

July 19, 1999

MEMORANDUM FOR THE SECRETARY

FROM: Gregory H. Friedman (Signed)
Inspector General

SUBJECT: INFORMATION: Report on "The Office of Defense Programs Robotics and Intelligent Machines Projects"

BACKGROUND

Robotics and Intelligent Machines (RIM) are systems composed of machines, sensors, computers, and software capable of executing various tasks with minimal human intervention. They have wide range application for solving many operational challenges including nuclear waste cleanup and weapons manufacturing and dismantlement. RIM accelerates cleanup and reduces the amount of exposure humans experience from nuclear materials.

Recently, the Department achieved a major milestone in publishing a technology roadmap. The roadmap lays out a pathway and milestones to simultaneously improve operations and accelerate RIM research and development through the year 2020. However, the success of the roadmap is dependent on how well each of the Department's programmatic organizations manages its portion of RIM initiatives. The Offices of Defense Programs and Environmental Management are the organizations most involved with RIM. We estimated that Defense Programs funded about \$14 million and Environmental Management funded about \$24 million of Departmental RIM projects. It is anticipated that funding for these activities will increase substantially in the future. The objective of this audit was to determine whether Defense Programs RIM research and development projects were effectively managed.

RESULTS OF AUDIT

RIM projects may not have been managed in the most effective manner. The Office of Defense Programs did not have accurate information regarding the number of projects funded, the amount of funds expended, or locations where work was being accomplished. Furthermore, Defense Programs had not maintained such data at the Headquarters level or established a reporting system that extracted the data from contractors performing the work. In addition, overall responsibility for RIM activities in Defense Programs had not been assigned. Lack of a reporting system and an integrated management approach could result in unnecessary redundancy of projects and lessen assurance that fund usage was prioritized and resources were used as envisioned. We therefore recommended that Defense Programs establish enhanced management controls including a central point of contact with oversight responsibility for RIM projects.

MANAGEMENT REACTION

Management's comments did not fully satisfy the intent of our recommendations. Defense Programs planned to establish a mechanism to collect reliable and timely information, but did not specify what that mechanism would be nor when it would be implemented. Defense Programs also agreed to adopt an integrated management approach under a single point of contact at Headquarters for all of its RIM activities should they become part of a Departmentwide national initiative. However, the latter action will not be taken until a decision is made that RIM activities are of sufficient importance to be consolidated

will not be taken until a decision is made that RIM activities are of sufficient importance to be consolidated into a formal program with assigned program responsibility. With Departmental operating costs for RIM activities currently exceeding \$66 million per year and expected to increase significantly, the Office of Inspector General believes such a decision would be appropriate at this time.

Attachment

cc: Deputy Secretary
Under Secretary

AUDIT
REPORT

THE
OFFICE OF DEFENSE PROGRAMS
ROBOTICS AND INTELLIGENT
MACHINES PROJECTS



JULY 1999

U.S. DEPARTMENT OF ENERGY
OFFICE OF INSPECTOR GENERAL
OFFICE OF AUDIT SERVICES

The Office of Defense Programs Robotics And Intelligent Machines Projects

TABLE OF CONTENTS

Overview

Introduction And Objective	1
Conclusions And Observations	1

Management Of Robotics And Intelligent Machines Projects

Details Of Finding	3
Recommendations And Comments	7

Appendices

1. Scope And Methodology.....	10
2. Robotic Manufacturing Science And Engineering Laboratory.....	11
3. Summary Of Related Office Of Inspector General Reports	12
4. OIG Estimates Of Departmental RIM Funding	13

Overview

INTRODUCTION AND OBJECTIVE

Robotics and Intelligent Machines (RIM) are systems composed of machines, sensors, computers, and software capable of executing various tasks with minimal human intervention. Such systems have wide range application from the development of smart cars that drive themselves to robotic devices that make surgery safer and quicker. RIM technology can be used by the Department in nuclear waste cleanup and weapons manufacturing and dismantlement. Benefits of RIM application include accelerated cleanup, improved productivity, quality and cost efficiency, and the reduction of human exposure to nuclear materials.

