Comprehensive Baseline Environmental Audit

**of Former Underground
Test Areas in Colorado,
Nevada, and New Mexico**

**U.S. Department of Energy
Office of Environmental Audit
Washington, DC 20585**

May 1994

MASTER

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PREFACE

Preface

U.S. Department of Energy

Comprehensive Baseline Environmental Audit of Former Underground Test Areas in Colorado, New Mexico, and Nevada

The Secretary of Energy's July 20, 1993, Environment, Safety, and Health Policy establishes daily excellence in protection of the worker, the public, and the environment as the hallmark and highest priority of all DOE activities. That policy also calls for a proactive program of continuous improvement to move the Department beyond minimal compliance with laws and regulations. To further that policy, the Office of Environment, Safety and Health (EH) has established a program to conduct environmental audits of DOE programs and operating facilities. This program, which is within the Office of Environmental Audit (EH-24) is part of the oversight responsibilities within DOE. The ultimate goal of this program is to enhance environmental protection and minimize risk to public health and the environment through systematic and periodic evaluations of the Department's environmental programs within line organizations.

Through its environmental evaluation program, which provides measurable goals with milestones, EH-24 is committed to helping establish DOE as a model of responsible environmental stewardship. In addition, this program serves to reinforce the Secretary's goal of building on ongoing efforts to attain and maintain compliance in cooperation with regulatory authorities and other stakeholders.

This document contains the findings identified during the Comprehensive Baseline Environmental Audit of Former Underground Test Areas in Colorado, Nevada, and New Mexico conducted May 16–May 26, 1994. The audit's objective is to advise the Secretary of Energy, through the Assistant Secretary for Environment, Safety and Health, of the adequacy of environmental programs and activities at former underground test areas in Colorado, Nevada, and New Mexico to ensure their compliance with Federal, State, local, and DOE environmental requirements. Covering all areas of environmental protection, the scope of the audit was comprehensive and included focused reviews of environmental management systems.

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EXECUTIVE SUMMARY

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EXECUTIVE SUMMARY

This report documents the results of the Comprehensive Baseline Environmental Audit of Former Underground Test Areas (FUTAs) in Colorado, Nevada, and New Mexico. Audit team activities included reviews of internal documents and environmental monitoring reports concerning FUTAs; interviews with U.S. Department of Energy (DOE), United States Environmental Protection Agency's Environmental Measurements Systems Laboratory (EMSL), and contractor personnel; and onsite visits to four of the eight FUTAs in Colorado, Nevada, and New Mexico (GNOME, GASBUGGY, SHOAL, and RULISON). Interviews with senior DOE Headquarters managers were conducted May 11-12, 1994, in Germantown, MD. The remaining interviews were conducted at the Nevada Operations Office (NV) in Las Vegas, Nevada, the week of May 16-20, 1994. The four FUTAs were visited May 21-26, 1994. All phases of the audit were performed by the DOE Office of Environmental Audit (EH-24), a unit of the Office of Environment, Safety and Health (EH).

The audit's scope was comprehensive and included programmatic evaluations of groundwater and surface water monitoring programs, inactive waste sites, environmental radiation and sample data quality assurance, and compliance with Federal and State environmental requirements. The audit also reviewed several areas of environmental management, including staffing and resources, risk management, organizational structure, and internal and external communication.

The audit team identified 13 findings, and evaluation of these findings resulted in the development of one key finding, as follows:

NV's Environmental Restoration Division (ERD) lacks adequate staff and budget authority to manage and oversee environmental protection activities effectively for FUTAs.

ERD oversight of FUTAs currently is limited by inadequate staffing and a lack of budget authority for FUTAs. Although ERD is likely to receive approval from the Office of Environmental Management (EM) to add, by the end of the current calendar year, 12 or 13 full-time-equivalent employees, one of whom will be responsible for providing management oversight of FUTAs, additional staff will be required for management and oversight of FUTAs as remedial investigation and feasibility study activities increase in the future. The lack of a budget to perform all needed environmental protection activities for FUTAs was inherited during the transfer of program responsibility from the Office of Defense Programs (DP) to EM in November 1993. Although a budget is expected for FUTAs in Fiscal Year 1996, some reprogramming of resources will be necessary until the budget is authorized.

Consistent with the Secretary's decentralization policy, the Albuquerque Laboratory and Nevada Program Division (EM-452) and ERD manage environmental protection activities at FUTAs by emphasizing a clear distinction between Headquarters and field functions. EM-452 establishes program goals and policy for FUTAs, develops guidance, and conducts performance evaluations to measure ERD's performance. ERD is responsible and directly accountable for implementing environmental protection activities for FUTAs, including managing activities of the Desert Research Institute (DRI), International Technology Corporation (IT), and EMSL; planning and developing environmental monitoring programs; and ensuring compliance with Federal, State, and local regulations. Although this

management approach has resulted in distinctly different roles, responsibilities, and authorities for each organization, both EM-452 and ERD are committed to working as a team, each supportive of the other, to achieve program goals and implement EM policy. This close working relationship was brought about by frequent and effective informal and formal communication between both organizations as evidenced by well-documented, clearly communicated organizational roles, responsibilities, and authorities that are understood by all personnel, and effective oversight of and assistance to ERD's environmental protection activities by EM-452. In addition, virtually all of the findings reported by the audit team were self-identified, and considerable progress has been made by ERD in formulating a strategy for FUTAs since EM received program responsibility in November 1993. With the addition of more staff and funding, and the early involvement of the Environmental Protection Agency and State regulators, the audit team is confident that ERD will develop long-term environmental programs that will ensure protection of the environment and the public and demonstrate DOE's commitment to environmental excellence.

During the audit, the team noted several strengths in oversight and management of FUTA environmental programs. These strengths are as follows:

- Staff Technical Qualifications – EM-452 and ERD staff interviewed during this audit are highly qualified to manage programs and projects effectively and perform technical evaluations of environmental activities that are the responsibility of their respective organization. Notably, all of the management and staff have considerable technical experience in fields such as hydrology, geology, groundwater management, or geochemistry, which facilitates developing a thorough understanding of the environmental issues confronting the program.
- Internal Communications – Formal and informal communication within and between EM-452 and ERD has been successful in achieving a thorough understanding of roles, responsibilities, and authorities within and between both organizations. In addition, frequent and informal communication among EM-452, ERD, IT, and DRI has brought about close working relationships that are used to promote efficient and effective management of environmental protection activities at FUTAs.
- Oversight – EM-452 management and staff provide a high degree of oversight through continual field visits and program and performance evaluations. EM-452 is also regarded by ERD, IT, and DRI as an additional source of expertise that is often called upon for opinions on the feasibility of technical solutions associated with environmental problems at the Nevada Test Site (NTS) or at other test areas. Additionally, NV has created a position for a hydrology programs manager who reports to the Assistant Manager for Environmental Restoration and Waste Management. One of the main responsibilities of this position is to maintain close coordination among various hydrogeologic activities, whether or not they are associated with FUTAs, to ensure that overlap of hydrogeologic programs, plans, and projects is kept to a minimum. Because this position reports directly to the Assistant Manager for Environmental Restoration and Waste Management, the incumbent can effectively integrate all NV hydrogeology and hydrology

activities, allowing for efficient use of EM resources for these activities and for sharing lessons learned among and between programs.

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SECTION 1.0

INTRODUCTION

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1.0

INTRODUCTION

This report documents the results of the Comprehensive Baseline Environmental Audit of Former Underground Test Areas (FUTAs) in the States of Colorado, Nevada, and New Mexico. DOE and contractor systems for management of environmental protection activities on the Nevada Test Site (NTS) were not within the scope of the audit. The audit was conducted May 16–May 26, 1994, by the Office of Environmental Audit (EH-24).

DOE 5482.1B, "Environment, Safety, and Health Appraisal Program," establishes the mission of EH-24, which is to provide comprehensive, independent oversight of Department-wide environmental programs on behalf of the Secretary of Energy. The ultimate goal of EH-24 is to enhance environmental protection and minimize risk to public health and the environment. EH-24 accomplishes its mission using systematic and periodic evaluations of DOE's environmental programs within line organizations and supplemental activities that strengthen self-assessment and oversight functions within program, field, and contractor organizations.

These evaluations function as a vehicle through which the Secretary and program managers are apprised of the status and vulnerabilities of Departmental environmental activities and environmental management systems. Several types of evaluations are conducted, including:

- comprehensive baseline environmental audits;
- routine environmental audits;
- environmental management assessments; and
- special issue reviews.

The purpose, scope, and approach of the comprehensive baseline environmental audit of FUTAs in the States of Colorado, Nevada, and New Mexico are described below.

1.1

PURPOSE

The purpose of this audit is to provide to the Secretary of Energy, through the Assistant Secretary for Environment, Safety and Health, concise information pertaining to the following areas:

- current environmental compliance status, and vulnerabilities associated with the status, at FUTAs in Colorado, Nevada, and New Mexico;
- adequacy of environmental management programs and systems;
- DOE vulnerabilities and liabilities associated with compliance status, environmental conditions, and management practices;
- compliance with DOE Orders and DOE environmental policies, identified in Table 3-1, that address environmental management programs;

- adherence to accepted technical practices;
- special issues; and
- noteworthy environmental practices.

