's potential utility at an earlier date.

No near-term effort now underway to clarify RECOVER's benefits

ACDA is funding a Brookhaven revision of the cost-effectiveness study but Brookhaven and ACDA officials agree that the revision, as currently foreseen, would still not be a definitive study of RECOVER.

The revised Brookhaven study will again focus on cost-effectiveness. However, ACDA and IAEA officials have stressed that RECOVER should not be evaluated solely in terms of cost-effectiveness because unquantifiable benefits are held to be of importance.

IAEA criticized the initial report for considering each facility type in isolation, rather than as parts of an overall RECOVER network. Brookhaven was willing to revise the report to accomodate this concern, but not to attempt to aggregate its findings for each different facility type into a cost-effectiveness projection for a global RECOVER network. Brookhaven officials believed that only IAEA has the necessary data about each individual facility under safeguards to make a meaningful projection of a RECOVER network's optimum size, cost, and benefit. We were told that IAEA would probably not share such data with the analysts.

Other types of information needed for a comprehensive assessment of RECOVER may also be held closely by IAEA. Although Brookhaven based its estimates of reinventory costs on IAEA

documents, IAEA disagreed with the LWR estimates, citing recent problems with certain reinventory devices. As a result of these problems, IAEA officials maintained, reinventories at LWRs could involve methods costing up to 20 times more than those assumed by Brookhaven. In such cases, RECOVER might be marginally cost-effective. However, U.S. and foreign officials have suggested that IAEA may not always choose to use the more costly methods following a C/S failure. Therefore, RECOVER's true cost-effectiveness at LWRs cannot be calculated unless IAEA were to specify how often it uses the more costly methods. Again, IAEA apparently may not provide such information. Brookhaven officials were willing to prepare a cost-effectiveness analysis of RECOVER with LWRs assuming use of the more costly reinventory methods, but would not generalize the results to cover all LWRs.

IAEA's Director General believes that a system analytical study is needed to indicate RECOVER's benefits and ACDA has included in its RECOVER research program the preparation of safeguards plans for facilities using RECOVER. However, ACDA plans provided to us did not include the preparation of an overall system analytical study, although a plan for using RECOVER at research reactors was to be prepared.

POLITICAL AND LEGAL QUESTIONS REMAIN TO BE ADDRESSED

IAEA has indicated interest in exploring legal and political issues associated with RECOVER. These issues could be especially important because some nations have expressed concern over transmitting encrypted safeguards information directly to IAEA headquarters without their knowing its contents. In other countries, some legal restrictions are placed on transmission of encrypted data over telephone lines.

Nevertheless, ACDA has not focused on potential legal and political problems that could inhibit IAEA's implementation of RECOVER or carried out any studies on the subject. ACDA officials have worked out legal problems in connection with the international test and evaluation of the prototype RECOVER system but the participating countries represent only a small fraction of the 50 nations with installations safeguarded by IAEA. 1/

Despite the lack of a detailed analysis, some ACDA officials believe that facility attachments--agreements between IAEA and member nations' safeguarded facilities which establish procedures and

---

1/ACDA had sent a questionnaire to participating nations and others concerning legal issues early in the project. Few countries responded, however.

rules for carrying out inspection visits--would have to be renegotiated before RECOVER could be used. A former RECOVER project officer disagrees, however, and believes that RECOVER could be used under existing facility attachments.

IAEA officials also disagree with one another on this question. An IAEA legal official we spoke with believed modifications might be required. Countries not party to the Treaty on the Non-Proliferation of Nuclear Weapons, he added, are not bound by relevant provisions in IAEA documents for updating facility attachments and may not concur in RECOVER's use. However, a key IAEA safeguards specialist believed that facility attachments would not have to be changed to accommodate RECOVER.

Political considerations and RECOVER's design

In apparent anticipation of encountering different viewpoints among member nations, however, ACDA appears to have factored political considerations into RECOVER's design. For example, one ACDA official told us that a decision had been made to transmit only C/S sensor status information via RECOVER, as opposed to actual safeguards data. It was hoped no nation would object to transmission of this least objectionable type of data. Also, countries could see a benefit if there could be a timely IAEA reaction to signals of trouble: costly and disruptive reinventories of facilities would not need to be done. Moreover, RECOVER was defined as a measure to save manpower, according to a Department of State officer, because such a definition would please some nations and win their support.

Considering these factors, ACDA devised requirements with which a RECOVER system for routine safeguards use must comply. These include

--Unintrusiveness to avoid interference with host facility operations.

--Security to prevent unauthorized access to collect data.

--Reliability to assure detection and reporting of sensor data and avoid more intrusive safeguards measures.

--Economy/simplicity to keep system support costs to member nations low.

A key IAEA safeguards expert believes that the problem of political acceptability among member nations may have peaked in 1981 and that some countries now are less worried about RECOVER.

Participant nations' opinions

Opinions of the participant nations have been diverse, but none have agreed or refused to accept RECOVER for routine safeguards use to date. Although one representative expressed a belief that there would be no problems in having his country revise agreements to use RECOVER if IAEA adopted it for safeguards purposes, we found no evidence of views on RECOVER's acceptability among IAEA member nations not now participating in the project.

However, the use of RECOVER at certain types of facilities and not others could lead to perceptions by countries using designated facility types that they were being singled out. This could produce negative attitudes towards RECOVER and further restrict its use.

RECOVER's most enthusiastic foreign supporter may be Japan. Originally interested in the project for the purpose of saving inspection staffdays as well as for increasing safeguards effectiveness, Japan has subsequently incorporated RECOVER into the Japan Support Program for Agency Safeguards, a program for providing IAEA with technical assistance for safeguards development. In addition, Japanese involvement has expanded to include demonstrating the use of RECOVER to transmit inspection reports and developing a regional RECOVER concept.

NON-IAEA ALTERNATIVE USES FOR RECOVER ARE BEING STUDIED

RECOVER has attracted some interest beyond the international safeguards area. Although research into alternative uses for RECOVER and related technology is in its earliest stages, three potential applications of the system have been considered.

The concept of remotely monitoring ships carrying nuclear materials is being developed by the United States and Japan as a bilateral research and development project. Officials are hopeful that improvements in the physical security of nuclear shipments may result. Furthermore, use of a RECOVER-like system to verify arms control agreements, notably restrictions on producing chemical weapons, has only just begun to gain foreign attention through discussions at international forums. Finally, the possibility of using RECOVER for domestic safeguards purposes has been considered. Although U.S. safeguards authorities have concluded that RECOVER has little utility for U.S. domestic safeguards, Japanese safeguards specialists continue to investigate potential advantages of applying a RECOVER-like system to Japan's national safeguards system.

See appendix II for further information on these proposed applications.

CONCLUSIONS

RECOVER's eventual role in the international nuclear safeguards system remains an open question.

IAEA has not accepted RECOVER for possible routine safeguards use and will not make a decision to do so until 1984 at the earliest. It has yet to specify the definitive criteria that RECOVER would have to meet in order to ensure IAEA acceptance and routine use. In essence, it has adopted a "wait-and-see" attitude on the system, which has not been a top IAEA priority. Although IAEA officials' attitudes have become more favorable towards RECOVER, the Agency continues to call for more realistic testing and evaluation of RECOVER before committing itself to the use of remote monitoring.

U.S., IAEA, and foreign officials have yet to agree on how RECOVER will benefit IAEA. Although efficiency has been advanced as a primary RECOVER program goal, the Brookhaven report appears to raise serious doubts about the potential cost-effectiveness of a worldwide system. Involved parties do not appear to have the basic information needed to make informed decisions on RECOVER. The Brookhaven report is being revised but the revision will not satisfy the need for a comprehensive assessment of RECOVER's potential for improving international safeguards.