In 1997, the Congress urged the Department and other Federal agencies to work together and establish a robotics and intelligent machines industry in the nation. Congress requested each agency to develop a plan that identified where fundamental research was most needed and the initiatives to accomplish those needs. In response to congressional guidance, the Department developed a technology roadmap, which focused on mission needs and how RIM can improve capabilities both now and into the future.

Within the Department, RIM activities cut across most program offices. However, the Offices of Defense Programs and Environmental Management were the Departmental organizations most involved with RIM. During Fiscal Year 1998, we estimated that Defense Programs expended about \$14 million and Environmental Management about \$24 million for RIM research. It is anticipated that funding for these activities will increase substantially in the future. In addition, the Department has built a \$30 million laboratory at Sandia National Laboratories specifically designed to support RIM activities.

The objective of this audit was to determine whether Defense Programs RIM research and development projects were effectively managed.

CONCLUSIONS AND OBSERVATIONS

Defense Programs RIM activities may not have been managed in the most effective manner. Specifically, Defense Programs did not have accurate information regarding the number of projects funded, the amount of funds expended, or locations where work was being accomplished. Defense Programs had not maintained such data at the Headquarters level or established a reporting system that extracted the data from contractors performing the work. Also, Defense Programs had not designated responsibility for RIM activities to one point of contact. Lack of a reporting system and an integrated management approach could result in

the unnecessary redundancy of projects and lessen Defense Programs assurance that fund usage was prioritized and resources were used to achieve program results envisioned.

Recently, the Department achieved a major milestone in publishing a technology roadmap. It lays out a pathway and milestones to simultaneously improve operations and accelerate RIM research and development through the year 2020. However, the success of the roadmap is dependent on how well each of the Department's programmatic organizations manage their portion of RIM initiatives.

The audit identified issues that management should consider when preparing its yearend assurance memorandum on internal controls.

(Signed)
Office of Inspector General

Management Of Robotics And Intelligent Machines Projects

Inaccurate RIM Project Information

The Office of Defense Programs did not have the information needed to effectively manage its RIM research projects. Responsibilities for RIM activities had been assigned to two primary Defense Programs organizations--the Office of Advance Design and Production Technologies (Office of Technologies) and the Office of Research and Testing (Office of Research). While these offices had ultimate responsibility for RIM activities, they could not provide accurate information on the number of projects funded, the amount of funds expended, or locations where work was being accomplished.

Number And Funding Of Projects Unknown

Neither office responsible for RIM activities could provide accurate information on the number and funding of projects carried out by contractors or where work was being accomplished. For example, Office of Technologies officials estimated that about \$3 million provided to Albuquerque had been expended on three robotic projects during Fiscal Year 1998. When the Office of Inspector General could not substantiate this information, the Office of Technologies revised the estimate and indicated that only two projects costing about \$2 million had been undertaken. Albuquerque officials subsequently advised that only \$1.8 million had been expended on robotic efforts at the Robotics Manufacturing Science and Engineering Laboratory (RMSEL). (See Appendix 2.) In an effort to reconcile the differences, we contacted RMSEL, a component of Sandia National Laboratories, and found that the Office of Technologies had funded several RIM tasks costing about \$1.4 million. Due to insufficient records, the three different estimates from the Office of Technologies, Albuquerque, and the RMSEL contractor could not be reconciled.

Similarly, the Office of Research officials did not know the magnitude of RIM research that it funded. They referred the Office of Inspector General to the contractor at RMSEL to whom they had delegated day-to-day management of all RIM activities. The contractor, however, only maintained information on projects being accomplished at that site. RMSEL records indicated that the Office of Research funded approximately \$6.1 million for Fiscal Year 1998 RIM activities. However, we could not validate this information.

Defense Programs officials advised that funding to the Albuquerque Operations Office and RMSEL for RIM research was not specifically earmarked as such but included as part of larger programs. Since

Defense Programs management role in RIM activities was broad and general in nature, Headquarters officials were uncertain of the amount Albuquerque and the contractor subsequently dedicated to such research.