The information gathered during this audit will assist DOE in determining patterns and trends in environmental deficiencies and strengths. The Office of Environmental Management (EM) and the Nevada Operations Office (NV) are expected to use this information fully to develop corrective actions, make appropriate modifications to specific programs to prevent recurrence, and supplement their formalized lessons-learned programs to ensure broad application to other operations, programs, and facilities.

1.2 SCOPE

The scope of the audit was comprehensive, addressing all environmental media and Federal, State, and local regulations, with the exception of environmental requirements that pertain to the National Environmental Policy Act. Also addressed were DOE Orders and formalized program operating procedures. FUTAs generally lack buildings, water and wastewater treatment systems, hazardous waste treatment and storage facilities, and other facility improvements normally associated with DOE laboratory and defense production operations because most of the facilities constructed for each underground test area were removed. Given this situation, the technical disciplines assessed were limited to the areas of environmental radiation, quality assurance, groundwater, surface water/drinking water, and inactive waste sites. The audit also included a review of the environmental monitoring programs and related sampling and analysis activities, and the effectiveness of environmental management programs and systems.

1.3 APPROACH

The audit was conducted in accordance with the DOE Environmental Audit Program Guidance (January 1994 Draft Final) and the DOE Environmental Audit Manual (DOE/EH-0125), and followed accepted audit techniques. The audit was conducted by a team of professionals managed by a DOE Headquarters Team Leader from EH-24 and a Deputy Team Leader from the Richland Operations Office, and staffed by contractor technical support personnel. The names, areas of responsibility, affiliations, and biographical sketches of the team members are provided in Appendix A. The audit included three phases: planning, onsite activities, and post-audit activities.

Once the site selection was approved by the Assistant Secretary for Environment, Safety and Health (EH-1), the Team Leader contacted both EM and NV management and staff to begin development of the scope of the audit. These initial contacts assisted EH-24 in developing the audit plan, identifying environmental programs that are considered essential to EM's and NV's respective missions, and selecting the former underground test areas to be evaluated by the team.

A memorandum announcing the environmental audit and requesting information about the management systems and environmental protection programs was sent to NV's Environmental Restoration Division (ERD) during the planning stage. A pre-audit site visit was conducted February 7-8, 1994. ERD's response to the information request

memorandum, combined with the pre-audit site visit and planning activities with EM and ERD, formed the basis for the document entitled "Plan for the Comprehensive Baseline Environmental Audit of Former Underground Test Areas in the States of Colorado, New Mexico and Nevada" (see Appendix B), which included a preliminary agenda for field visits. The team modified the preliminary agenda throughout the audit as more information was obtained and additional areas of interest were identified.

Before the team arrived at the site, interviews were conducted in Germantown, Maryland, with the Albuquerque Laboratory and Nevada Programs Division (EM-452) staff responsible for management of environmental restoration activities at NV. At the site, audit activities included interviews with ERD, Desert Research Institute (DRI), International Technology Corporation (IT), and Environmental Protection Agency's (EPA) Environmental Monitoring Systems Laboratory (EMSL) personnel, as well as document reviews (including previous audit and self-assessment reports). The team conducted a debriefing that was open to NV, DRI, and IT personnel. No regulatory officials attended the onsite debriefing or were contacted by the team prior to or during the onsite phase of the audit. Lists of site documents reviewed and interviews conducted are provided in Appendices C and D, respectively. Using these sources of information, the audit team developed findings as discussed in Sections 2.0, 3.0, and 4.0 of this report.

Deficiencies identified by the audit team are defined as findings that, in the judgment of the team, may not satisfy environmental regulations, applicable DOE Orders, environmental permit conditions, or compliance agreements with regulatory agencies.

Each finding is prefaced by a performance objective(s) that specifies the particular standard that is not being met. The findings are not arranged in order of significance.

During the audit, DOE and contractor activities were reviewed for noteworthy practices, i.e., activities or programs that have general application to DOE functions and may warrant special recognition for the purpose of transferring these processes to other DOE programs.

The purpose of this audit was to identify causal factors that contributed to the observed environmental deficiencies. Identification of the apparent causal factors contributing to each finding was essential in determining root causes. To understand the reasons a finding was identified, a systematic "apparent causal factor" analysis was performed. (See Appendix E for definitions of causal factors.) This approach was initiated by a series of "why" questions concerning the causes of the finding. The apparent causes were compiled and the bases for those causes are given in the supporting information for each finding. The apparent causal factors will be used to determine the actions required to correct the deficiencies found and to prevent recurrence.

1.4 BACKGROUND AND PROJECT DESCRIPTION

Between 1961 and 1973, the U.S. Atomic Energy Commission (now the United States Department of Energy) conducted underground nuclear testing at eight locations non-contiguous to NTS. These test areas are located in the States of Alaska, Mississippi, Colorado, Nevada, and New Mexico. (See Figure 1-1 for the locations of the test areas throughout the United States.) Field reviews of FUTAs in Colorado, Nevada, and New Mexico were conducted as part of the audit; detailed descriptions of these areas are

Figure 1-1. Locations of Former Underground Test Areas in the U.S.

presented in Section 4.0 of the report. Background information on, and a brief description of, each project conducted at these locations are presented below.

Alaska

Amchitka Island, Alaska, the southernmost island in the Rat Island group in the Aleutian chain, was the site of three nuclear detonations. LONGSHOT was an 80-kiloton nuclear test conducted by the U.S. Department of Defense on October 29, 1965, at a depth of 2,300 feet. LONGSHOT's event measurements were used to develop technology to detect underground nuclear detonations as part of the Vela Uniform Program. MILROW was a 1-megaton seismic calibration test conducted on October 2, 1969, at a depth of 4,000 feet. CANNIKIN, a test of the approximately 5-megaton proposed warhead for the Spartan missile, was conducted on November 6, 1971, at a depth of 5,875 feet.

Mississippi

The State of Mississippi has one site where two underground nuclear detonations occurred. Project STERLING and Project SALMON were conducted as part of the Vela Uniform Program to obtain event measurements relating to the detection of underground nuclear detonations. Project SALMON was conducted at a depth of 2,717 feet in a domed salt structure on October 22, 1964, and had a yield of 5.5 kilotons. Project STERLING was detonated on December 3, 1966, in the cavity remaining after Project SALMON and had a yield of 380 tons. Two methane-oxygen explosions also were detonated in the test cavity on February 2, 1969, and April 19, 1970.

These underground detonations were located in Lamar County, Mississippi, 21 miles southwest of Hattiesburg, Mississippi. The property is held in private ownership, but DOE has sole and exclusive right to regulate and control access to the subsurface and the right to prevent removal of any material. DOE is in the process of acquiring all rights to the test area.

Nevada

Underground nuclear testing has been conducted at NTS near Mercury, Nevada, since its establishment in the 1950s. Testing was also conducted at two other locations in the State: Project FAULTLESS and Project SHOAL.

Project FAULTLESS was the only nuclear test conducted at the Central Nevada Test Area, located in southern Nevada, 60 miles east of Tonopah. The purpose of the test was to determine the behavior of seismic waves generated by nuclear device detonation in Hot Creek Valley and to evaluate the potential usefulness of the site for high-yield experiments. The device was detonated at a depth of 3,200 feet on January 19, 1968, and had a yield of 1 megaton. The detonation produced an unusual collapse crater which resulted in a large irregular block bounded by local faults.

Project SHOAL was conducted 30 miles southeast of Fallon, Nevada, as part of a joint Department of Defense-Atomic Energy Commission program to improve the ability to detect and identify underground nuclear explosions. The device was detonated on October 26, 1963, with an estimated yield of 12.0 kilotons. Two experiments were conducted as part of the project, the first to determine the effect of nuclear detonation in granite (all

previous experiments were conducted in tuffaceous material) and the second to compare the seismic activity of natural earthquakes with that of underground nuclear explosions.

Colorado

Two locations in Colorado were sites for underground nuclear detonations: Project RIO BLANCO and Project RULISON.

Project RIO BLANCO, located 36 miles northwest of Rifle, Colorado, consisted of simultaneous detonation of three nuclear devices on May 17, 1973. The project was the third gas production experiment in the Plowshare Program and was designed to fracture a 1,300-foot section of a tight gas formation. The nuclear devices were located at depths of 5,839, 6,230 and 6,690 feet, and had a total explosive yield of approximately 90 kilotons.

Project RULISON, located near Parachute, Colorado, was conducted at a depth of 8,426 feet on September 10, 1969, and had a yield of 43 kilotons. The project was the second Plowshare Program test devised to stimulate the production of gas from tight gas formations.

New Mexico

Two sites in New Mexico were used for underground nuclear detonations of Projects GASBUGGY and GNOME.

Project GASBUGGY, located 55 miles east of Farmington, New Mexico, was conducted at a depth of 4,240 feet on December 10, 1967, and had a yield of 29 kilotons. The project was part of the Plowshare Program and was the first underground nuclear detonation to determine the economic feasibility of stimulating natural gas production. Radionuclides were released to the atmosphere during the production testing of the gas wells in 1968, 1969, and 1973.

Project GNOME, the first event in the Plowshare Program, was conducted in Eddy County, New Mexico, approximately 30 miles southeast of Carlsbad. The test was to explore feasibility of isotope and power recovery, and to expand data on underground nuclear explosive phenomenology. The project was conducted in bedded salt at a depth of 1,216 feet on December 10, 1961, and had a yield of approximately 3 kilotons. The detonation resulted in a hemispheric cavity 134–196 feet in diameter and approximately 75 feet high, and an inadvertent vent to the atmosphere causing downwind fallout. A subsequent planned event at this location, Project COACH, was canceled.