Despite IAEA's expressed interest in examining legal and political issues which RECOVER's use might raise, no detailed studies of such topics have been performed. Such studies could help to dispel confusion over the potential need to revise IAEA subsidiary arrangements and facility attachments and identify potential obstacles to RECOVER's deployment.

RECOMMENDATIONS

We recommend that the Director, ACDA, request IAEA to specify criteria for IAEA's eventual acceptance of an operational RECOVER system.

Furthermore, we recommend that the Director assess the RECOVER program, taking into account the following factors:

--IAEA's criteria;

--results of any ongoing or completed facility studies and field tests;

--the nature and importance of RECOVER's unquantifiable benefits at various facility types;

--RECOVER's cost-effectiveness as described by the revised Brookhaven study;

--the number and significance of facilities at which RECOVER could provide quantifiable and/or unquantifiable benefits;

--the suitability of RECOVER for worldwide, regional, and local applications; and

--legal and political issues bearing on RECOVER's international acceptance for routine safeguards use.

We also recommend that the Director of ACDA present the results of the assessment to IAEA and request its decision regarding acceptance of RECOVER for routine safeguards use. If IAEA, following its review of ACDA's assessment, does not commit itself to eventually accepting a RECOVER system that fulfills its criteria, we recommend that the Director terminate all further development of RECOVER for IAEA and examine the feasibility of alternative uses for it.

AGENCY COMMENTS AND OUR ANALYSIS

In response to our draft report, ACDA commented that its efforts on remote verification must be viewed in the context of exploring remote verification's feasibility and utility as a promising concept for potential use by IAEA. It stated that ACDA's external research program serves to explore innovative concepts, and that some of these concepts did not come into routine use by IAEA until years after ACDA completed the initial research and development phase.

ACDA stated that it could not accept our recommendation that it ask IAEA to specify criteria for accepting RECOVER partly because of Section 31 of the Arms Control and Disarmament Act of 1961. 1/ Under Section 31, ACDA said, "there is not, nor can there be," a requirement to obtain from an international organization definitive criteria for its acceptance of a research product as a precondition for conducting such research. Moreover, according to ACDA, IAEA cannot and should not commit itself *a priori* to using specific safeguards equipment developed by a particular member nation.

In regards to our next recommendation, ACDA stated that it did not believe that an assessment was called for, in light of the above comments and on-going executive branch discussions. ACDA preferred to depend on the normal review appropriate to RECOVER's

---

1/Section 31 authorizes ACDA to conduct external research for international safeguards and other purposes.

stage of development. It noted that ACDA staff had proposed expenditure of $75,000 in fiscal year 1983 for further development and study of RECOVER.

ACDA further commented that in view of Section 31 and practices established by executive branch agencies, IAEA, and IAEA member states for conducting international safeguards research, our recommendation that the Director of ACDA, upon completion of a program assessment, request IAEA's decision on eventual acceptance of RECOVER for routine safeguards use was not appropriate.

The Department of State agreed with us that the next step in the RECOVER development program should be to focus on the role RECOVER would play in an improved IAEA safeguards regime. However, the Department noted that it did not agree with some of our recommendations. It stated that our recommendation concerning IAEA's provision of criteria "appears to be premature," although the Department also believed that IAEA should now seek to define how a remote verification capability would be used and the features a system should have. The Department commented that our recommendation tying further development to an IAEA decision regarding acceptance of RECOVER would require IAEA to commit itself to buying a "partially developed and unproven system," and would thus run counter to IAEA's "prudent" policy on procurement. The Department did not object to the assessment we recommended but believed that development should proceed following the assessment's completion.

DOE commented that our report was correct in recommending that substantial questions of system acceptability be addressed prior to a further major effort along lines pursued in the past. In general, DOE added, serious and detailed consideration should be given to whether or not technical assistance, once completed, would be used as intended. However, DOE noted that IAEA may not be able at this time to provide necessary and sufficient criteria for placing RECOVER in routine operational use. According to DOE, an IAEA response to requests for such criteria would have to reflect a high level of confidence in the success of the system, which may not yet have been adequately defined and demonstrated.

NRC commented that it shared the view expressed in our report that the direction and scope of the RECOVER program needed to be assessed. The assessment, according to NRC, should include a careful consideration of how RECOVER could be integrated into IAEA's safeguards approaches.

We do not believe our recommendations are "premature" or "inappropriate" in the context of RECOVER's stage of development. We agree with ACDA and the Department of State that IAEA should not now commit itself irrevocably to purchasing and using the unproven RECOVER system as it now stands. However, our recommendations were not intended to achieve such an objective. Instead, our purpose is to obtain from IAEA, RECOVER's intended customer, as definitive

an expression of its intentions regarding RECOVER as is now possible. We do not consider this to be an unreasonable objective, given that RECOVER has been under development for the past six years and that IAEA has had "hands-on" experience with the prototype system since December 1979. However, in light of the above comments, we have clarified the language of our recommendations to make our original purpose as clear as possible.

In regards to our recommendation that ACDA request IAEA to provide its criteria for accepting RECOVER, we would expect that the criteria should address the same issues identified by the Department of State in its comments: "IAEA should seek at this time to define more specifically how such a remote verification capability would be used and therefore what features the system should have." IAEA's criteria could also include requirements regarding future RECOVER testing in order to insure that IAEA did not eventually find itself burdened with an unreliable or unproven system.

The provision of such criteria would therefore not constitute "a priori" acceptance of RECOVER, in our opinion. Further, obtaining IAEA's criteria would give the executive branch a greater degree of assurance that IAEA will eventually accept the system being developed for it by ACDA, if certain criteria can be met.

Finally, Section 31 of the Arms Control and Disarmament Act of 1961 does not contain any language that would either require or prohibit ACDA from obtaining IAEA's criteria for accepting the product of ACDA research. Section 31 was also not relevant to our other recommendations.

We believe that our recommendation that the Director of ACDA assess the RECOVER program is justified in light of RECOVER's current status. In considering ACDA's comments, we noted that the other agencies involved indicated agreement with our recommendation. Moreover, the "normal review appropriate at this stage of development," referred to by ACDA, would not necessarily address all of the key elements cited in our recommendation. Thus, it would fail to assess the scope and direction of the program in a comprehensive manner.

Our recommendation that ACDA request a decision from IAEA concerning eventual acceptance of a RECOVER system that would fulfill IAEA criteria is the logical extension of the preceding recommendations. Although ACDA's comments emphasize the long-term research aspect of the RECOVER program, eventual IAEA acceptance and implementation has long been an ACDA goal for the RECOVER project. Moreover, the request for a decision would follow the comprehensive assessment of RECOVER, which should seek to resolve unanswered questions about the system and take into account available results of ongoing field tests. IAEA's decision could also be contingent on RECOVER's eventual capability to fulfill criteria defined by IAEA itself. We therefore disagree that our recommendation would force IAEA to use an unproven system.

We are in no way contending that ACDA cannot conduct research. We do believe, however, that as such research progresses, an end purpose should evolve.

IAEA is the intended end-user for RECOVER as the system has been conceived and developed to date. If after analyzing the assessment results, IAEA cannot commit in principle to eventually accepting a RECOVER system which would meet its own specified criteria, there would seem to be no purpose in continuing development of RECOVER for IAEA at that time. Consequently, we believe our recommendation to terminate the project is appropriate.

CHAPTER 3

MANAGEMENT PROBLEMS RAISE QUESTIONS ABOUT ACDA'S FUTURE ROLE IN RECOVER'S DEVELOPMENT

ACDA has had difficulties in managing RECOVER's development. The program has fallen behind schedule after the development and installation of a small prototype system. Milestones for IAEA's implementation of RECOVER and for completion of a key RECOVER component, intended to link RECOVER with actual IAEA sensors, have been missed.