Location Of Projects Unknown

Defense Programs officials also did not know where all RIM projects were being performed. Officials were of the opinion that all RIM research projects were being conducted at RMSEL. Contrary to this belief, RIM research funded by Defense Programs was being conducted at several other laboratories.

In an effort to determine the total magnitude of the Department's RIM research, we queried all Departmental laboratories to identify if robotics work was being conducted. In addition to RMSEL, we found that Defense Programs funded about \$5.8 million of RIM research at the Los Alamos and Lawrence Livermore National Laboratories and the Savannah River Technology Center. We also found that other offices within Defense Programs, such as the Tritium and National Ignition Facility Project Offices, had funded RIM projects. Defense Programs officials were uncertain why other laboratories were conducting RIM research but stated that Albuquerque had distributed RIM funds to laboratories other than RMSEL to assist in RIM projects. Consequently, we were unable to determine the exact amount of Departmental RIM expenditures.

A Departmental Benchmark

For benchmarking purposes we obtained information from the Office of Environmental Management on reporting systems and other controls it used to analyze and control RIM costs. The Office of Science and Technology within Environmental Management centrally managed approximately \$7.6 million of RIM activities from Headquarters in Fiscal Year 1998. This office provided the control and direction and made the fundamental decisions regarding RIM activities although the field sites carried out actual RIM projects. Further, the Office of Science and Technology implemented a reporting system to ensure that information regarding the funding, number, and locations of the projects was maintained and readily available for review. A technical project officer was also located at each site to manage RIM projects. Additionally, monthly meetings were held with technical officers to discuss funding

needs, project status, and cost performance data. These and other controls enabled the Office of Science and Technology to maintain accurate and timely information regarding its RIM projects and eliminated the possibility of duplicative research. The Office of Science and Technology also used an integrated approach to manage its RIM activities. Under the approach, all aspects of RIM activities were coordinated to eliminate the possibility of duplication.

**Departmental
Regulations Require
Effective And Efficient
Management Of
Resources**

Federal and Departmental policies and procedures provide guidance on the management and use of Federal resources. Office of Management and Budget Circular A-123 and Departmental Order 413.1 require that Federal resources be managed effectively and efficiently to achieve intended program results. Resources are to be used consistently with the agency's mission, in compliance with laws and regulations, and protected from waste, fraud, and mismanagement. Further, managers are to implement management controls to help ensure revenues and expenditures are accounted for properly. Management controls are defined as the organizational structure and the policies and procedures used to ensure that resources are used consistent with the agency's mission and that reliable and timely information is obtained, maintained, reported, and used for decision making.

The Government Performance and Results Act of 1993 reinforced the importance of management systems and achievement of mission, goals, and objectives. This Act requires the creation of long-range strategic plans that defined organizations' missions and formed the basis for performance measurement. In keeping with the requirement, the Department's 1998 Strategic Plan (Plan) recommended implementing reporting systems that provided useful information for analyzing and controlling costs. Such reporting systems, if reliable, increase the Department's responsiveness, effectiveness, and efficiency in providing information needed to manage operations, including achievement of goals. Accurate and timely data for RIM activities was needed to measure the Department's success in achieving its goals and mission defined in the technology roadmap. The Plan also stressed the need for an integrated organizational approach for managing Headquarters, field, and contractor operations. An integrated approach is the effective collaboration of planning, conducting, and management of research and development activities.

Lack Of Management Controls And An Integrated Management Approach

The Offices of Technologies and Research did not have accurate information on RIM research expenditures because neither office had established and implemented a reporting system specifically for RIM projects. In addition, there was no requirement that RIM research activities carried out by the two Defense Programs offices be integrated.

Defense Programs had not established a reporting system or required periodic reporting from contractors performing RIM research activities because, according to officials, RIM was considered an initiative with less funding than a program category. Program category is the current budgetary level at which Defense Programs becomes more active in managing research and development projects. Although officials were unsure of the exact amount of Defense Programs RIM expenditures, they believed the amount of funds dedicated to RIM activities were minimal in relation to its \$4 billion budget. Therefore, RIM had not been given the same level of attention as larger dollar value initiatives.