1.5 ENVIRONMENTAL PROGRAMS AND ORGANIZATION

The DOE Office of Environmental Management formulates and directs programs designed to assist clean-up of DOE inactive waste sites and facilities, manage wastes, promote innovative environmental technologies that lead to permanent disposal solutions at reduced costs, and oversee the transition of surplus facilities. In support of the mission, the Office of Environmental Restoration (EM-40) provides guidance to programs and activities to achieve the goal of remediating inactive facilities and sites contaminated by wastes generated from past DOE nuclear operations. This office is responsible for all DOE

operations, facilities, or sites that serve or will serve no future production need and have been assigned to EM for environmental restoration.

Some of EM-40's functions include: management of remedial action programs and activities including all aspects of assessment and clean-up of inactive potential release sites; management of decommissioning and decontamination programs and activities that assure the safe caretaking of surplus nuclear facilities; and integration and development of systems. The organization chart of EM-40 is included as Figure 1-2.

Under the Deputy Assistant Secretary for Environmental Restoration (EM-40) and the Director of the Southwestern Areas Programs (EM-45), EM-452 is the program office responsible for establishing policy and program goals and objectives for environmental restoration activities at NV. Within NV, ERD has oversight responsibility for environmental restoration programs at NTS and eight former underground nuclear testing areas throughout the United States. The Director of ERD reports to the Assistant Manager for Environmental Restoration and Waste Management. An organization chart for NV is included as Figure 1-3 and an organization chart for the Environmental Restoration Division is included as Figure 1-4.

Three NV organizations support environmental monitoring activities at FUTAs. Through an interagency agreement, EMSL's Nuclear Radiation Assessment Division conducts sampling and analysis activities for the Long-Term Hydrological Monitoring Program (LTHMP) (see the Environmental Radiation Overview for a detailed discussion of LTHMP), which includes performing the groundwater and surface water sampling in the vicinity of FUTAs. The Radioanalysis Branch does the actual radionuclide determinations and sample counting. IT is NV's environmental support contractor at NTS, as well as the investigator for remedial investigation and feasibility studies at FUTAs. DRI also conducts special studies and investigations for NV at NTS and FUTAs. DRI's large staff of highly skilled and educated personnel has focused primarily on hydrogeologic issues and concerns.

Office of the Deputy Assistant Secretary for Environmental Restoration

Figure 1-2. DOE Office of Environmental Restoration
Organization Chart

Nevada Operations Office

Figure 1-3. Nevada Operations Office Organization Chart

Nevada Operations Office, Environmental Restoration Division

Figure 1-4. Nevada Operations Office Environmental Restoration Division Organization Chart

SECTION 2.0

SUMMARY OF AUDIT RESULTS

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2.0

SUMMARY OF AUDIT RESULTS

This section of the report summarizes the results and conclusions of the Office of Environmental Audit's (EH-24's) Comprehensive Baseline Environmental Audit of Former Underground Test Areas (FUTAs) in the States of Colorado, Nevada, and New Mexico conducted May 16-27, 1993.

Consistent with the Secretary's decentralization policy, the Albuquerque Laboratory and Nevada Program Division (EM-452) and the Nevada Operations Office's (NV) Environmental Restoration Division (ERD) manage environmental protection activities at FUTAs by emphasizing a clear distinction between Headquarters and field functions. EM-452 establishes program goals and policy for FUTAs, develops guidance, and conducts performance evaluations to measure ERD's performance. ERD is responsible and directly accountable for implementing environmental protection activities for FUTAs, including managing activities of the Desert Research Institute (DRI), International Technology Corporation (IT), and the Environmental Protection Agency's Environmental Monitoring Systems Laboratory (EMSL); planning and developing environmental monitoring programs; and ensuring compliance with Federal, State, and local regulations. Although this management approach has resulted in distinctly different roles, responsibilities, and authorities for each organization, both organizations are committed to working as a team, each supportive of the other, to achieve program goals and implement EM policy. This close working relationship between EM-452 and ERD was brought about by frequent and effective informal and formal communication between both organizations as evidenced by well-documented, clearly communicated organizational roles, responsibilities, and authorities that are understood by all personnel; and effective oversight of and assistance to ERD's environmental protection activities by EM-452. In addition, virtually all of the findings reported by the audit team were self-identified, and ERD has already made considerable progress in formulating a strategy for FUTAs since EM received program responsibility in November 1993. With the addition of more staff and funding, and the early involvement of the Environmental Protection Agency (EPA) and State regulators, the audit team is confident that ERD will develop long-term environmental programs that will ensure protection of the environment and the public and demonstrate the Department of Energy's (DOE) commitment to environmental excellence.

2.1

STRENGTHS

The team identified the following oversight and project management strengths during the conduct of the audit:

- Staff Technical Qualifications – EM-452 and ERD staff interviewed during this audit are highly qualified to manage programs and projects effectively and perform technical evaluations of environmental activities that are the responsibility of their respective organization. Notably, all of the management and staff have considerable technical experience in fields such as hydrology, geology, groundwater management, or geochemistry, which facilitates developing a thorough understanding of the environmental issues confronting the program.
- Internal Communications – Formal and informal communication within and between EM-452 and ERD has been successful in achieving a thorough

understanding of roles, responsibilities, and authorities within and between both organizations. In addition, frequent and informal communication among EM-452, ERD, IT, and DRI has brought about close working relationships that are used to promote efficient and effective management of environmental protection activities at FUTAs.

- Oversight – EM-452 management and staff provide a high degree of oversight through continual field visits and program and performance evaluations. EM-452 is also regarded by ERD, IT, and DRI as an additional source of expertise that is often called upon for opinions on the feasibility of technical solutions associated with environmental problems at NTS or at other test areas. Additionally, NV has created a position for a hydrology programs manager that reports to the Assistant Manager for Environmental Restoration and Waste Management. One of the main responsibilities of this position is to maintain close coordination among various hydrogeologic activities, whether or not they are associated with FUTAs, to ensure that overlap of hydrogeologic programs, plans, and projects is kept to a minimum. Because this position reports directly to the Assistant Manager for Environmental Restoration and Waste Management, the incumbent can effectively integrate all NV hydrogeology and hydrology activities, allowing for efficient use of EM resources for these activities and for sharing lessons learned among and between programs.

2.2 KEY FINDING

In the judgment of the team, the key finding presented below is integral to understanding the nature and scope of the environmental protection activities at FUTAs assessed.

ERD lacks adequate staff and budget authority to manage and oversee environmental protection activities effectively for FUTAs.

ERD oversight of FUTAs is limited by inadequate staffing and a lack of budget authority for FUTAs. Although ERD is likely to receive approval from EM to add, by the end of the current calendar year, 12 or 13 full-time-equivalent (FTE) employees, one of whom will be responsible for providing management oversight of FUTAs, additional staff will be required for management and oversight of FUTAs as remedial investigation and feasibility study (RI/FS) activities increase in the future. The lack of a budget to perform all needed environmental protection activities for FUTAs was inherited during the transfer of program responsibility from the Office of Defense Programs (DP) to EM in November 1993. Although a budget is expected for FUTAs in Fiscal Year 1996, some reprogramming of resources will be necessary until the budget is authorized.

2.3 FINDINGS SUMMARY

The following paragraphs briefly describe the findings in each of the disciplines included in the audit. The number of findings identified is not directly proportional to the level of environmental protection offered by a program.

Thirteen findings were identified during the audit. These are considered to represent situations where conditions or practices do not meet the requirements of Federal and State regulations, and/or DOE Orders and directives. None of the findings appear to pose near-term threats to public health and the environment.

Environmental Management (EM). Two findings were identified in the environmental management portion of this audit, one in the staff resources section relating to ERD's lack of staff resources for oversight of FUTAs and one in the environmental planning and risk management section relating to the lack of funding of environmental protection activities at FUTAs.

ERD oversight of environmental activities at FUTAs currently is restricted in its scope by limited staff; however, ERD has received tentative approval from EM to add 12 or 13 FTEs, one of whom will be responsible for providing management oversight of FUTAs, by the end of the calendar year. ERD's oversight of environmental activities at FUTAs also has been restricted in its scope by limited funding available to support FUTA programs.

Groundwater (GW). One finding was identified in the groundwater portion of the audit. ERD lacks a plan that adequately characterizes FUTAs according to DOE Orders, the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), or the National Contingency Plan. Characterization of the hydrogeologic regime is essential to develop an effective sampling and analysis program that can monitor and assess the impact of former underground nuclear tests on the environment.

Quality Assurance (QA). One quality assurance finding was identified during the audit. ERD has not established requirements for formal QA programs with all its contractors performing environmental monitoring and surveillance tasks associated with FUTAs. The environmental management plan (EMP) only discusses data quality objectives (DQOs) for tritium analysis and gamma counting. DQOs are not specified for other radionuclides, such as plutonium-239 or strontium-90, that may require analysis. EMSL appears to have adequate QA associated with the analysis of groundwater samples obtained for the Long-Term Hydrological Monitoring Program (LTHMP). Formal well-sampling protocols, however, have been lacking. A QA program does not currently exist for DRI programs, in part because adequate funding has not been available to develop a QA program for its activities.