ACDA officials, recognizing that the project is having difficulty making the transition from research and development to implementation, acknowledge that delays are partly due to ACDA's not having the technical staff resources of organizations that usually develop such equipment.

Although there is general agreement that no insurmountable technical barriers block RECOVER's use, additional technical development is necessary before RECOVER could be used routinely by IAEA. The small RECOVER prototype, built for demonstration purposes, would be "useless" to IAEA as part of routine safeguards practices, according to an ACDA official.

However, ACDA's past problems in developing RECOVER--with little involvement of other U.S. agencies--suggest that the additional technical development tasks could strain ACDA's capabilities. ACDA officials believe that the project should be transferred to another agency but other agencies do not now appear likely to assume control of RECOVER's development in the near future.

Uncertainties also persist regarding the likely cost of actually implementing an operational RECOVER system. System cost estimates vary because the eventual size of such a system is unknown and because existing cost estimates for components are incomplete and out-of-date. Executive branch officials believe that a special extra-budgetary fund--financed by the United States and other IAEA members--may be required to pay for RECOVER's implementation.

RECOVER IS BEHIND SCHEDULE

RECOVER appears to be at least two to three years late in achieving goals set by ACDA for the system's initial implementation as a routine safeguards tool. The degree to which the project has fallen behind schedule is difficult to determine because a formal, long-range schedule for RECOVER's implementation has never been set.

In 1979 ACDA stated that it planned to turn the prototype RECOVER system over to IAEA by the end of 1980. However, as of early 1983, IAEA had yet to take over the existing RECOVER research and development program or the prototype system itself.

In 1980 a key ACDA official predicted that RECOVER would begin implementation as an actual safeguards tool by 1982, and that the United States would no longer be involved with the project by 1983. However, in 1982 he conceded that those milestones could not be met and that he could not foresee when the United States would no longer be involved with RECOVER. Recent estimates indicate that RECOVER could be initially incorporated into routine safeguards use no sooner than 1984, and a network linking 100 of the more than 840 facilities safeguarded by IAEA may not be operational before 1987. 1/

The ACDA official attributed the program's failure to meet the 1982 implementation goal to

--ACDA's difficulties in managing the development of a major safeguards system,

--unanticipated delays in the development of C/S sensors and interfaces compatible with RECOVER and IAEA's needs,

--personnel changes in the program's management staff, 2/ and

--ACDA's initial over-optimism.

A U.S. national laboratory safeguards expert familiar with RECOVER informed us that ACDA had "grossly underestimated" the time needed to develop RECOVER, resulting in unrealistic and over-optimistic expectations as to when it would be implemented.

ACDA LACKS IN-HOUSE CAPABILITY TO DEVELOP RECOVER

ACDA--a small foreign policy agency--has had to depend heavily on private contractors during the RECOVER project because it lacks both the capability to develop equipment prototypes and the large staff to perform and integrate the many tasks involved in a project as large as RECOVER. ACDA has done safeguards research before but

---

1/As of December 1981 ACDA was still hopeful that IAEA would initiate operational use of the existing RECOVER system for its secondary function--the transmittal of IAEA inspector reports--by December 1982. By September 1982 ACDA program officials no longer believed that goal would be achieved.

2/RECOVER has had four project officers since 1978.

RECOVER, according to one ACDA official, was the largest such project it had undertaken. ACDA officials believe ACDA's limitations have contributed to the program's delays.

Camera interfaces have been delayed and redesigned at U.S. expense

We found that ACDA's limitations contributed to one of the most serious problems RECOVER has encountered to date--a significant delay in the development of an interface to link RECOVER with IAEA's camera surveillance system. Lack of the interfaces has delayed tests of RECOVER with actual IAEA sensors--a prerequisite for IAEA acceptance--and led to IAEA criticism of ACDA.

In early 1979, ACDA awarded an $80,000 sole source contract to its primary contractor for the design and development of interfaces to IAEA's camera system. After accepting the initial design and interface, ACDA directed the firm to produce duplicate interfaces for use during the November 1980 international demonstration. The interfaces, however, failed during the demonstration and cost the RECOVER program prestige, money, and time.

ACDA's limited resources in staff size and expertise apparently precluded adequate testing and detection of interface design flaws before the international test. Consequently, ACDA accepted a faulty design and equipment. ACDA officials said ACDA did not discover the technical flaw in the initial interface design it accepted from the firm in 1979 because the RECOVER project officer would not have had time, given the officer's many other RECOVER duties, to closely inspect the interface design. ACDA acknowledged that an organization with a large team of technical staff could have discovered such a flaw.

Because the firm had proceeded with development of the interfaces only after ACDA accepted the initial design, the firm's officials believed the company had met its contractual obligations. It therefore specified that the redesign would cost almost $25,000.

ACDA officials, notwithstanding a reluctance "to pay twice" for the interfaces, felt constrained to accede to the firm's terms for fear of losing the contractor's participation. ACDA believed that no other contractor could perform the interface design effort until after the RECOVER system design had been sufficiently documented by the firm to permit its use by another contractor.

Despite ACDA's difficulties with the interfaces in November 1980, the March 1981 contract for their redesign excused the firm from environmental testing in order to hasten development

and allow for interface delivery in time for the June 1982 RECOVER experts meeting.1/

ACDA and contractor officials told us that reliability testing was limited because of insufficient funds. The firm's officials informed us that normally a rigorous series of environmental tests would be conducted during development.

Coordination problems

ACDA did not act effectively to facilitate IAEA-contractor coordination of information and equipment during certain phases of interface development:

--ACDA, although contractually obligated, did not furnish requested IAEA camera specifications to the firm before initial interface fabrication because ACDA said that IAEA considered such information proprietary. As a result, the firm did not detect operational differences in the cameras which produced irregularities in camera performance and led to interface mistakes.

--ACDA, despite a series of complaints from the firm in 1981-82 concerning a failure to receive camera units from IAEA, did not facilitate the equipment's delivery. The firm subsequently suspended interface work temporarily in December 1981 pending receipt of new camera components.

Due in part to these problems, the delivery date of the first completed and tested replacement interfaces slipped by several months.

According to ACDA, in December 1982 the firm completed U.S. tests of the latest version of the interface design, involving actual IAEA sensors and RECOVER multiplexers. These tests occurred almost three years after a workable interface was originally to have been ready.

MORE TECHNICAL WORK NEEDS TO BE DONE

Although the RECOVER prototype has demonstrated to IAEA the feasibility of transmitting encrypted data via the international

---

1/A lack of adequate testing may also have been involved in difficulties with some of the on-site multiplexers ACDA purchased. In 1982 IAEA's U.S.-supplied RECOVER expert complained that faulty on-site multiplexers were being sent to Vienna from the firm via ACDA. The problems with the on-site multiplexers were not discovered until they were installed in the United Kingdom and West Germany--where they, too, failed to operate.

telephone system, RECOVER experts have identified several aspects of the system which need more technical work.

Development of compatible sensors has lagged

One of the major causes of the delay in RECOVER's implementation has been the unavailability of IAEA-accepted seals that can be used with RECOVER. IAEA's existing metal seals cannot be monitored by RECOVER. Although the RECOVER-usable fiber optic seal's 1/ completion has been "just around the corner" for years, the U.S. Government and private firms have yet to develop a good working model, according to one ACDA official.

A recent planning document indicates that ACDA has recognized that the lack of sensor interfaces currently precludes RECOVER's possible implementation. It places a priority on completing the testing and transfer of the camera interfaces and fiber optic seals to IAEA. U.S. fiber optic seals and similar West German seals (which failed in initial IAEA tests) are expected to be available for testing by 1983.

However, IAEA officials believe that remotely monitored fiber optic seals were "useless" without accompanying remotely monitored intrusion detectors. These devices--similar to motion- or sound-detecting burglar alarms--are not currently being developed for use with RECOVER, although ACDA has plans to do so in the future.