Further, Defense Programs lack of overall knowledge of robotic projects occurred because the office did not use an integrated approach for managing RIM activities. As previously stated the two Defense Programs offices that funded RIM research had been decentralized to the greatest extent feasible. These offices carried out the planning, budgeting, and management of robotic activities independently of each other. Further, each relied on other organizations such as Albuquerque or the contractor at RMSEL for day-to-day management and review of RIM activities. No one individual or office within Defense Programs had total oversight responsibility for RIM.

Project Oversight Needed Improvement

Without adequate information Defense Programs did not have complete assurance that RIM projects were not being duplicated at various sites or that funds were always used to achieve the intended program results. While duplicative research was not found during the review, observations of Departmental activities at RMSEL raised questions on the appropriateness of fund usage. More specifically, Defense Programs officials advised that RMSEL was funded to provide one central facility for employees working on RIM projects. Headquarters, however, did not have documentation to this effect and referred the Office of Inspector General to the Albuquerque Operations Office. There we found that RMSEL approval had been granted based on the understanding that the laboratory was to meet the RIM needs of the Department that industry was not currently supplying or developing. However, during the audit we learned that about half of the RIM

projects at the laboratory were for other Federal agencies and the private sector. While we did not draw a conclusion on the overall need for the facility, based on its current usage, we did question the need for a facility of this magnitude when the number, funding, and locations of Departmental RIM activities were not readily apparent. In our view, this is an example where better coordination and communication was needed to ensure that funds were appropriately justified and used.

In addition, more attention to robotics activities was needed to ensure that the Department fulfills its role in successfully completing the Department's vision and subsequent development of a national RIM industry. At the time of the audit, there was no specific accounting for the funding of total RIM activities conducted at eight Department-owned, contractor-operated laboratories throughout the United States. We estimated that RIM operating costs for these activities exceeded \$66 million in Fiscal Year 1998. (See Appendix 4.) Further, RIM funding was expected to increase significantly as research and development was planned by the Department through 2020. Given the current size of RIM efforts and plans for significant future increases, the Department, and in particular the Office of Defense Programs, should have information systems in place to better manage RIM activities and to ensure stated goals are achieved.

RECOMMENDATIONS

We recommend that the Assistant Secretary for Defense Programs:

1. Establish management controls including policies and procedures that require the accurate accountability of RIM projects.
2. Develop an integrated management approach for RIM projects. At a minimum it should include:
 - Establishing one central point of contact within Defense Programs to have oversight responsibility for RIM projects. This individual or office should be responsible for maintaining a reporting system that contains reliable and timely information.
 - Requiring all offices and field sites with RIM projects to periodically report to this individual or office.
 - Coordinating the planning, budgeting, and management of RIM

projects. As the program expands, establish goals, objectives, and performance measurement criteria—including benchmarks, as appropriate—consistent with the Government Performance and Results Act.

MANAGEMENT REACTION

In its response to our draft report, Defense Programs stated that in the past, integrated management and reporting on RIM activities was not required because the effort was small in relation to the total program budget. Management acknowledged, however, that the emerging interest in RIM within the Department and the Congress calls for increased attention to the Department’s ongoing activities. Defense Programs therefore agreed to “...establish a mechanism to collect reliable and timely information that will provide for a periodic review of RIM efforts at a single point of contact.” However, management’s response did not specify what the mechanism would be or when it would be implemented. Defense Programs also agreed to adopt an integrated management approach under a single point of contact for all of its RIM activities *should they become part of a Departmentwide national initiative* (emphasis added).

Management stated that the RMSEL facility was subject to a multi-year process of planning and approval by the Department and Congress. Defense Programs acknowledged that a significant amount of work at RMSEL was currently being done in support of others. However, officials believe that the facility would be a critical asset should the Department enter into a national RIM initiative.

Management’s comments do not fully satisfy the intent of our recommendations.

AUDITOR COMMENTS

Regarding the establishment of management controls (recommendation 1), Defense Programs should specify what “mechanism” it will use to collect reliable and timely information, when the mechanism will be implemented, and the nature of the proposed periodic review.