Environmental Radiation (RAD). One radiological finding was identified during the audit. ERD has neither evaluated all FUTAs nor established an appropriate rationale and design for long-term radiological environmental monitoring and surveillance activities as required by DOE Orders. The current LTHMP attempts to detect radionuclide contaminants in public drinking water supplies, but it is not adequate to characterize the aquifers and groundwater. Both ERD and EM realize the inadequacies of LTHMP and have recently completed a draft planning document that describes a strategy for evaluating FUTAs.

Inactive Waste Sites (IWS). No inactive waste sites findings were identified during the audit.

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SECTION 3.0

OVERVIEWS AND PROGRAMMATIC ENVIRONMENTAL FINDINGS

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3.0

OVERVIEWS AND PROGRAMMATIC ENVIRONMENTAL FINDINGS

The findings presented in the following pages are not necessarily in order of importance. They are grouped by area of investigation, as listed in the Performance Objectives and Criteria for Conducting DOE Environmental Audits (DOE/EH-0358), and are preceded by an overview. The overview describes the approach the management or technical specialist took in conducting that portion of the audit, the Nevada Operations Office (NV) programs and activities related to the area of investigation, characterization of the strengths and weaknesses of NV activities, and a brief summary of the finding(s).

Each finding is organized into three sections: a performance objective, a finding statement, and a discussion. The performance objective specifies the particular practices or standards, as described in DOE/EH-0358, against which the finding is being evaluated. A list of the environmental laws and regulations, DOE Orders, and DOE environmental policies reviewed in this audit is provided in Table 3-1. The discussion details the facts and observations supporting the finding and also provides a summary of the causal factors for the deficiency.

Within each finding, references to other findings, interviews, and documents are presented parenthetically. An example of a referenced finding is "(see Finding GW-1)," in which "GW" refers to "Groundwater" and "1" is the finding number. Abbreviations used to identify findings areas are as follows:

EM	Environmental Management
GW	Groundwater
QA	Quality Assurance
RAD	Radiation
IWS	Inactive Waste Sites

These abbreviations are used so that the reader can more easily determine the specific areas of investigation from which the finding was derived.

Specialists on the team covered more than one of the areas listed above, and interviews and document reviews quite often were completed with multiple areas of responsibility in mind. In order to reduce unnecessary duplication when referencing interviews and documents, they are identified by specialist rather than by area. An example of a referenced interview is "(I-A-1)," in which "I" signifies an interview, "A" represents a team member as identified below, and "1" is the specifically assigned sequential interview number. Documents referenced are designated "D" for document, followed by the letter designation for the team member and a sequential number (e.g., D-A-1). The lists of documents reviewed and interviews conducted are presented in Appendices C and D respectively.

Apparent causal factors discussed for the findings are defined in Appendix E.

TABLE 3-1
FEDERAL REGULATIONS, REQUIREMENTS, AND GUIDELINES
EVALUATED AS PART OF THE AUDIT

Requirements/ Guidelines	Sections/Title	Authority
Executive Order 12580	Superfund Implementation	Office of the President
33 U.S.C. 1251 et seq.	Clean Water Act	EPA
40 U.S.C. 9601, Section 103	Comprehensive Environmental Response, Compensation, and Liability Act – Notices, Penalties	EPA
40 U.S.C. 9601, Section 120	Comprehensive Environmental Response, Compensation, and Liability Act – Federal Facilities	EPA
42 U.S.C. 6901 et seq.	Resource Conservation and Recovery Act	EPA
42 U.S.C. 7401 et seq.	Federal Water Pollution Control Act	EPA
Titles I-VI	Clean Air Act Amendments of 1990	EPA
10 CFR 834 (Draft January 8, 1991)	Radiation Protection of the Public and Environment	DOE
29 CFR 1910.120	Occupational Safety and Health Standards, Hazardous Waste Operations and Emergency Response	OSHA/EPA
40 CFR 50-88	Clean Air Act Implementing Regulations	EPA
40 CFR 112	Oil Pollution Prevention	EPA
40 CFR 122/123	National Pollutant Discharge Elimination System (NPDES)/State Pollutant Discharge Elimination System (SPDES)	EPA
40 CFR 131	Water Quality Standards	EPA
40 CFR 141	National Primary Drinking Water Regulations	EPA
40 CFR 142	National Primary Drinking Water Regulations Implementation	EPA
40 CFR 260-280	Hazardous Waste Regulations	EPA
40 CFR 300	National Oil and Hazardous Substances Contingency Plan (NCP)	EPA
40 CFR 302	Designation, Reportable Quantities, and Notification	EPA
40 CFR 355	Emergency Planning and Notification	EPA

TABLE 3-1 (Cont'd)
FEDERAL REGULATIONS, REQUIREMENTS, AND GUIDELINES
EVALUATED AS PART OF THE AUDIT

Requirements/ Guidelines	Sections/Title	Authority
40 CFR 370	Hazardous Chemical Reporting: Community Right-To-Know Act	EPA
40 CFR 372	Toxic Chemical Release Reporting	EPA
40 CFR 761	Polychlorinated Biphenyls (PCBs) Manufacturing, Processing, Distribution in Commerce, and Use Prohibitions	EPA
DOE 3410.1B	Training	DOE
DOE 4320.1B	Site Development Planning	DOE
DOE 4700.1	Project Management System	DOE
DOE 5000.3B	Occurrence Reporting and Processing of Operations Information	DOE
DOE 5400.1	General Environmental Protection Program	DOE
DOE 5400.3	Hazardous and Radioactive Mixed Waste Program	DOE
DOE 5400.4	Comprehensive Environmental Response, Compensation, and Liability Act Requirements	DOE
DOE 5400.5	Radiation Protection of the Public and the Environment	DOE
DOE 5480.1B	Environment, Safety, and Health Program for Department of Energy Operations	DOE
DOE 5480.4	Environmental Protection, Safety, and Health Protection Standards	DOE
DOE 5480.19	Conduct of Operations Requirements for DOE Facilities	DOE
DOE 5480.20	Personnel Selection, Qualification, Training, and Staffing Requirements at DOE Reactor and Non-Reactor Nuclear Facilities	DOE
DOE 5482.1B	Environment, Safety and Health Appraisal Program	DOE
DOE 5484.1	Environmental Protection, Safety, and Health Protection Information Reporting Requirements	DOE
DOE 5500.3A	Emergency Notification, Reporting, and Response Levels	DOE
DOE 5700.6C	Quality Assurance	DOE
DOE 5820.2A	Radioactive Waste Management	DOE

TABLE 3-1 (Cont'd)
FEDERAL REGULATIONS, REQUIREMENTS, AND GUIDELINES
EVALUATED AS PART OF THE AUDIT

Requirements/ Guidelines	Sections/Title	Authority
DOE 6430.1A	General Design Criteria	DOE
DOE/EH-0070	External Dose Conversion Factors for Calculation of Dose to the Public	DOE
DOE/EH-0071	Internal Dose Conversion Factors for Calculation of Dose to the Public	DOE
DOE/EH-0125	DOE Environmental Audit Manual	DOE
DOE/EH-0173T	Environmental Regulatory Guide for Radiological Efficient Monitoring and Environmental Surveillance	DOE
DOE/EH-0256T	Radiological Control Manual	DOE
DOE/EH-0263T	Implementation Manual for Application of Best-Available Technology Process for Radionuclides in Liquid Effluents	DOE
DOE/EH-0326	Protocols for Conducting Environmental Management Assessments of DOE Organizations	DOE
DOE/EH-0358	Performance Objectives and Criteria for Conducting DOE Environmental Audits	DOE
January 1994 Draft Final	DOE Environmental Audit Program Guidance	DOE
June 8, 1993, Secretarial Policy Statement (58 FR 117)	Radiological Health and Safety Policy	DOE
November 1992 Guidance	Implementation Guide for Radiological Survey Procedures (Draft)	DOE
Interim Guide March 8, 1991	DOE Guidance on the Procedures in Applying the ALARA Process for Compliance with DOE 5400.5	DOE
Implementation Guidance	Implementation Guidance for DOE Order 5400.1	DOE
EPA-450/4-87-013	On-site Meteorological Program Guidance for Regulatory Modeling Applications	EPA
OSWER Directive 9355.3-01	Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA	EPA
ANSI N13.1-1969	Guide to Sampling Airborne Radioactive Materials in Nuclear Facilities	ANSI

3.1 ENVIRONMENTAL MANAGEMENT

3.1.1 Overview

The purpose of the environmental management portion of the audit was to evaluate whether the management of the Albuquerque Laboratory and Nevada Programs Division (EM-452) and NV's Environmental Restoration Division (ERD) ensures compliance with environmental protection guidelines and promotes excellence for activities at the former underground test areas (FUTAs). The regulations, requirements, and guidelines used to assess environmental management compliance are listed in Table 3-1.

The focus of the audit was to determine the following:

- Whether the organizations have clear lines of authority, well-defined roles and responsibilities, and sufficient organizational structure;
- Whether communication is effectively used to share information both internally within ERD and EM-452, and between EM-452 and ERD;
- Whether staff resources are sufficient to develop and implement environmental protection programs; and
- Whether environmental planning and risk management programs such as short- and long-term planning activities, priority setting, and allocation of resources are sufficient to meet programmatic and regulatory needs.

