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AUDIT REPORT

PREDICTION AND MAPPING CAPABILITIES FOR ATMOSPHERIC RELEASES OF HAZARDOUS MATERIALS

MARCH 2001

U.S. DEPARTMENT OF ENERGY
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OFFICE OF AUDIT SERVICES

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MEMORANDUM FOR THE DIRECTOR, OFFICE OF EMERGENCY RESPONSE

FROM: Lawrence R. Ackerly, Regional Manager
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Office of Inspector General

SUBJECT: INFORMATION: Audit Report on "Prediction and Mapping Capabilities for Atmospheric Releases of Hazardous Materials"

BACKGROUND

Since the development of nuclear weapons, the Department of Energy (DOE) and its predecessors have sought to track and mitigate the impact of any atmospheric dispersion of hazardous materials, primarily radioactive particles. Today, DOE sites generally obtain predictions and maps of those dispersions from one or more of the following sources—the National Oceanic and Atmospheric Administration (NOAA), DOE's Atmospheric Release and Advisory Capability (ARAC), and locally developed in-house services. The objective of this audit was to determine if there was duplication of atmospheric prediction and mapping capabilities for hazardous material dispersions within DOE.

RESULTS OF AUDIT

There was unnecessary duplication of atmospheric prediction and mapping capabilities for hazardous material dispersions within DOE. Although ARAC was capable of providing prediction and mapping services to the 18 DOE sites that had the potential for atmospheric release of hazardous materials, most of those sites had either acquired their own prediction and mapping capabilities or had contracted with NOAA for those services. Duplicate capabilities were unnecessary because they were not being maintained for backup.

We also found that ARAC was duplicating services that NOAA was capable of providing for external events (that is, dispersions not on DOE sites). For example, both provided services to entities that had nuclear materials, such as nuclear power plants. Both also predicted and mapped potential terrorist releases of chemical and biological agents. Such services were, however, NOAA's responsibility, not DOE's.

We estimated that DOE can save between $1.56 million and $6.18 million per year if duplication were eliminated. To eliminate duplication, we recommended that the Office of Emergency Response (1) define the internal needs for predictions and maps, (2) select and implement the most cost-effective approach to eliminate internal duplication, and (3) cease providing predictions and maps to other entities.

MANAGEMENT REACTION

Management concurred with Recommendation 1 and stated that it had developed a draft policy to define internal needs and requirements for predictions and maps. Management nonconcurred with Recommendation 2, however, and stated that the report did not adequately consider the cost of recreating unique capabilities that already existed within ARAC. Management disagreed with Recommendation 3, stating that responsibility for predicting and mapping external events is not limited to NOAA or DOE.

PREDICTION AND MAPPING CAPABILITIES FOR ATMOSPHERIC RELEASES OF HAZARDOUS MATERIALS

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INTRODUCTION AND OBJECTIVE

Since the development of nuclear weapons, the Department of Energy (DOE) and its predecessors have sought to track and mitigate the impact of any atmospheric dispersion of hazardous materials, primarily radioactive particles. DOE sites obtain predictions and maps from one or more of the three sources listed below.

- The National Oceanic and Atmospheric Administration (NOAA). Since the 1950s, NOAA's Air Resources Laboratory has provided predictions and maps to DOE's Nevada Test Site. NOAA also provides these products to the Idaho National Engineering and Environmental Laboratory.

- The Atmospheric Release and Advisory Capability (ARAC). Established by the Atomic Energy Commission (AEC) - one of DOE's predecessor agencies - in the early 1970s, ARAC was intended to improve AEC's emergency response capabilities. ARAC is capable of providing prediction and mapping services to any DOE sites that request its services.

- In-house Resources. By acquiring or developing software, sites are capable of providing their own predictions and maps.

Because several sources of predictions and maps existed, the audit objective was to determine if there was duplication of atmospheric prediction and mapping capabilities for hazardous material dispersions within DOE.

CONCLUSIONS AND OBSERVATIONS

There was duplication of atmospheric prediction and mapping capabilities for hazardous material dispersions within DOE. Although DOE's ARAC was capable of providing prediction and mapping services to the 18 DOE sites that had the potential for atmospheric release of hazardous materials, most of those sites had either acquired their own prediction and mapping capabilities or had contracted with NOAA for those services. We also found that ARAC was duplicating services that NOAA was capable of providing for external events (that is, dispersions not on DOE sites). Such services were, in fact, NOAA's responsibility, not DOE's. Duplication occurred because DOE had not appropriately managed its prediction and mapping capabilities. We estimated that DOE can save between $1.56 million and $6.18 million per year if duplication were eliminated.

The audit identified a material internal control weakness that management should consider when preparing its yearend assurance memorandum on internal controls.