Further, the Defense Programs position that it will adopt an integrated management approach (recommendation 2) only at some future, unspecified threshold of activity seems unwise. Departmental operating costs for RIM activities exceeded \$66 million in Fiscal Year 1998 and are expected to increase significantly. Although the \$14 million figure for Defense Programs is indeed relatively small in relation to the overall Defense Programs budget, However, previous reports by the Office of

for Defense Programs is indeed relatively small in relation to the overall Defense Programs, previous reports by the Office of Inspector General have detailed situations in which emerging programs that were not well integrated resulted in unnecessary expenditures, duplicative research, inefficiencies, and criticism from Department stakeholders.

Appendix 1

SCOPE

The audit was performed between August 1998 and May 1999. Our review was limited to the Office of Advanced Design and Production Technologies and the Office of Research Testing within Defense Programs. The review covered Robotics and Intelligent Machines research and development projects and funding for Fiscal Year 1998. Site visits were made to the Sandia National Laboratories and the Albuquerque Operations Office in Albuquerque, New Mexico.

METHODOLOGY

To accomplish the objective, we obtained and reviewed applicable regulations and Departmental orders pertaining to management controls. In addition, discussions were held with Departmental and contractor officials who provided information on management controls. We also gathered and analyzed pertinent data pertaining to RIM projects. Further, we reviewed policies and procedures used by the Offices of Technologies and Research to manage RIM projects. Finally, we reviewed related reports by the Office of Inspector General.

The audit was conducted in accordance with generally accepted Government auditing standards for performance audits and included tests of internal controls and compliance with laws and regulations to the extent necessary to satisfy the audit objective. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed. We tested the accuracy and reliability of computer-processed data regarding RIM projects and funding. As discussed in the report, we concluded that this data was not accurate or reliable.

The Office of Defense Programs waived the exit conference.

ROBOTIC MANUFACTURING SCIENCE AND ENGINEERING LABORATORY



The Robotic Manufacturing Science and Engineering Laboratory (RMSEL) is a \$30,000,000 central facility for employees working on RIM research. Presently, there are more than 150 researchers working at the laboratory who are involved in design and development of robots for tasks such as manufacturing, environmental cleanup, weapons production, and dismantlement of nuclear weapons. Located at Sandia National Laboratories, the 73,000 square foot building's justification was based on it meeting Departmental RIM needs that private industry was not supplying or providing. The facility opened in October 1996.

Appendix 3

SUMMARY OF RELATED OFFICE OF INSPECTOR GENERAL REPORTS

Prior audits related to research and development and integration in the Department of Energy were:

Audit of the U.S. Department of Energy's Implementation of the Government Performance and Results Act, DOE/IG-0439, February 1999. The Department's implementation of the Results Act was incomplete in that some program offices' Fiscal Year 1999 budgets did not clearly integrate the activity-level performance data with the higher-level strategic planning data.

Audit of the U.S. Department of Energy's Participation in the Partnership for a New Generation of Vehicles Program, DOE/IG-0422, July 1998. Although research projects being pursued by the Department contributed to the goals of the Partnership for a New Generation of Vehicles Program, it was unlikely that some of the technologies would be fully developed in time to meet the 2004 program timeframe.

Audit of the Department of Energy's Management of Research and Development Integration, DOE/IG-0417, March 1998. The Department did not have a system in place to ensure that research and development projects were integrated although Congress and others had called for such an approach.

Report on the Coordination of Long-Term Energy Research and Development Planning, DOE/IG-0232, November 1986. The Department's lack of a unified long-term research and development plan was discussed.

OIG ESTIMATES OF DEPARTMENTAL RIM FUNDING

Robotics Manufacturing Science and Engineering Laboratory	\$22,768,586
Lawrence Livermore National Laboratory	4,510,000
Savannah River Technology Center	3,715,000
Los Alamos National Laboratory	2,980,000
Pacific Northwest National Laboratory	2,741,300
Oak Ridge National Laboratory	22,188,000
Lawrence Berkeley National Laboratory	1,857,000
West Valley Nuclear Services	<u>5,800,000</u>
TOTAL	<u>\$66,559,886</u>

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