The general approach was to focus on four management areas: organizational structure, internal and external communication, staff resources, and environmental planning and risk management. The approach involved a review of DOE Orders and applicable background documents, including organization charts, functional descriptions, environmental management program plans, mission statements, and activity data sheets (ADSs). Interviews were conducted with NV management and staff and with ERD support contractors from the Desert Research Institute (DRI), International Technology Corporation (IT), and the Environmental Protection Agency's Environmental Monitoring Systems Laboratory (EMSL). These contractors have historically provided and continue to provide support for environmental protection activities and groundwater monitoring at both the Nevada Test Site (NTS) and FUTAs. In addition, before the onsite activities, interviews were conducted at the Department of Energy (DOE) Headquarters with EM-452 and the Office of Development Testing and Acquisition (DP-25) to better understand the transition of programmatic responsibilities from the Office of Defense Programs (DP) to EM.

Organizational Structure. The organizational structure and environmental functions in both EM-452 and ERD are well defined, clearly communicated, and understood by all persons interviewed during this audit.

Programmatic responsibility for FUTAs was officially transferred from DP to EM in November 1993. Since that time, EM-452 has formally been assigned responsibility to oversee ERD's performance of environmental protection activities associated with FUTAs. Roles, responsibilities, and accountabilities are documented in job descriptions and are clearly communicated, well defined, and understood by personnel in both EM-452 and ERD.

(D-A-14 and D-A-15). In addition, reporting relationships within ERD are well defined, clearly communicated, and effectively integrated into the overall organizational structure (D-A-13; I-A-1).

Internal and External Communication. Interviews were conducted with EM-452 and ERD to identify barriers or impediments to the flow of environmental information and to assess whether communication of environmental compliance information effectively reaches all organizational levels.

Elements of an internal communication system evaluated included regular formal processes such as staff meetings, management reports, routing of key documents, memorandums, as well as informal processes such as telephone calls and informal meetings. External communication efforts reviewed included interfaces with regulatory and external oversight groups, contractors performing work for ERD, and community programs. The team did not conduct interviews with State regulatory representatives from Colorado, Nevada, or New Mexico.

Formal internal communication in the form of memorandums, project plans, and technical strategy plans is regularly exchanged between and among EM-452, ERD, DRI, and IT. These exchanges have been successful in helping to establish a strong and cooperative working relationship that is effective in developing programmatic priorities. Informal channels of communication are also encouraged as a means of furthering cooperation between these organizations.

Communication between ERD and Federal and State regulators in Nevada, Alaska, and Mississippi appears to be conducted in an effective manner because the public in these states receives information in a number of ways, such as public meetings and site-specific fact sheets, as part of NV's community relations activities (D-A-45; I-A-6). The team did not contact regulators in Colorado and New Mexico to assess the effectiveness of communication in those areas.

Staff Resources. As a result of the transfer of programmatic responsibility for FUTAs from DP to EM in November 1993, oversight of FUTAs has increased, and demands for oversight of all environmental activities for FUTAs will continue to increase as anticipated remedial investigations/feasibility studies (RI/FS) are performed in conjunction with the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) process. ERD has one program manager dedicating approximately 30 percent of his time to issues concerning FUTAs. This is an insufficient staffing level to oversee environmental activities of FUTAs and to meet other environmental protection responsibilities, especially in light of future RI/FS activities at FUTAs (I-A-1 and I-A-13).

As regulations and programs change and/or accelerate at FUTAs, additional oversight and reporting to EM and the regulatory agencies will place greater burdens on ERD. ERD is anticipating approval of an additional 12 or 13 new full-time-equivalent (FTE) employees from EM. ERD has indicated its intention to assign one of the new FTEs to provide additional management and oversight of FUTAs (I-A-1 and I-A-13). The audit team viewed the need for additional staff as critical in adequately meeting environmental goals at FUTAs.

Environmental Planning and Risk Management. This portion of the audit included a review of short- and long-term environmental planning, financial planning, and resource allocation, and prioritization of projects to identify and address environmental risks.

Planning for environmental restoration programs at FUTAs is conducted through several mechanisms and includes participation by EM-452, ERD, IT, DRI, and EMSL. In this process a program manager in ERD coordinates with contractors and EM-452 to develop strategic plans for each FUTA (I-A-7 and I-A-13). Once this process is completed, it is expanded into a project plan (D-A-38). At the project level, each contractor prepares project-specific work and management plans that are reviewed and approved by ERD staff.

ADSs are fundamental budget formulation documents used by ERD (D-A-34). ADSs are developed by each program manager and include proposed projects, information on priority and funding levels, and a short narrative description of proposed activities. ADSs are the basic worksheets used to develop the 5-year plan and are updated annually. Prioritization of projects and resource allocation for corrective actions are determined by the program manager. The technical scope, assumptions, and funding for individual activities are provided in the current year's work plans. ADSs are submitted to DOE Headquarters by ERD on an annual fiscal-year basis, along with technical scope summaries and schedules.

As a result of limited funding from DP, ERD has not been able to allocate sufficient resources to fund environmental activities at FUTAs. Both EM and ERD realize that effective management of and planning for environmental restoration and monitoring activities must contain a commitment of funds to perform these activities. They are currently requesting a budget of approximately \$4.0 million for Fiscal Year 1996 to cover environmental monitoring and RI/FS activities at all FUTAs, identification and characterization of environmental risks associated with FUTAs, implementation of community relations programs, and modifications to Agreements in Principal with Colorado and New Mexico to include FUTAs.

Two findings were identified in the environmental management portion of this audit, one relating to ERD's lack of staff for oversight of FUTAs, and the other concerning the lack of funding for FUTA environmental programs.

3.1.2 Findings

EM-1: **Staff Resources**

Performance Objective: Best management practices suggest that an organization responsible for oversight, assessment, and environmental compliance activities have adequate staff levels to achieve its goals.

Finding: ERD does not have adequate environmental staff to effectively manage and oversee FUTAs to ensure compliance with all regulatory requirements.

Discussion: ERD is responsible for providing oversight to ensure that environmental protection programs are implemented by IT, DRI, and EMSL, and that NV is compliant with all appropriate Federal, State, and local regulations at FUTAs. ERD currently has 12 full-time-equivalent (FTE) employees, and expects to add 12 or 13 more within the year. Currently one FTE is spending approximately 30 percent of his time overseeing the eight FUTAs (I-A-1 and I-A-13). An increase in ERD staffing levels is necessary, given the level of effort required to ensure that eight FUTAs in five states comply with all Federal, State, and local regulations, develop formal community relations plans, and oversee remedial investigation and feasibility study activities and ongoing and future characterization and monitoring activities to achieve environmental goals. As a result of limited staff resources, NV has not been able to modify Agreements in Principal with New Mexico and Colorado to include FUTAs, has not formalized community relation plans for each FUTA (with the exception of test areas in Mississippi and Alaska), and has not adequately characterized the test areas and identified the environmental risks associated with past testing activities.

It is critical that ERD assure EM-452 that environmental protection activities are appropriate in size and cost while meeting all environmental protection and regulatory compliance requirements. To ensure this, additional staff above current FTE levels must be allocated. At least one additional FTE is expected to be allocated to FUTAs in the near future, but ERD management expects that an additional one or two FTEs are necessary to meet the programmatic and regulatory needs for FUTAs (I-A-1 and I-A-6).

The probable causal factors for this finding are risk in that DP did not give the risks associated with failing to meet environmental requirements a high priority and therefore staff resources were not allocated; and change, in that EM has only recently been given programmatic responsibility for FUTA environmental programs and has not had sufficient time to reallocate FTEs as of this audit.

EM-2: Funding of Environmental Activities

Performance Objective: Best management practices suggest that the commitment of funds for environment-related activities be satisfactory to serve the organization's environmental performance goals.

Finding: EM, and formerly DP, have not provided a commitment of funds for environmental protection activities to meet ERD environmental performance goals for FUTAs.

Discussion: Before transferring programmatic responsibility to EM in November 1993, DP provided limited funding of approximately \$330,000 per year for long-term monitoring at all FUTAs (D-A-46). The budget provided only enough funds to perform groundwater sampling and analysis efforts at FUTAs but not to plan and implement other environmental protection activities. Remediation and clean-up efforts at the Mississippi and Alaska FUTAs were accomplished by reprogramming environmental restoration funds at NV. As a result of the lack of sufficient funds to meet the environmental protection goals for all FUTAs, ERD has been unable to effectively characterize hydrogeologic aspects and identify risks associated with each test area, develop and implement community relations plans, and modify Agreements in Principal with Colorado and New Mexico to include FUTAs (I-A-1 and I-A-13).

EM and ERD realize that effective management of and planning for environmental restoration and monitoring activities must contain a commitment of funds sufficient to perform these activities. They are requesting a budget of approximately \$4.0 million for Fiscal Year 1996 to cover environmental monitoring and remedial investigation and feasibility study (RI/FS) activities at all FUTAs. Funding of monitoring and RI/FS activities at NTS and in Mississippi has received priority over similar activities at FUTAs in Colorado, Nevada, and New Mexico. This prioritization was primarily a result of public scrutiny of the FUTA in Mississippi (I-A-1 and I-A-15). Should the test areas in Colorado, Nevada, and New Mexico receive intense public scrutiny in the near future, ERD will not be in a position to adequately characterize the environmental risks to the public (I-A-13 and I-A-15). Planned funding to perform monitoring and RI/FS activities at FUTAs has been distributed over the next five years; however, should further investigation indicate that installation of additional monitoring wells be required at FUTAs in Colorado, Nevada, and New Mexico, it is unlikely that these levels will be adequate (D-A-30 and D-A-34; I-A-13).