Other possible sensors for use with RECOVER

Among the systems which might be interfaced to RECOVER in the future are

--The surveillance television and recording system being developed by Sandia National Laboratories for IAEA. It is considered unique among other video camera systems in that it uses motion detectors and redundant recorders. ACDA awarded Sandia a contract in September 1982 for $190,000 to develop an interface for RECOVER. It will take Sandia approximately one staff year to identify and implement the modifications.

--Nuclear fuel bundle counters and closed circuit telesion for CANDU reactors being developed by Canada.

1/A fiber optic seal uses a loop of light-conducting filaments and an electronically-controlled and coded pulse of light to verify that the seal has not been broken.

--Portal monitors under research and development in Japan for use in fast critical assemblies. However, as yet, IAEA has not accepted the portal monitor for routine safeguards use.

--The integrated monitoring system, built by Sandia. ACDA officials are considering it for interfacing.

RVU upgrade will be needed

Both ACDA and IAEA agree that the RVU will have to be substantially upgraded to handle more facilities before it will be ready for implementation. The present RECOVER demonstration system can only accommodate about 30 to 40 multiplexers and monitoring units. Were the present system to be given to IAEA without any additional modification, according to an ACDA official, it would be useless as an operational system. The upgrade would add a mini-computer to the RVU and update the system's software.

Communications functions need improvement

RECOVER experts believe changes are needed to optimize RECOVER's communications functions, in part because of low line utilization and successful call rates. Technical changes under consideration include

--changing RECOVER's encryption system, "cumbersome" communications protocol, and modem (the device connecting computers via telephone) in order to increase RECOVER's line utilization rate. IAEA officials generally agreed that, although such matters were not urgent enough to require decisions during 1983, they must be reviewed before RECOVER could be implemented for routine safeguards use;

--redesigning the on-site multiplexer by adding memory and software changes. These modifications would ensure that the multiplexer would disconnect the telephone properly and would accommodate new data terminal equipment for inspector reports transmission (should this function be agreed upon). Although the firm prepared new multiplexers to fix a disconnection problem, they did not operate properly when tested at two facilities in May 1982;

--upgrading monitor units to accept actual sensor data (as opposed to simple status data), which would involve hardware as well as software changes. Most probably, the monitor unit also would need to be changed to allow two-way communication.

The first of the above changes is required to help alleviate some significant problems with RECOVER's communications. Some

scientists consider RECOVER's low efficiency in using its time on-line to be a major weakness. One RECOVER communications expert noted that, of data transmitted in a RECOVER session, only about 10 to 20 percent contains any real data on the status of C/S devices. This low efficiency yields not only exorbitant telephone costs per call, but also limits the number of facilities which can be included. Moreover, RECOVER was designed to transmit data at a low rate (a minimum under international standards), because different national telephone systems vary in ability to handle higher transmission rates 1/ and because fewer errors are made at lower transmission rates than at higher ones. Tests indicate that RECOVER could selectively quadruple its data transmission rate, however.

The importance of such issues is underscored by the results of a six-month reliability test of RECOVER which revealed a low rate of successful calls. For 8 participating facilities, the percentage of "good calls" ranged from 4 to 83 percent, with an average of 13.5 percent; 2 additional facilities had no successful call completions. A RECOVER expert maintained that these figures were overly pessimistic and misleading because they included attempts made by the RVU that had been thwarted by problems in the international telephone system--such as busy trunk lines--rather than by flaws in RECOVER. Once the RVU reaches the on-site multiplexer, the success rate for completed interrogations was much higher. If the RVU fails to connect with the multiplexer after three successive failures, the RVU moves on, returning later. If it cannot get through to the facility within a designated timeliness goal, an alarm is raised in Vienna.

Theoretically, however, according to the expert, a large RECOVER network plagued with bad connections and failed attempts could get backed up. A network of about 100 facilities would need a bigger and better RVU.

Despite difficulties, RECOVER's use of the international telephone network as its medium of data transmission is considered by project officials to be the best and most cost-effective way to transmit RECOVER data.

Portable verification unit is too heavy and fragile

Redesigning the portable verification unit is necessary to reduce its size and weight and to make it less fragile and more

---

1/Of RECOVER participant countries, one could barely handle the low level, while another could utilize much higher levels. Thus, this rate was inefficient for the second country's telephone network but almost too efficient for the first's.

reliable. The unit's display is subject to breakage. Also, a shock, an electrical transient, or a storm can cause the unit to lose memory; similarly, an inspector's failure to plug in the portable verification unit within a 24-hour period can cause the unit to lose its communication code inserted from the RVU in Vienna, thus preventing the unit from being used during the inspection tour. A more rugged unit is being developed to address such problems.

OTHER AGENCIES HAVE HAD A SMALL ROLE IN RECOVER

ACDA officials recognized ACDA's limitations as early as 1980, following initial deployment of the prototype system. Despite ACDA's subsequent efforts to broaden RECOVER's base in the executive branch, other U.S. agencies have not become heavily involved in RECOVER.

The Department of Energy did not agree to a 1980 ACDA request that at least some portions of the RECOVER program be shifted to DOE's Office of Safeguards and Security. After receiving a relatively neutral IAEA assessment of RECOVER's status, DOE concluded that IAEA was not ready to commit itself to RECOVER's routine use and that DOE funding for RECOVER as a research and development project would be inappropriate. DOE funding has been limited to $100,000 in 1981 and 1982 for Brookhaven's assessment of RECOVER cost-effectiveness. Until recently, other U.S. national laboratories have had little involvement with RECOVER.

Beginning in fiscal year 1981, the interagency U.S. Program of Technical Assistance to Safeguards 1/ (POTAS)--established to help meet IAEA's urgent safeguards equipment needs--has provided $263,000 for 1981 and 1982 to support IAEA's evaluation of RECOVER and to provide a cost-free RECOVER expert. Another $60,000 will be made available by POTAS in 1983. 2/ In 1981, however, POTAS management challenged the need for a cost-free expert in Vienna during 1982 because it believed remaining RECOVER testing could be done in the United States, and it recommended that the prototype system be "mothballed." A compromise was arrived at by redefining the expert's role to include other tasks not directly related to RECOVER.

1/POTAS is funded by the Department of State and managed by DOE with oversight by an interagency committee. The committee includes representatives of ACDA, DOE, NRC, and the Department of State.

2/Because ACDA does not believe that it can, by law, provide money directly to IAEA, POTAS officials have also administered $260,000 in ACDA funds for the support of the research agreement. The $260,000 has been made available to IAEA via POTAS through a series of reimbursable agreements between ACDA and POTAS since 1979.

Nuclear Regulatory Commission (NRC) involvement has been very limited because RECOVER has been an ACDA initiative, rather than the result of an IAEA request. In 1982 NRC officials decided to support RECOVER's integration into IAEA safeguards, but they have committed no funds to date. The Department of State has been supportive of ACDA and RECOVER, according to State officials, but--aside from its contribution via POTAS--the Department has not directly funded any aspects of the program.

Despite ACDA's belief that RECOVER is a worthwhile project that should be transferred to another agency, it currently appears unlikely that another U.S. sponsor for the project will be readily available in the near future. DOE officials informed us that DOE's position remains unchanged: DOE is awaiting IAEA's decision on using RECOVER operationally before providing any funds directly to RECOVER. As for POTAS, its use as the primary vehicle for funding RECOVER could be questionable, given that ACDA and other U.S. officials generally believe that RECOVER is not urgently needed. POTAS was established to meet IAEA's urgent needs and U.S. officials associated with POTAS have informed IAEA that the United States wishes to place more emphasis on the Agency's crucial near-term needs and less on longer-term solutions for generic problems.