Office of Inspector General

Duplication Of Capabilities

Unnecessary Duplication

DOE had duplicate capabilities for predicting and mapping dispersions on its sites. ARAC was capable of serving all 18 DOE sites that had the potential for atmospheric release of hazardous materials. Nine sites, however, had acquired and used their own prediction and mapping capability and two sites had contracted with NOAA for these services. Only seven sites were dependent upon ARAC's capabilities. These duplicate capabilities, however, were unnecessary because they were not maintained as backup systems or to routinely validate predictions.[1] Beyond being unnecessary, duplicate capabilities could be detrimental. The use of more than one capability in an emergency could hinder the response because, according to DOE and NOAA officials, multiple predictions could conflict to some degree. Once a conflict arose, valuable time might be lost trying to reconcile the differences.

Further, ARAC and NOAA were capable of and often performed prediction and mapping services for the same types of external events (that is, dispersions not on DOE sites). For example, both provided services to facilities that had nuclear materials, such as nuclear power plants. Both also predicted and mapped potential terrorist releases of chemical and biological agents. A key distinction, however, is that NOAA, not DOE, had a responsibility to predict and map dispersions not on DOE sites.

Duplication Inconsistent With Federal Plans And DOE Order

The *Federal Radiological Emergency Response Plan* (*Radiological Plan*) and the *Federal Response Plan* apply Governmentwide to radioactive dispersions and hazardous, nonradioactive dispersions, respectively. Under both plans, DOE is responsible for mapping and predicting atmospheric dispersions while those dispersions are on a DOE site. Similarly, other Federal agencies are responsible for mapping and predicting atmospheric dispersions on their sites. However, NOAA is responsible for predicting and mapping any dispersion not on a Federal site. Accordingly, any prediction and mapping service provided by ARAC to sites other than DOE's own sites is questionable. Also questionable is any duplication of predicting and mapping capabilities within DOE. DOE Order 151.1, *Comprehensive Emergency Management System*, has the objective of eliminating duplicate emergency management within DOE. Therefore, it is

[1] Sites that had their own capability or had contracted with NOAA used ARAC's capabilities only 19 times during the two-year period October 1997 through September 1999. All 19 times were exercises, only one of which was for validation. Most of these exercises were done at the request of DOE Headquarters.

inconsistent with the Order for DOE to have duplicate capabilities to map and predict atmospheric dispersions of radioactive and other hazardous materials on DOE sites.

DOE Did Not Provide Oversight

DOE had duplicate capabilities for predicting and mapping dispersions on its sites because it did not manage prediction and mapping as a DOE-wide activity. ARAC was created in 1972 to take advantage of computing capabilities at Lawrence Livermore National Laboratory. At that time, computing was significantly more costly than today and required large mainframes. Later, personal computers and software for creating predictions and maps became available and DOE sites migrated to developing their own capabilities. Presently, DOE's Office of Emergency Response (Emergency Response), which oversees prediction and mapping within DOE, wants predictions and maps done by ARAC. Emergency Response officials stated that they wanted a common system throughout DOE and a connectivity between the sites and ARAC. However, the sites that have a local capability or have contracted with NOAA prefer to maintain their own capability.[2] Site safety managers stated that they wanted their own capabilities in order to obtain more detailed and timely results. While Emergency Response knew that duplication existed, its officials told us that as a new office it had not had time to develop guidance on the issue.

Externally, ARAC predicted and mapped radioactive particle dispersions that were not on DOE sites because DOE was the lead Federal agency for operating the Federal Radiological Monitoring and Assessment Center (Center). As the Center implements the *Radiological Plan*, Emergency Response officials were in a position to select the organization that would predict and map a dispersion that was not on a DOE site. These officials stated that they preferred to use ARAC rather than NOAA because they were reluctant to provide sensitive DOE data to NOAA. However, DOE has for over 40 years provided sensitive data to NOAA to support the weapons program at the Nevada Test Site. Emergency Response officials also stated that they were concerned about NOAA's ability to serve multiple programs, such as counter-terrorism programs and weapons of mass destruction programs. NOAA officials told us that NOAA had extensive experience in both programs through work done with the Department of Defense. Thus, even though NOAA was responsible, DOE still authorized ARAC to predict and map radiological dispersions externally.

[2]Most of the sites that did not have their own capability or had not contracted with NOAA stated that they had no preference for a provider of services other than they sought to minimize costs.

Further, DOE allowed ARAC to expand its capabilities to mapping and predicting non-radiological hazardous materials dispersions not on DOE sites. In fact, most of ARAC's hazardous material dispersion mapping and predicting has been for external entities, primarily Federal, in recent years. For example, in Fiscal Years (FYs) 1998 and 1999, ARAC provided 76 maps and predictions for chemical and biological agents. Of these, 71 were for external entities and events, such as the Goodwill Games. Nevertheless, the *Federal Response Plan* designates NOAA as the provider of predictions and maps for hazardous material dispersions not on a DOE site.