The apparent causal factors for this finding are risk, in that the risks associated with FUTAs in Colorado, Nevada, and New Mexico were not considered when all environmental protection activities were prioritized by DP; and change, in that EM has only recently been given oversight responsibility.

3.2 GROUNDWATER

3.2.1 Overview

The purpose of the groundwater portion of the audit was to evaluate the programmatic and technical status of groundwater protection and monitoring programs at FUTAs. The standards used to assess the sites were the Performance Objectives and Criteria for Conducting DOE Environmental Audits (DOE/EH-0358). The performance criteria are established in DOE Orders; applicable Federal, State, and local regulations; industry guidance; and best management practices. The regulations include the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) as amended by the Superfund Amendments and Reauthorization Act (SARA), and the National Contingency Plan (NCP). The Federal regulations, requirements, and guidelines used to assess compliance are listed in Table 3-1. The State requirements include Colorado Rules and Regulations for Water Well Construction and Pump Installation, Colorado Ground Water Standards, Colorado Hazardous Waste Clean Up Acts, Nevada Water Quality Standards, Nevada Water Pollution Control Law, New Mexico Water Quality Regulations, New Mexico Environmental Department procedures for plugging and abandoning monitoring wells, and New Mexico Remedial Action Contingency Plan Regulations. State regulations, requirements, and guidelines used to assess compliance are listed in Tables 4-1, 4-2, and 4-3.

The general approach to the audit was to interview personnel within EM-452, IT, DRI, and EMSL who have direct experience and knowledge of FUTAs. The approach also included a review of facility reports, field logs, maps, and other related documents; a list of the documents reviewed is included in Appendix C. Onsite inspections at SHOAL, GNOME, GASBUGGY, and RULISON were conducted to examine groundwater monitoring wells, identify potential sources of groundwater contamination, and verify documented information reviewed. Other audit team specialists (i.e. radiation, and management systems) were consulted to develop any common issues.

Groundwater management and planning for FUTAs is the responsibility of ERD. The test areas were previously the programmatic responsibility of DP and were transferred to EM in November 1993. The primary contractor for conducting groundwater investigations at most FUTAs is IT, with significant technical input from DRI. EMSL has conducted all groundwater monitoring operations since 1972 and plans to conduct future sampling and analysis activities. A close working relationship has developed among and between EM-452, ERD, EMSL, IT and DRI, which provides for efficient and effective management of groundwater protection activities at FUTAs.

Radionuclides, such as tritium, strontium, cesium, and iodine, associated with the tests are of principal concern to groundwater contamination, but other forms of contamination may be present at the sites. A survey of hazardous materials associated with the actual testing has been conducted; some of the materials found are polyvinyl chloride, polystyrene, phenolic, neoprene, lead, copper, beryllium, and zinc (D-B-12). Mud pits containing waste lubricating fluids used during drilling are present at each test area. These pits may contain elevated concentrations of metals, volatile organic compounds, and semi-volatile compounds and may contribute to soil and groundwater contamination. Other activities such as disposal of material into wells and the emplacement hole after the detonation of a nuclear device may also contribute to contaminating groundwater. Complete

characterization of each FUTA is just starting, with the goal of determining the nature and extent of all contamination.

Investigative and groundwater monitoring activities at FUTAs are generally performed in accordance with Federal and State guidelines. ERD personnel indicated that the various EPA regions associated with FUTAs are aware of these sites and public health departments in New Mexico and Colorado receive results of the sampling in the Offsite Environmental Monitoring Report (I-B-87).

Although groundwater monitoring is currently conducted at FUTAs, no formal rationale for the sampling locations is available, and some of the current sampling locations may in fact be located in areas hydrologically isolated from the test cavity.

Considerable geologic and hydrogeologic data are available that were collected during the planning and post-detonation stages of each test. This information will be reassessed and, based upon the interpretation of this information, additional investigations and installation of monitoring wells could be required.

Inadequacies in groundwater protection activities for the test areas stem from insufficient resources, i.e., inadequate funding and staff, and the short time EM has had programmatic responsibility for these test areas. EM and ERD are requesting budget authority to fund groundwater protection activities for all FUTAs; they are aware of deficiencies in the program and are developing a plan for correcting the deficiencies (I-B-1, 7-9).

One finding was identified in the groundwater portion of this audit, pertaining to the lack of a plan to adequately characterize the geology, hydrogeology, and contamination at FUTAs.

3.2.2

Finding

GW-1

Site Characterization Plan

Performance Objective: DOE 5400.4 Section 7.a states "It is the policy of DOE to respond to releases and potentially imminent releases of hazardous substances where such releases are on, or the sole source of the release is from, any facility . . . under DOE jurisdiction, custody or control. . . ." This response shall be in accordance with the provisions of the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), as amended, as well as those of the National Contingency Plan (NCP) and Executive Order 12580. The Order further states "DOE responses shall include both removal and/or remedial actions, as appropriate, to reduce adverse impacts on public health and the environment from releases regardless of whether the facility is listed on the National Priorities List."

CERCLA and NCP (40 CFR 300.430) have guidelines for contamination assessments. These guidelines state that groundwater should be adequately characterized to understand flow path, source verification of contaminants, and other hydrogeologic features.

The NCP states (40 CFR 300.430 (d) (1)) that the purpose of the remedial investigation is to collect data necessary to adequately characterize the site for the purpose of developing and evaluating effective remedial alternatives.

Finding: ERD has not developed a plan to define aquifer relationships, subsurface stratigraphy, extent of contamination, background conditions, and local flow paths and velocities for FUTAs in accordance with DOE Orders, CERCLA, or the NCP.

Discussion: Proper characterization of the hydrogeologic regime is essential in order to develop an effective sampling and analysis program that can monitor and assess the impacts of former underground nuclear tests on the hydrogeologic regime. In general, the following information is unavailable at all of FUTAs:

- locations of major fracture traces and faults through which groundwater is most likely to travel;
- the permeability, porosity, and interconnectedness of fractures;
- lateral and vertical extent of the contaminant plume;
- groundwater and contaminant flow directions and velocities;
- the structure and physical properties of the test cavity;
- the nature of groundwater flow within and/or through the test cavity; and
- identification of the source term necessary for groundwater modeling.

The 1992 Annual Site Environmental Report stated that local flow directions at NTS can be radically different from the regional trend as a result of large topographic changes across the area and the importance of fractures to groundwater flow onsite. This is likely to be

true for most, if not all, of FUTA locations. For example, characterization of the fracture system is of particular importance at the SHOAL site because the detonation point was located in a granitic-rock body where fractures will likely determine the direction of groundwater flow. DRI stated that there are a number of large uncertainties about groundwater flow under the SHOAL test area. Most of the uncertainty is due to a lack of data on flow conditions in the fractured granite of the Sand Springs Range, which resides near ground zero of the test (D-B-3).

Another aspect of characterization is proper location of groundwater monitoring wells. Many of the wells currently sampled are not located to assess groundwater flow or contaminant migration near the cavity. Only a few wells are located down-gradient of the cavity at the test areas. For example, DRI noted that the Long-Term Hydrological Monitoring Program sampling locations at the GASBUGGY site cannot ensure that contaminants are not migrating offsite, but only that certain water supplies have not yet been contaminated; this is also true for most other test areas (D-B-3; I-B-1 and I-B-7).

Most of the wells used in the long-term Monitoring Program were not initially designed as monitoring wells; however, because of the limited funds available for improvements to the program, the wells still are being used for sampling groundwater. Later assessment by DRI has determined that sampling of some of these wells provides no information regarding contaminant migration (D-B-3).

The current sampling procedures of the deep wells are also insufficient for proper site characterization. The sampling conducted by EMSL collects water from only one location within a well. It is not known whether the location corresponds to the location of the contamination. DRI is currently investigating vertical spatial variation of concentrations in a well at the GASBUGGY site, but not in all wells that are being used to assess migration of contaminants from the test cavity.

A significant amount of geologic and hydrogeologic information was collected for the underground tests, but the information has not been compiled into a comprehensive document for each test area. Since the cost of installing new wells at these sites is very high, this information will assist ERD in determining the need to select well locations.

In addition to characterizing the hydrogeologic regime, soils should be assessed for nonradiological contamination because, in general, there is a lack of information regarding nonradiological contamination at each test area. Pits were excavated during the drilling of the emplacement hole to receive lubricating muds and fluids. One of these pits at the FAULTLESS site was sampled and toxicity-characteristic leaching procedures indicated that elevated concentrations of chromium were present (I-B-9). It is possible the mud pits at the remaining sites received similar materials. These pits should be completely characterized to determine the potential presence of any Hazardous Substance List compounds such as volatile organic compounds, semi-volatile compounds, and metals.

The apparent causal factor for this finding is the lack of resources, in that sufficient funding and associated personnel have not been available to develop a plan to characterize all FUTAs.

3.3 QUALITY ASSURANCE

3.3.1 Overview

The purpose of the environmental quality assurance (QA) program portion of the audit was to evaluate whether NV has environmental QA programs in place to ensure that relevant programs, procedures, and practices meet regulatory and standards requirements for accurate, representative, and reliable environmental data.