THE UNITED STATES IS PAYING FOR RECOVER'S DEVELOPMENT

The United States has funded RECOVER's development to date. Uncertainties exist over who will fund RECOVER's implementation and how much it will cost. The United States may help pay for putting RECOVER into IAEA's routine safeguards use.

ACDA has allocated $4.1 million

ACDA funding for RECOVER between 1976 and 1982 has amounted to about $4.1 million. Almost $3.4 million has been devoted to developing the RECOVER system itself. Another $260,000 has been made available to support the ACDA-IAEA research agreement, and almost $465,000 has been provided to interface RECOVER to a variety of C/S devices--including the Sandia television system.

ACDA FUNDING OF RECOVER

Year	System development	Support of ACDA-IAEA agreement	Sensor development	Totals
1976	$ 216,253	$ -	$ -	$ 216,253
1977	52,674	-	48,474	101,148
1978	1,031,846	-	47,788	1,079,634
1979	491,570	95,000	90,086	676,656
1980	763,115	75,000	-	838,115
1981	784,660	90,000	72,359	947,019
1982	55,783	-	205,945 1/	261,728
Totals	$3,395,901	$ 260,000	$ 464,652	$4,120,553 2/

1/Includes $190,000 for interfacing RECOVER to the Sandia television and recording system.

2/Does not include cost of the 1982 RECOVER demonstration at the United Nations, estimated to be about $30,000.

ACDA's funding for RECOVER's development has included the expenditure of about $230,000 for various promotional activities, including a film on RECOVER and extensive demonstrations at the 1980 Treaty on the Non-Proliferation of Nuclear Weapons Review Conference in Geneva, and the 1982 United Nations Special Session on Disarmament in New York.

ACDA officials informed us that about $75,000 in 1983 funds will be allocated for RECOVER.

IAEA support is limited

The IAEA-ACDA research agreement in effect exempts IAEA from bearing any cost for RECOVER research, development, and evaluation. According to IAEA officials, IAEA's contribution to RECOVER has been limited to

--providing, on a part-time basis, the services of certain IAEA research and development officials,

--supplying space for the prototype RVU, and

--hosting several meetings of the international RECOVER evaluation group.

IAEA's projected budgets for future years do not contain funds for RECOVER, and under IAEA's budgeting practices, could not until 1985. IAEA officials told us that they expect U.S. support for RECOVER's development, testing, and evaluation to continue. The

Director General of IAEA informed us that "stronger U.S. support than has been available during the last 15 months would be required to advance RECOVER to an implementation phase."

The support of other participating nations has been encouraged, according to ACDA. ACDA was unable to provide us with any figures concerning amounts that may have been provided but a RECOVER project official confirmed that "U.S. funding has far exceeded all others."

According to IAEA's Director General, IAEA would probably expect installation of an operational RECOVER safeguards system at its headquarters and abroad to take place with member states' assistance and funding. IAEA informed us that initial commissioning and training would need active U.S. assistance. Other IAEA officials would not rule out the possibility that IAEA would turn to the United States for financial aid in deploying RECOVER. Executive branch officials believe that RECOVER's implementation may require the establishment of a special extra-budgetary fund, financed by the United States and other member nations. 1/

IAEA believes that the annual cost of operating a RECOVER system, once installed, would have to be funded from IAEA's safeguards budget. The United States has provided about one quarter of the safeguards budget in recent years.

Cost estimates vary

There are no reliable estimates of a RECOVER system's likely implementation costs, and U.S. and IAEA officials were generally unwilling to speculate. A 1982 attempt by ACDA to project equipment costs for RECOVER's potential implementation during 1984-1987 produced widely varying estimates. Total implementation costs for the 4-year period ranged from a low estimate of about $320,000 to a high of over $4 million. The uncertainty was due to the lack of any real knowledge concerning (1) the type of facilities at which RECOVER would be used and (2) the number of each type that would employ RECOVER. An ACDA official subsequently said that these estimates were not reliable. A Department of State official estimated that the costs of deploying RECOVER could be as high as $10 million.

The costs of the various RECOVER components themselves have not been precisely estimated. In July 1980 the contractor produced

---

1/In commenting on our draft report, the Department of State noted that the potential need for extra-budgetary funding is not unique to RECOVER, but rather may be a mechanism chosen by IAEA to finance an intensive safeguards equipment procurement program in the near future, should that prove necessary.

a set of component cost estimates that did not allow for anticipated profits by component manufacturers and did not include the cost of the RVU itself. Moreover, the estimates are expressed in 1980 dollars and must now be corrected for inflation. To compensate, Brookhaven officials in 1981 added 20 percent to the contractor's figures, used the contractor's cost projections for annual maintenance costs, and calculated costs for spares.

The Brookhaven analysts estimated that a RECOVER network intended to monitor 200 light water reactor spent fuel ponds would involve, per facility, capital costs of over $18,000 and annual operating costs of $1,240. A fast critical facility would require about $45,000 in capital costs (including spare parts but excluding RVU costs) and $6,000 to $7,000 in annual operating costs.

However, the Brookhaven estimates also are not definitive because Brookhaven, for example, did not

--always assume a global system;

--account for post-1981 inflation; and

--include RVU upgrade costs of a minicomputer, estimated at twice the $40,000 RVU cost in Brookhaven calculations.

CONCLUSIONS

ACDA did not anticipate that it would retain control over RECOVER for as long as it has. Although its lack of a large in-house team of technical specialists has led to problems, ACDA has been unable to secure significantly wider participation by other, more technically capable organizations. The problems encountered in developing the camera interfaces and in meeting overall program milestones indicate that ACDA may have found its resources taxed to the limit by the RECOVER program. Program delays may have harmed ACDA's efforts to secure new sponsors for RECOVER.

Despite its difficulties, ACDA has succeeded in developing and deploying a central prototype system, with little help from other U.S. agencies, and in attracting IAEA and foreign interest in what may yet prove to be a useful safeguards tool. However, ACDA's past management problems with RECOVER are significant because more technical work is necessary before the system could be ready for implementation. Research and development continues on making some sensors usable with RECOVER, but failure to complete development of interfaces for the camera and of the fiber optic seal could continue to delay availability of RECOVER-monitorable sensors. Moreover, redesign of some components seems necessary to allow for system growth.

To date, ACDA has provided most of the funds for RECOVER's development and it is unclear when its support of the project will no longer be needed. IAEA financial support, although in accord with the IAEA-ACDA research agreement, appears to have been nominal. Despite the possibility that a special multinational fund may be required to pay for RECOVER and other safeguards systems, there are no up-to-date estimates of how much the various RECOVER components would cost.

RECOMMENDATIONS

We recommend that, concurrent with the actions recommended in Chapter 2, the Director, ACDA, request assistance from the Departments of State and Energy, and the Nuclear Regulatory Commission in order to determine (1) RECOVER's priority among all U.S. safeguards equipment development efforts and (2) the appropriate division of responsibilities among U.S. Government agencies for expeditiously completing RECOVER tests and studies.

We also recommend that the Director develop more reliable and up-to-date cost estimates for RECOVER components and use these estimates to make cost projections for an operational RECOVER system. The previously recommended assessment of RECOVER should help develop such estimates and projections.

AGENCY COMMENTS AND OUR ANALYSIS

In commenting on the draft of this report, ACDA, DOE, the State Department, and NRC agreed with us that the RECOVER system is not yet ready for operational use by IAEA. ACDA agreed with our recommendation that up-to-date cost estimates are needed.

In regards to our recommendation that the Director of ACDA confer with the heads of other executive branch agencies and NRC, ACDA commented that representatives of the Department of State, DOE, and NRC have met, and will continue to meet, in various forums to discuss U.S. efforts on remote verification and secure transmission of inspector data. ACDA stated that there is agreement that, although RECOVER is a long-term effort, further work on interfaces, detailed utility studies, and facility tests should continue "at an appropriate level." According to ACDA, arrangements are being worked out among ACDA, the Department of State, DOE, and DOE contractors on an integrated approach for continuing these efforts.