DOE Can Reduce Costs

Based on our analysis of the capabilities currently used by the DOE sites, elimination of this duplication could result in savings ranging from $1.56 million to $6.18 million annually, or $7.8 million to $30.9 million over the next five years. As there are qualitative considerations in addition to cost considerations, we have not recommended one alternative over the other (that is, we have not recommended that all sites use ARAC and eliminate their own capabilities or that all sites provide their own capabilities and ARAC cease operations). However, we have recommended that duplication be eliminated.

RECOMMENDATIONS

We recommend that the Director, Office of Emergency Response manage predicting and mapping as a DOE-wide activity by:

1. Defining the internal needs and requirements for predictions and maps of atmospheric dispersions of hazardous materials on DOE sites;

2. Selecting and implementing the most cost-effective approach that meets DOE's needs and requirements while eliminating internal duplication; and,

3. Ceasing to provide prediction and mapping services to external entities when DOE is not the designated provider of such services.

MANAGEMENT REACTION

Management agreed with the first recommendation but disagreed with the remaining two recommendations.

Recommendation 1: Management stated it concurred and had already developed Draft Policy Notice 153.XX to define the internal needs and requirements for predictions and maps of atmospheric dispersions of hazardous materials on DOE sites. This policy establishes requirements for ARAC to support all DOE facilities and sites with a uniform, consistent all-hazards atmospheric dispersion modeling emergency response service. The purpose of this new policy was to improve

real-time consequence assessment capabilities for Departmental sites and facilities and to avoid unnecessary duplication at DOE or National Nuclear Security Administration sites/facilities. ARAC has submitted a schedule to DOE for implementing its new Intranet/Internet technology and is currently working with the sites to complete installation.

Recommendation 2: Management did not concur, stating that the facts in the Office of Inspector General (OIG) report are over a year old and do not reflect the technical and procedural enhancements that have been made within the ARAC program during the past year and which served as the basis of the Draft Policy Notice cited above. Further, management stated that it would be difficult to assess accurately if there would be cost savings by any of the OIG suggested options.

Management also stated that the cost of recreating the unique capabilities that already exist within ARAC and the cost of providing the support and services to all the Departmental programs and other Federal, state, and local customers have not been adequately considered. The recommendation did not take into account the operational benefits of centralizing this capability to ensure a uniform and consistent product that is required for any off-site release. Distinguishing between overlapping capabilities requires a technical analysis that cannot be based solely on cost and the number of models used. A cost saving can be associated with the integration of ARAC's new Intranet/Internet technology and DOE's new policy statement on ARAC's role at the sites, whereby all DOE sites will become fully connected to ARAC, including those that may not be on the DOE Emergency Communications Network.

Recommendation 3: Management did not concur, stating that during a major crisis, consequence management activities are tied directly to using the best available technologies, services, and capabilities. Generally, this involves both a local capability associated with immediate, on-scene response and a national level capability to access more advanced technical support that is usually too costly for every locality (facility and site) to maintain.

The OIG report labels all apparent redundancy in capabilities as unnecessary, without any technical evaluation of the so-called "redundant" systems and the purposes for which these systems may seem redundant. The OIG did not conduct a technical evaluation to assess whether any of the apparent redundancy was necessary, and thus could not reveal that much of the "redundancy" is associated with

revealing different measurements and/or impacts. In addition, "unnecessary duplication" of capabilities was already being addressed by a DOE policy that was initiated prior to the start of the review.

The OIG report also appears to view DOE's role under the *Radiological Plan* as duplicating responsibilities of NOAA regarding external atmospheric and mapping services. This position appears to be based on an interpretation of the responsibilities called out in the plan. However, Section II.D.3 of the *Radiological Plan* (specifically the section on "Response Functions and Responsibilities--Radiological Monitoring and Assessment") states that DOE has responsibility to provide dose projections and the Department of Commerce (NOAA being the pertinent agency) has the responsibility to prepare and disseminate predictions of plume trajectories, dispersion, and deposition. The *Radiological Plan* does not limit such activities to either DOE or NOAA. Any changes that are to be made concerning DOE capabilities and responsibilities require coordination with and acceptance by the 17 Federal agencies that are signatories to the plan. Additionally, the plan is not a mandatory document and agencies are not legally bound to follow it.

The different roles of the two agencies are being described in a draft Memorandum of Understanding (MOU), Coordinated and Integrated Development and Disseminating of Meteorological and Atmospheric Dispersion Products in a Nuclear Emergency. Even though it is yet to be finalized and signed, the MOU speaks of the differing roles. The draft MOU states "NOAA and ARAC dispersion products are designed for different purposes. NOAA products are designed for immediate dissemination, driven by National Centers for Atmospheric Prediction forecast output fields."