Environmental QA program issues were specifically evaluated against the QA requirements in DOE 5400.1, "General Environmental Protection Program"; DOE 5700.6C, "Quality Assurance"; and DOE/EH-0173T, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance." The regulations, requirements, and guidelines used to assess compliance are listed in Table 3-1.

The team assessed key QA issues that are incorporated in the following information provided by NV, IT, DRI, and EMSL:

- Environmental Monitoring Plan (EMP);
- Annual Addenda to the EMP;
- Offsite Environmental Reports by EPA;
- Environmental QA Program;
- regular QA audits, appraisals, and surveillances;
- formal procedures for environmental activities;
- QA aspects of laboratory and field activities; and
- QA in workplans and special investigations.

The general approach used for identifying issues and conducting the audit of the environmental QA programs included interviews with NV, EMSL, IT, and DRI personnel responsible for program development and implementation, as well as review of documentation supporting these programs. Areas of particular interest included the following:

- established formal plans, procedures, and protocols;
- clearly defined responsibilities and authorities;
- requirements for staff training and/or experience;
- control of recordkeeping, reporting, and documents;
- verification and validation of computer software; and

- oversight and review of programs.

The audit team also conducted inspections of several FUTAs, specifically the SHOAL, GNOME, GASBUGGY, and RULISON test areas. The scope of the audit also included the FAULTLESS and RIO BLANCO test areas, which were not visited. Other FUTAs in Mississippi (SALMON and STERLING) and Alaska (LONGSHOT, MILROW, and CANNIKIN) were not included in the scope of this audit, although they were discussed in interviews because they are included in the Long-Term Hydrological Monitoring Program (LTHMP).

ERD has three organizations supporting environmental monitoring activities at FUTAs. Through an interagency agreement, EMSL's Nuclear Radiation Assessment Division conducts sampling and analysis activities for LTHMP (see the Environmental Radiation Overview for a detailed discussion of LTHMP) and the Radioanalysis Branch does the actual radionuclide determinations and sample counting. IT is NV's environmental support contractor at NTS, as well as the investigator for remedial investigation and feasibility studies at FUTAs. DRI also conducts special studies and investigations for ERD at NTS and FUTAs. DRI's large staff of highly skilled and educated personnel has focused primarily on hydrogeologic issues and concerns.

For over two decades LTHMP has been the major environmental activity for monitoring migration of radionuclides from FUTAs (see Finding RAD-1). QA associated with actual sample analysis appears to be appropriate; however, EMSL has only recently documented an acceptable standard operating procedure for well sampling. ERD's lack of data quality objectives for radionuclides other than tritium and gamma counting is also a concern. The team determined that the funding associated with past DRI investigations of FUTAs has been inadequate to allow development of a comprehensive QA program for these activities; the result could adversely affect the credibility of data currently being generated (see Finding QA-1). The team concluded, nonetheless, that IT has a well-developed QA program, which should aid the development of defensible data that can be used to assess compliance with Federal and State regulations.

One finding was identified in the environmental quality assurance portion of the audit pertaining to the lack of established QA requirements for all environmental monitoring activities associated with FUTAs.

3.3.2

Finding

QA-1: Environmental Quality Assurance Program

Performance Objective: DOE 5400.1, "General Environmental Protection Program," Chapter IV, Section 10, requires that contractors establish a quality assurance (QA) program, consistent with DOE 5700.6C, that covers each element of environmental monitoring and surveillance programs and that is commensurate with the program's nature and complexity.

DOE 5700.6C, "Quality Assurance," states "It is DOE policy to establish quality assurance requirements to assure that risks and environmental impacts are minimized, and that safety, reliability, and performance are maximized through the application of effective management systems commensurate with the risks posed by the facility. . . ."

Finding: NV has not established requirements for formal QA programs with all its contractors performing environmental monitoring and surveillance tasks associated with FUTAs.

Discussion: NV has three organizations performing environmental monitoring and surveillance tasks associated with FUTAs—EMSL, IT, and DRI. EMSL's Nuclear Radiation Assessment Division has been conducting sampling for the Long-Term Hydrological Monitoring Program (LTHMP) for more than two decades, and the Radioanalysis Branch currently performs the tritium analysis, gamma counting, and other radiochemical evaluations. The Environmental Radiation Overview and Finding (RAD-1) discusses the objectives of LTHMP more completely, but the two basic activities are collecting and analyzing groundwater samples for radionuclides from wells, springs, and bodies of surface water near FUTAs (I-C-2 and I-C-3). Over the years, DRI has performed special hydrogeological studies in the regions near many of the test areas. These studies are mainly hydrogeologic in nature and may involve determination of groundwater flow patterns, evaluation of well integrity, and optimization studies on well installation (I-C-7 and I-C-8). DRI recently performed a critique of the groundwater monitoring at FUTAs, based on existing reports and data, and made a number of recommendations for program improvements. During actual field investigations, DRI may log or sample wells for tritium and other stable isotopes as part of a specific investigation (I-C-8). Until November 1993, funding for LTHMP was the responsibility of DP, and funds for past investigations performed by DRI on FUTAs have not been sufficient for an adequate level of quality assurance consistent with DOE 5700.6C (I-C-7 and I-C-8). Through document review and interviews with various NV and contractor staff, several deficiencies were noted in the Environmental Quality Assurance Program as it pertains to FUTAs. These deficiencies are noted below:

- EMSL appears to have an adequate level of QA associated with the analysis of groundwater samples obtained for LTHMP (D-C-80, D-C-81, and D-C-82). There has been, however, a lack of formal well sampling protocols (I-C-2, I-C-3, and I-C-10). This could potentially invalidate years of LTHMP data (I-C-1 and I-C-10). ERD recognized this concern and recently required EMSL to develop written procedure for well sampling that are acceptable to ERD (I-C-1, I-C-10, and I-C-79).

- DRI is a contractor with unique hydrogeological expertise and very good academic qualifications. As a DOE contractor, it needs to maintain a QA program commensurate with the complexity and nature of its investigations, and that will ensure the validity and soundness of study conclusions relating to investigations of FUTAs. A QA program does not currently exist, in part because adequate funding was not available to develop a QA program for its activities.
- ERD has developed an Environmental Monitoring Plan (EMP) for NTS and FUTAs (D-C-61). The EMP quality assurance and quality control section only addresses EMS sample collection and analysis as it relates to LTHMP activities. Quality assurance and quality control requirements for other contractors (i.e., DRI and IT) are not stated. The EMP only discusses Data Quality Objectives (DQOs) for tritium analysis and gamma counting; DQOs are not specified for other radionuclides, such as plutonium-239 or strontium-90, that may require analysis.

The team reviewed IT's QA program during the onsite portion of the audit. IT is an environmental support contractor for NTS and will be responsible for remedial investigation and feasibility studies (RI/FS) under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) for FUTAs. The team found that IT has an adequate QA program for such activities and has been proactive by incorporating recently developed draft ANSI-E4 standards (for environmental sampling) into its program (I-C-9 and I-C-11).

The apparent causal factors for this finding are resources, in that DP did not allocate sufficient funds for DRI studies; appraisals, in that DP failed to provide appropriate oversight of LTHMP; and policy implementation, in that ERD has not developed a comprehensive QA program for all environmental monitoring and surveillance activities for FUTAs.

3.4 ENVIRONMENTAL RADIATION

3.4.1 Overview

The purpose of the environmental radiation portion of the audit was to evaluate whether ERD has programs in place to ensure compliance with Federal, State, and local environmental laws and regulations. Additionally, the audit was to determine whether ERD implements DOE Orders designed to protect the environment and public health with respect to FUTAs.

Environmental radiation protection issues were specifically evaluated against DOE 5400.1, "General Environmental Protection Program"; DOE 5400.5, "Radiation Protection of the Public and the Environment"; DOE 5820.2A, "Radioactive Waste Management"; DOE 5400.4, "Comprehensive Environmental Response, Compensation, and Liability Act Requirements"; DOE/EH-0173T, "Environmental Regulatory Guide for Radiological Effluent Monitoring and Environmental Surveillance"; and Secretarial Policy Statement dated June 8, 1993, "Radiological Health and Safety Policy"; as well as accepted industry practices and standards of performance. The regulations, requirements, and guidelines used to assess environmental radiation compliance are presented in Table 3-1.

The environmental radiation portion of the audit also was to determine whether effective and comprehensive environmental radiation protection programs were in place and whether there are sufficient planning, oversight, and staff for these programs. This portion of the audit also evaluated the extent to which NV has developed and implemented specific programs and plans that, if properly managed, would help maintain compliance and reduce potential legal and financial liabilities associated with FUTAs.

The team assessed issues that are incorporated in the following information provided before and during the audit:

- Environmental Monitoring Plan (EMP);
- Annual Addenda to the EMP;
- Annual Site Environmental Reports for NTS and FUTAs;
- Offsite Environmental Reports by EPA;
- Groundwater Protection Management Program Plan;
- Decontamination and Decommissioning (D&D) Plans and Reports for FUTAs;
- Environmental As Low As Reasonably Achievable (ALARA) Program;
- Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Preliminary Assessment;
- Specific reports on studies/investigations at FUTAs; and
- ERD oversight of FUTA support contractors.