NRC commented that RECOVER's direction and scope needed to be be assessed and that NRC would be prepared to cooperate in the recommended interagency review.

DOE and the Department of State did not comment on the above recommendations.

We recognize that representatives of the executive branch and NRC have met in working-level groups to discuss RECOVER and other safeguards projects. However, these meetings, and other efforts cited by ACDA, have not addressed the thrust of our recommendations. Although there is a general agreement that RECOVER is not urgently needed, the meetings have failed to assign a priority to RECOVER among all U.S. safeguards efforts. Moreover, ACDA's efforts, as described above, have not secured a consensus within the executive branch regarding an appropriate division of responsibilities for completing the project. Therefore, we believe our recommendation is justified, given (1) the importance ACDA officials have placed on transferring RECOVER to another agency, (2) the many U.S. safeguards projects competing for support, and (3) the willingness of NRC to participate in an interagency review and the lack of any expressed objection by DOE and the Department of State.

SOURCES OF INFORMATION

We used the following sources of information to address the objectives of this review.

U.S. agencies

We reviewed records and interviewed officials at the Arms Control and Disarmament Agency; the Departments of State and Energy; the Nuclear Regulatory Commission; and the U.S. Mission to the International Atomic Energy Agency in Vienna.

National laboratories

U.S. national laboratories are Government-owned, contractor-operated facilities, which conduct extensive research and development. To gain insight into the relationship of RECOVER to other safeguards development projects, we visited the Brookhaven National Laboratory's International Safeguards Project Office and Technical Support Organization. In addition, we contacted officials at the Los Alamos, Sandia, and Batelle national laboratories.

Foreign governments

We attended the 1982 IAEA conference of U.S. and foreign RECOVER experts and met with RECOVER program participants from the governments of Australia, Bulgaria, Canada, West Germany, Japan, and the United Kingdom. The purpose of these meetings was to discuss the participants' experiences with the RECOVER project and their assessment of its progress and problems.

International organization

We visited the headquarters of the International Atomic Energy Agency in Vienna, and met with IAEA officials to determine their opinions on RECOVER's utility and acceptability for international safeguards use.

Private industry

We met with representatives of RECOVER's primary contractor to discuss their involvement in the design and development of RECOVER's concept and components. Also, we met with a former RECOVER project officer to discuss RECOVER's origins and history and to determine the nature of other projects based on RECOVER technology.

Reports

We also reviewed a number of other published reports, including the following:

--Annual Presidential Reports on Nuclear Non-Proliferation;

--Brookhaven National Laboratory report on RECOVER's cost-effectiveness;

--various IAEA reports; and

--our previous reports on related issues.

PROPOSED ALTERNATIVE USES FOR RECOVER

TRANSEAVER

As sea transport of nuclear materials has grown in recent years, there have been suggestions that the physical security of sea shipments can be improved. NRC determined one way to improve the security of these shipments would be to provide a remote shipment status monitoring capability similar to that which would be provided for fixed sites by the RECOVER system. NRC and ACDA have joined resources on investigating the feasibility of a concept called TRANsport-by-SEA-VERification (TRANSEAVER).

The TRANSEAVER concept combines RECOVER-type components with MARISAT (MARItime SATellite) equipment, penetration resistant shipping containers, and remotely monitorable sensors to provide continual monitoring of the locations and the integrity of nuclear material containers in seaborne shipment. Deviation from planned course or attempted tampering of the cargo would produce an alert upon demand at a central command console.

TRANSEAVER would use C/S devices and components common to RECOVER and criteria, i.e., reliability, security, etc., similar to those applied to RECOVER.

TRANSEAVER, developed through a $70,000 sole source contract with a private firm, is a bilateral project of the United States and Japan. There is no IAEA involvement, however, and none expected in the foreseeable future because IAEA does not deal with physical security.

Chemical weapons

In 1981 ACDA proposed that the United Nations Committee on Disarmament consider the potential for using RECOVER to remotely monitor instruments verifying compliance with a future treaty banning chemical weapons production. As a result of U.S. efforts to bring the concept to the attention of other countries, a working paper was produced during the March 1982 meeting of the Committee. The paper proposes conducting an international technical study to identify chemical weapons verification problems analogous to those faced by IAEA and amenable to a RECOVER-style system. One possibility would be monitoring of inactive chemical weapons production plants to verify that no activity is occurring. A RECOVER system could help cover the gap between inspector visits. The technical study would include a demonstration of the concept.

ACDA officials speculated that a chemical weapons-RECOVER would be only one part of an overall network of overlapping and complementary verification methods.

The general reaction to the proposal has been cautious interest, according to ACDA officials. They also stressed that the precise nature of a chemical weapons-RECOVER is still hypothetical and undefined at this time.

Cautioning that RECOVER should not be considered a panacea, one ACDA official emphasized that the system is a particular type of remote monitoring system, tailored for IAEA, that appears to have some applicability for certain chemical weapon uses. He is uncertain whether other suggested applications have any validity because monitoring systems generally are structured to meet particular needs.

Comprehensive Test Ban Treaty

It is not clear, according to ACDA, what RECOVER's application could be in verifying compliance with a Comprehensive Test Ban Treaty. The current RECOVER design, however, could not monitor seismic stations used to detect unlawful nuclear detonation, according to an ACDA official.

Domestic safeguards

To date, there has been consideration of using RECOVER in some countries' domestic safeguards systems. Principal interest has been shown by the United States and Japan. The U.S. Government has concluded, however, that RECOVER would have limited use for the U.S. domestic safeguards system. Japan, on the other hand, is pursuing examination of possible RECOVER applications for that country's safeguards program.

Little use for U.S. domestic safeguards

In February 1982 NRC completed a review on the applicability of RECOVER to NRC's program for U.S. domestic safeguards of nuclear facilities. The review found that while such a remote monitoring capability as RECOVER may be useful for international safeguards, where the objective is limited to detection of diversion, it is of quite limited utility for domestic safeguards at facilities possessing formula quantities of special nuclear material, where the objective is preventing theft. Prevention of theft requires a capability for rapid assessment of and response to unauthorized activities and an on-site security organization capable of continuous status monitoring, assessment, and responses. The only benefit to be gained by NRC from such a system would be a marginal increase in assurance that all such events were reported.

The review also noted that the utility of RECOVER is further reduced by limitations in its ability to monitor large bulk processing plants handling or capable of producing types of special nuclear material that are directly usable in a nuclear explosive.

Furthermore, U.S. domestic licensees are responsible for notifying the Commission about safeguards events.

Japanese interest in RECOVER for domestic use

Japanese safeguards specialists in early 1982 completed a study of the use of RECOVER in their domestic safeguards program. According to the State Department, this possibility has elicited significant interest by Japanese government officials.

UNITED STATES ARMS CONTROL AND DISARMAMENT AGENCY

November 26, 1982

Mr. Frank C. Conahan
Director, International Division
General Accounting Office
Washington, D.C. 20548

Dear Mr. Conahan:

This is in response to your letter, dated October 28, 1982, to Mr. Rostow requesting comments on the draft GAO report entitled "The RECOVER System Is Not Ready For Use In Improving International Nuclear Safeguards." The recommendations made in the draft report are addressed in Attachment A whereas comments and corrections of a technical nature made directly to Messrs. Toureille and Phillips of your staff in a meeting held in my office on November 24 are summarized in Attachment B.

[See GAO NOTE.]

The remarks below are intended to provide you with additional information on our perspective on the RECOVER effort.