AUDITOR COMMENTS

Although management concurred with Recommendation 1, its comments were nonresponsive. The policy presented does not provide guidance that will reduce duplication and, in fact, may expand the duplication to sites not previously utilizing ARAC without a reduction in site level effort.

Recommendation 1: Draft Policy Notice 153.XX does not define the internal needs and requirements necessary for making an informed decision regarding the best source for prediction and maps. Rather, the policy pre-supposes ARAC is needed at all sites.

Recommendation 2: While management challenges the OIG's projected savings if ARAC were eliminated, it failed to address the primary issue of eliminating duplicated facilities. There was no need to consider the cost to recreate the unique capabilities of ARAC because DOE has not performed any comparative studies to determine if ARAC's capabilities are indeed unique or if other sources available and being used by DOE sites are capable of providing the services that would meet the requirements identified by implementing Recommendation 1. Even though management stated that technical and procedural enhancements have occurred in the year since the audit began, these enhancements have not reduced duplication or altered the need for our recommendation. In fact, implementation of the draft policy as currently written will expand, rather than reduce duplication, since it requires all sites to simultaneously connect to ARAC while allowing sites to continue to use their own site models. The detailed funding information presented to DOE management during the course of the audit demonstrated the savings that could be achieved by eliminating duplication.

Recommendation 3: The OIG has recognized during the audit that a national capability is needed. However, the *Radiological Plan* assigns that responsibility to NOAA, not DOE. Therefore a technical evaluation of prediction and mapping systems was appropriately not part of our review. We relied on the expertise of those who developed the plan to assign the responsibility to those agencies that were most capable in their respective fields. DOE's responsibility is to provide dose projections while NOAA has responsibility to predict and map dispersions. Further, as pointed out in its management comments, DOE should not unilaterally take over another agency's responsibility without coordination with and acceptance by the 17 Federal agencies that are signatories to the *Radiological Plan*. Finally, management stated that the different roles of ARAC and NOAA are being outlined in a draft MOU. We are familiar with this document. The MOU, however, has been ineffective because it has existed for several years in a draft stage and has not yet been agreed to by NOAA.

SCOPE

The audit was performed from October 6, 1999 to September 25, 2000, at ARAC (Livermore, California), Emergency Response (Washington, D.C.), and the Oakland Operations Office (Oakland, California). Other sites contacted for information but not visited were: Sandia National Laboratories (Livermore, California, and Albuquerque, New Mexico); Mound Plant (Miamisburg, Ohio); the Pantex Plant (Amarillo, Texas); the Rocky Flats Environmental Technology Site (Golden, Colorado); Oak Ridge National Laboratory (Oak Ridge, Tennessee); Los Alamos National Laboratory (Los Alamos, New Mexico); the Hanford Site (Richland, Washington); the Idaho National Engineering and Environmental Laboratory (Idaho Falls, Idaho); the Savannah River Site (Aiken, South Carolina); Brookhaven National Laboratory (Upton, New York); the Nevada Test Site; Pittsburgh Naval Reactors (West Mifflin, Pennsylvania); NOAA's Air Resources Laboratory (Silver Spring, Maryland); and the Department of Defense Threat Reduction Agency Headquarters (Fort Belvoir, Virginia). The audit covered DOE's prediction and mapping activities during FYs 1998 and 1999.

METHODOLOGY

To accomplish the audit objective, we:

- Reviewed applicable Federal and DOE regulations;
- Examined prior OIG, General Accounting Office, and DOE Headquarters reviews;
- Identified and reviewed atmospheric modeling and plume prediction at ARAC and DOE sites;
- Reviewed ARAC response logs for FYs 1998 and 1999 and compared them with NOAA activity logs;
- Assessed compliance with DOE Order 151.1 and the Federal emergency response plans;
- Interviewed Headquarters, ARAC, NOAA, Defense Threat Reduction Agency, and various DOE site personnel with expertise and experience in prediction and mapping activities; and,
- Reviewed DOE's FY 1999 *Performance Agreement* and *Accountability Report* for *Government Performance and Results Act of 1993* performance measures related to atmospheric dispersion and mapping of hazardous material dispersions.

The audit was performed 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. We tested controls

with respect to Emergency Response's management of emergency services, specifically its management of atmospheric modeling and hazardous plume prediction resources. Because our review was limited, it would not necessarily have disclosed all internal control deficiencies that may have existed at the time of our audit. We did not conduct a reliability assessment of computer-processed data because only a limited amount of such data was used during the audit. We did not conduct a technical evaluation of prediction and mapping systems; rather, our analysis was based on discussions with those individuals with experience in operating the systems. We did not find any relevant performance measures within Emergency Response.

We held an exit conference with Emergency Response officials on January 9, 2001.

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