The demands on the IAEA safeguards system are increasing rapidly. In order to meet the challenge of these demands for efficient as well as effective safeguards, the IAEA must take advantage of technological developments as they become available. ACDA's external research program serves to explore innovative concepts of potential use by the IAEA for safeguards. Some of these concepts have not come into routine use by the IAEA until years after ACDA has completed the initial R&D phase. For example, prototype spent fuel bundle counters for heavy water reactors which were developed and tested by ACDA during 1970-75 in cooperation with Canada are expected to come into routine IAEA use in 1983.

GAO NOTE: We have modified the report to reflect the information provided by those commenting on the report. ACDA's technical corrections have not been reproduced here; however, appropriate changes have been made to the report.

ACDA's safeguards research program has been involved in developing and testing new safeguards approaches, analytical techniques, and prototype safeguards equipment for nuclear facilities since 1968. Early work on isotopic correlations, resin bead analysis of chemical samples, and safeguards approaches based on diversion path concepts have resulted in safeguards procedures currently used by IAEA. A number of ACDA-sponsored research provided a foundation for others to build upon, resulting in efforts just now maturing to safeguards implementation. For example, prototype reprocessing plant safeguards instrumentation was developed in 1972, work on TV surveillance was undertaken and long-term research on fiber-optic seals was initiated in 1973, experience was gained in 1978 with motion detection and data encryption capability.

It should be pointed out, in no case were these development efforts predicated on an a priori acceptance by the IAEA of the equipment and/or results for routine safeguards use. Rather, these efforts were conducted in close cooperation with the IAEA using the iterative process fundamental to R&D.

This is the context in which ACDA's efforts on remote verification must be viewed; namely in the context of exploring the feasibility and utility of remote verification as a promising concept for potential use by the IAEA on a inter-facility, multi-facility, country, regional, and/or global basis. And in this context, there is no question that RECOVER has stimulated at the IAEA and in key member states serious consideration and analysis of remote verification for IAEA use. It is indeed significant when the Director General of the IAEA states that "RECOVER would improve safeguards by increasing assurance and credibility through timely warning of equipment malfunction and would be of great assistance to IAEA inspectors". It is no accident that Japan now spends $250,000 to modify the portal monitor at a nuclear facility for RECOVER and allocates around $400,000 in research on remote verification for potential IAEA safeguards use. To a certain extent the RECOVER project must have influenced Germany's efforts in remote verification and Canada's interest in bringing data from various nuclear facilities to a central location.

Finally, while we certainly agree with GAO's conclusion that the RECOVER system is not yet in an operational status for use by the IAEA, it should be pointed out that laboratory (Class I) and prototype (Class II) equipment for testing the feasibility of a concept, such as RECOVER, is by definition not intented for routine IAEA use. With this in mind, a more appropriate title for the report should be found. [See GAO NOTE.]

I hope that the above has served to provide you with ACDA's perspective of the work on RECOVER. Your final report will undoubtedly provide the reader with a useful stock-taking of this effort and bring together the views of interested agencies and individuals. Please be assured of our fullest cooperation and support in this effort.

Sincerely,

Joerg H. Menzel

Joerg H. Menzel
Chief, Nuclear Safeguards
and Technology Division

Attachments: As Stated

GAO NOTE: We have changed the report title.

ATTACHMENT A

ACDA Comments on GAO Draft Recommendations

1. "GAO recommends that before further effort is expended towards RECOVER's development, the Director of the Arms Control and Disarmament Agency obtain from the International Atomic Energy Agency definitive criteria for its acceptance of a operational RECOVER system for routine use."

ACDA derives its mandate to conduct external research for international safeguards from Section 31 of the Arms Control and Disarmament Act of 1961, as amended. This research program has been in existence since 1968. It is specifically designed to provide relevant information on international safeguards to U.S. policy makers, to explore innovative safeguards approaches of potential use by the IAEA, and to support the U.S. effort in strengthening IAEA safeguards. The program is characterized primarily by exploring the feasibility of new concepts and new technology, often with the close cooperation of one or more foreign governments and/or the IAEA.

Under Section 31 of the Act mentioned above there is not, nor can there be, a requirement to obtain from a foreign government or international organization definitive criteria for their acceptance of research results and/or equipment as a condition for conducting such research. Furthermore, the IAEA cannot, nor should it, commit itself a priori to using any specific safeguards equipment developed by a particular member state. Consequently, ACDA could not accept a recommendation as contained in the draft report.

2. "GAO recommends that, prior to expending further substantial efforts in developing RECOVER, the Director should reassess the RECOVER program in light of the problems outlined above and the International Atomic Energy Agency's criteria."

For FY-1983, ACDA staff has proposed the expenditure of $75,000 for RECOVER with emphasis on sensor interface development, more detailed studies on the steps necessary for the integration of remote verification and secure inspection data transmission into standard safeguards practices, and further communications development in regard to East-Bloc countries. Consequently, in light of the comments in item 1 above and the on-going discussions among Executive Branch Agencies on remote verification, we do not believe a reassessment is called for but rather the normal review appropriate at this stage of development.

3. "Upon completion of the reassessment, GAO recommends that the Director present the results to the Director General of the International Atomic Energy Agency and obtain his decision regarding acceptance of RECOVER for routine safeguards use. If the Director General does not indicate acceptance of RECOVER at that time, the Director of the Arms Control and Disarmament Agency should terminate all further development of RECOVER for international nuclear safeguards purposes."

In view of Section 31 of the Arms Control and Disarmament Act of 1961, as amended, and in view of the practices established by the Executive Branch Agencies, the IAEA, and IAEA member states for the conduct of research in support of international safeguards, this draft recommendation is not appropriate.

4. "GAO recommends that, concurrent with the actions recommended above, the Director of the Arms Control and Disarmament Agency confer with the Secretaries of State and Energy, and the Chairman of the Nuclear Regulatory Commission to obtain an executive branch determination of (1) RECOVER's priority among all U.S. safeguards equipment development efforts and (2) the appropriate division of responsibilities among U.S. government agencies for expeditiously completing RECOVER tests and studies."

Representatives of the agencies mentioned above have met, and will continue to meet, in various fora to discuss U.S. efforts on remote verification and secure transmission of inspection data. On the priority of RECOVER there is agreement that, while a long-term effort, further work on sensor interface, more detailed study of utility, and facility tests should continue at an appropriate level. Arrangements are being worked out among ACDA, State, DOE and its contractors on an integrated approach for continuing these efforts.

5. "Until the Director of the Arms Control and Disarmament Agency has obtained favorable International Atomic Energy Agency decision on adopting RECOVER for routine safeguards use, GAO recommends that he halt efforts to upgrade the central verification unit for implementation purposes."

Refer to items 1 and 3 above. Also, there are no current efforts to upgrade the Resident Verification Unit for implementation purposes. [See GAO NOTE on the next page.]

6. "Furthermore, the Director should develop more reliable and up-to-date cost estimates for RECOVER components and should direct that these estimates be used to develop accurate cost projections for the implementation of a RECOVER system."

We agree that up-to-date cost estimates are needed for the potential implementation of remote verification and secure inspection data transmission by the IAEA.

GAO NOTE: During our review we learned of a proposed ACDA plan to upgrade the RVU to handle "several hundred" facilities. Because we believed that the upgrade--which was to have been given top priority in 1983--would have been premature, our draft report recommended that it be postponed until IAEA accepted RECOVER. However, an ACDA official subsequently informed us that the proposal had failed to win further approval within ACDA shortly before ACDA received our draft report. Because ACDA no longer has plans to upgrade the RVU in 1983, we have deleted the draft recommendation from the final report.

Department of Energy
Washington, D.C. 20585

DEC 3 1982

Mr. J. Dexter Peach
Director, Resources, Community
and Economic Development Division
U. S. General Accounting Office
Washington, D. C. 20548

Dear Mr. Peach:

The Department of Energy (DOE) appreciates the opportunity to review and comment on the GAO draft report entitled "The RECOVER System Is not Ready for Use in Improving International Nuclear Safeguards." The draft GAO report correctly characterizes RECOVER as a system initiated by the Arms Control and Disarmament Agency (ACDA) and needing significant additional development before it can be used routinely for IAEA safeguards. The report is correct in recommending that substantial questions of system acceptability be addressed prior to a further major effort along lines pursued in the past. In general, serious and detailed consideration should be given to whether it is likely that technical assistance, carried through to completion, will then be used as intended. In this instance and at this time, the IAEA may not be able to provide necessary and sufficient criteria for placing RECOVER in routine operational use. An IAEA response to requests for such criteria would have to reflect a high level of confidence in the success of the system, which may not yet have been adequately defined and demonstrated, and would have to take into account the wishes of Member States of the IAEA. Such States are under no formal obligation to accept a RECOVER system. Some States would decline, at least initially.

Since the GAO staff prepared its report on the RECOVER system, ACDA has proposed informally to the interagency Technical Support Coordinating Committee that the U.S. Program of Technical Assistance to IAEA Safeguards assume primary responsibility for future work on RECOVER. Considerable interest has been expressed within this committee on the broader subject of remote monitoring of safeguards equipment by inspectors. Promising applications for remote monitoring exist within facilities now subject to continuous inspection by the IAEA and within facilities located near existing IAEA offices in Austria, Canada, and Japan. Possible steps now under consideration include reliability testing of much of the equipment that has been developed under RECOVER as well as the development and testing of other required equipment. If work goes forward successfully on more localized applications of remote monitoring, technical experience and acceptance by Member States may provide a sound basis for future decisions by the IAEA on the need and acceptability of more remote monitoring as envisioned in the RECOVER system.

GAO NOTE **We have modified the report to reflect the information provided by those commenting on the report.**

Comments of an editorial nature have been provided directly to members of the GAO audit staff. [SEE GAO NOTE.] DOE appreciates the opportunity to comment on this draft report and trusts that GAO will consider the comments in preparing the final report.

Sincerely,

Martha O. Hesse
Assistant Secretary
Management and Administration

GAO NOTE: DOE's editorial comments have not been reproduced here. However, appropriate changes have been made to the report.

UNITED STATES
NUCLEAR REGULATORY COMMISSION
WASHINGTON, D. C. 20555

NOV 30 1982

Mr. J. Dexter Peach, Director
Resources, Community and Economic
Development Division
U.S. General Accounting Office
Washington, D.C. 20548

Dear Mr. Peach:

This is in response to your letter of October 28, 1982, requesting comments on the draft report to the Congress entitled "The RECOVER System Is Not Ready For Use In Improving International Safeguards." The proposed report has been reviewed by the Nuclear Regulatory Commission staff.

NRC shares the view, noted in the draft report, that RECOVER is not ready for safeguards use and that the direction and scope of the program need to be reassessed. This reassessment should include a careful consideration of how RECOVER could be integrated into the IAEA safeguards approaches for the various types of facilities.

At the same time, the NRC believes the RECOVER concept merits further consideration as a tool to improve the effectiveness of the IAEA safeguards regime. In this connection, we would be prepared to cooperate in the recommended interagency review of RECOVER's priority among U.S. safeguards development efforts. In addition, the NRC plans to continue its participation in the U.S. interagency Technical Support Coordinating Committee for the U.S. Program of Technical Assistance to IAEA Safeguards (POTAS) which is already considering a number of the problems raised in your report.

With regard to the Brookhaven study, the review was basically limited to the global application of RECOVER and considered only benefits relative to the ability to reestablish inventories. When more localized applications are considered, and the benefits from timely detection are included, we believe that RECOVER could have application to bulk handling facilities to enable timely response to surveillance equipment problems.

During our review of the draft GAO report, we noted in two places (top of page 2 and bottom of page 15) that the statement is made that U.S. officials have rejected use of RECOVER for U.S. domestic safeguards.

GAO NOTE: We have modified the report to reflect the information provided by those commenting on the report.

APPENDIX V

Mr. J. Dexter Peach

It would be more appropriate from an NRC viewpoint, to indicate that an NRC review concluded that the RECOVER concept would have quite limited utility and would not be cost effective for the NRC domestic safeguards program (see pages 38 and 39).

To avoid confusion, the second full sentence on page 39 should be modified slightly to indicate that "U.S. domestic licensees are responsible for notifying NRC about safeguards events."

Sincerely,

William J. Dircks
Executive Director for Operations

DEPARTMENT OF STATE
Comptroller
Washington, D.C. 20520

29 NOV 1982

Dear Frank:

I am replying to your letter of October 28, 1982, which forwarded copies of the draft report: "The Recover System is not Ready for Use in Improving International Nuclear Safeguards."

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

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

Sincerely,

Roger

Roger B. Feldman

Enclosure:
As stated.

Mr. Frank C. Conahan,
Director,
International Division,
U.S. General Accounting Office,
Washington, D.C.

GAO NOTE: We have modified the report to reflect the information provided by those commenting on the report.

APPENDIX VI

GAO Draft Report: "The RECOVER System is Not Ready for Use in Improving International Nuclear Safeguards"

We agree with the GAO that the next step in the RECOVER development program should be to focus on the role RECOVER would play in an improved IAEA safeguards regime. We do not, however, agree with some of the specific recommendations proposed in the draft report. The RECOVER program is a U.S. initiative, rather than an IAEA requested project. The first step was to demonstrate the basic concept of remote verification of safeguards information. The next steps are generally well defined in the GAO draft report, but the recommendation for "definitive criteria for [IAEA] acceptance of an operational RECOVER system for routine use" appears to be premature. Rather, the IAEA should seek at this time to define more specifically how such a remote verification capability would be used and therefore what features the system should have. In addition, it must be noted that the IAEA does not commit itself to using any specific safeguards equipment until that equipment has been completely developed and tested in field conditions. We believe this policy of not buying "a pig in a poke" is a prudent procurement policy. The proposed recommendation that further hardware development of RECOVER be dependent upon a decision by the IAEA "regarding acceptance of RECOVER for routine safeguards use" would require the IAEA to commit itself to buying and using a partially developed and unproven system. We believe that hardware development should proceed upon completion of the reassessment outlined in your second recommendation.

Second, we note that the discussion on page 31 (and to some degree that on page 21) regarding possible extra-budgetary funding for RECOVER procurement is ambiguous and subject to misinterpretation. Since the IAEA's safeguards budget is severely constrained, procurement of the large quantities of new equipment projected to be necessary over the next five years may require some funding outside of the regular budget; however, it is not yet clear that the IAEA will need or seek such funding. Should the IAEA seek such extra-budgetary funding, and should the IAEA also decide to purchase a RECOVER system for routine safeguards use, the funding for RECOVER would be through this extra-budgetary procedure because RECOVER would be a very substantial equipment purchase. We believe that the GAO report should indicate that the potential need for extra-budgetary funding is not unique to RECOVER, but rather may be a mechanism chosen by the IAEA to finance an intensive safeguards equipment procurement program in the near future, should that prove necessary.

Third, the discussion regarding possible extra-budgetary funding of RECOVER procurement, and that the U.S. is paying for the development of this U.S. initiative, are in a chapter entitled "Management Problems also Raise Questions About ACDA's Future Role in RECOVER's Development." We do not see either of these specific subjects as reflecting management problems within ACDA, or elsewhere. RECOVER is entirely a U.S. initiative, and therefore U.S. funding is to be expected. In addition, the IAEA is not in a position to fund significant research and development work of any sort; this is the origin of the U.S. Program of Technical Support to Safeguards (POTAS) and the technical support programs of other countries.

Harry R. Marshall
Assistant Secretary, Acting
Bureau of Oceans and International
Environmental and Scientific Affairs

(465263)

END

DATE
FILMED

2-83

DTIC