The general approach used for identifying issues and conducting the audit of the environmental radiation protection programs consisted of interviews with ERD, EMSL, and contractor personnel responsible for program development and implementation, as well as review of documentation supporting these programs. Areas of particular interest to the team included the following:

- understanding of applicable regulatory requirements;
- long-term monitoring of FUTAs;
- responsibilities for program development and implementation;
- adequate characterization of FUTAs;
- regular monitoring and surveillance of FUTAs;
- appropriate analysis of groundwater and other media samples;
- formality of environmental radiation protection programs;
- detection of radionuclide migration from FUTAs; and
- requirements for training, recordkeeping, and reporting.

The scope of this audit also included onsite visits to several FUTAs and associated monitoring locations. Specifically, the SHOAL, GNOME, GASBUGGY, and RULISON FUTAs were visited. The FAULTLESS and RIO BLANCO areas were within the scope of the audit, but were not visited. Other FUTAs in Mississippi (SALMON and STERLING) and Alaska (LONGSHOT, MILROW, and CANNIKIN) were not included in the scope of this audit, although they were discussed in interviews since they are included in the Long-Term Hydrological Monitoring Program (LTHMP).

The above-noted FUTAs resulted from two major programs (Plowshare and Vela Uniform) initiated by the AEC to develop peaceful uses for nuclear devices. Investigations were performed to fracture tight rock formations to increase gas flow and to improve understanding of the characteristic of seismic waves generated by underground nuclear detonations. A specific goal of the Vela Uniform Program was to improve the capability to detect, identify, and locate underground nuclear detonations and differentiate them from other seismic events. These tests began in the early 1960s and continued for a decade. Although each underground detonation had unique objectives, many shared common post-test aspects. For example, blast cavities often were re-entered through drilling, and natural gas stimulation tests required gas production and flame-burn programs. Activities such as these resulted in the release of radionuclides to the environment at some FUTAs. The principal radionuclide released was tritium (H-3), but mixed-fission products (e.g., cesium-137 (Cs-137) and strontium-90 (Sr-90)) that were accidentally released to the atmosphere have also been detected at the GNOME site. This site was also chosen for a groundwater tracer study in which curie levels of H-3, Cs-137, Sr-90, and iodine-131 were injected into a well. The GNOME site surface areas have been decontaminated twice, most recently in 1979. It is not clear, however, whether release clean-up guidelines were comparable to current standards (i.e., DOE 5400.5, Chapter IV). Most FUTAs visited do

not have any surface structures, except for a surface ground-zero marker. Additionally, most have been surveyed for radiological contamination and cleared for unrestricted access. The team is confident that these sites do not pose an acute risk to public health and safety; however, a critical radionuclide pathway analysis has not yet been performed for FUTAs.

The initial radiological monitoring in the vicinity of FUTAs has been conducted by the U.S. Public Health Service, the U.S. Geologic Survey, EPA, and various commercial contractors. Various groundwater monitoring activities at NTS and FUTAs were consolidated into the Long-Term Hydrological Monitoring Program (LTHMP) in 1972. Since that time DOE and EPA have implemented an interagency agreement giving responsibility for LTHMP to EMSL's Nuclear Radiation Assessment Division. NRD collects the groundwater samples near FUTAs and the Radioanalysis Branch performs the radioanalyses. Routine samples are analyzed for H-3 and are counted for gamma emitters. The audit team has nonetheless raised concerns regarding the sampling of "target of opportunity" wells and the ability to detect early radionuclide migration, the lack of groundwater flow data at some FUTAs, unknown source term inventories in the test cavities, and the appropriateness of not screening samples for alpha and beta radiation emitters. For more than two decades LTHMP was the only program DP used for environmental monitoring in the vicinity of FUTAs. EM and ERD, after being given responsibility for FUTAs, drafted a strategy for managing FUTAs that follows CERCLA processes. Many of the recommendations are based on studies DRI conducted for ERD. DRI often has been contracted to perform special hydrogeological studies at the NTS and FUTAs and has a proven record of providing high-quality work products relating to FUTA studies. Additionally, ERD has contracted with IT to provide environmental support services with regard to remedial investigation and feasibility studies at FUTAs.

ERD recognizes the need to expand and modify the monitoring and surveillance programs for FUTAs and has been proactive in performing a CERCLA Preliminary Assessment and draft strategy for managing these sites. To date, ERD has been inadequately funded and staffed to address all the requirements necessary, but this deficiency is expected to change during the next several years. LTHMP is meeting the stated objective of monitoring drinking water supplies near FUTAs, but it is unlikely that current sampling would detect low-level radionuclide migration at most sites because the sampling locations are not based on groundwater gradient flow data. Further, there are no radiological surveillance activities for other media (i.e., soil, sediment, vegetation, or biota). Given this perspective, LTHMP is not meeting the performance requirements of DOE Orders.

A strength worth noting is that ERD and contractor staff appear to have appropriate experience and training for the development of the needed programs. The staff also show a great deal of dedication and enthusiasm for their individual areas of responsibility. The NV staff's active field involvement and continual oversight is noteworthy. One finding was identified in the environmental radiation area, addressing the need to evaluate and develop a rationale and design for long-term radiological environmental monitoring and surveillance.

3.4.2 Finding

RAD-1: Environmental Radiation Protection Programs

Performance Objective: DOE 5400.1, "General Environmental Protection Program," requires a written environmental monitoring plan for each site that releases significant pollutants, environmental surveillance screening to determine the need for a permanent surveillance program, and an environmental monitoring plan that contains the rationale and design criteria for the monitoring program.

Finding: ERD has not developed an environmental monitoring plan documenting the rationale and design for long-term radiological environmental monitoring and surveillance activities, as required by DOE 5400.1.

Discussion: NV has established a Long-Term Hydrological Monitoring Program (LTHMP) to determine whether radioactivity from underground nuclear tests has contaminated the groundwater in the vicinity of FUTAs. LTHMP was an outgrowth of monitoring activities performed during and after the underground nuclear tests, and during clean-up operations at the test areas. Oversight responsibility for FUTAs resides with DOE. As of November 1993 the funding and program responsibility moved from DP to EM. The task of groundwater sampling and analysis in the vicinity of FUTAs has been assigned to EMSL's Nuclear Radiation Assessment Division (NRD) in Las Vegas, Nevada, through an interagency memorandum of understanding (I-C-2, I-C-3, and I-C-10). The primary objective of LTHMP is to safeguard the public drinking water supply from radioactive contaminants created by nuclear testing (D-C-61). NRD has responsibility to collect groundwater samples, analyze samples for tritium (H-3) and gamma emitters, detect radionuclide migration, and ensure the safety of local drinking water; NRD believes that much of the sampling was fundamentally driven by the need for good public relations (I-C-2 and I-C-3). ERD recognizes that the LTHMP attempts to detect radionuclide contaminants in public drinking water supplies, but that it is not adequate to characterize the aquifers and groundwater. The Environmental Monitoring Plan (EMP) also assumes that groundwater is the principal media to be monitored, and tritium is the primary radionuclide of interest (D-C-61). Both ERD and EM realize the inadequacies of LTHMP, and have recently completed a draft planning document that describes a strategy for evaluating FUTAs (D-C-14).

The team reviewed numerous program plans and documents during the course of this audit and conducted interviews with ERD, EMSL, IT, and DRI staff; the team found all staff to be knowledgeable in their areas of responsibility and dedicated to providing quality work products. Funding for special investigations at FUTAs, however, had been inadequate while DP had programmatic responsibility (I-C-7, I-C-8, and I-C-10).

A number of deficiencies were noted during the audit that relate to environmental radiation monitoring and surveillance programs for FUTAs. These deficiencies are as follows:

- DOE 5400.1 requires that a written environmental monitoring plan be prepared for each site that uses, generates, releases, or manages significant pollutants or hazardous materials. The current EMP that covers FUTAs is inadequate with respect to the rationale and design criteria for the radiological monitoring programs for FUTAs. Additionally, DOE 5400.1

requires that an environmental surveillance screening program be undertaken for a DOE activity onsite and offsite to determine the need for a permanent surveillance program. The design of such a program is to satisfy the objectives of verifying regulatory compliance, characterizing trends, establishing baselines of environmental quality, and identifying new or existing environmental quality problems. The Lawrence Livermore National Laboratory recently performed a pilot study of risk assessment of selected programs at NTS (D-C-77). The study examined several pathways and scenarios for exposure and dose to the public from radionuclides. Similar studies have not been performed for FUTAs to determine long-term radiological environmental monitoring and surveillance needs (I-C-7, I-C-8, and I-C-10).

- A groundwater monitoring program and plan are required by DOE 5400.1 to determine and document the effects of DOE activities on groundwater quality and to demonstrate compliance with applicable Federal, State, and local laws and regulations. The program sampling plan, sampling analysis, and data management should document the rationale for selecting sample types and locations. Groundwater monitoring programs conducted in the vicinity of DOE activities have general requirements to obtain baseline conditions, demonstrate regulatory compliance, provide early detection of contamination, provide reporting mechanisms, identify existing contamination sources, provide data for decisions concerning land disposal, and protect groundwater resources. DOE 5400.1 also requires program design in accordance with Resource Conservation and Recovery Act (RCRA) requirements, if applicable. Similar considerations should be examined for FUTAs, which are inactive waste sites being managed under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA). The current NTS Groundwater Protection Management Program Plan, however, does not consider any of the above elements or requirements in its discussions of FUTAs (D-C-74) (also see Finding GW-1). The Plan only briefly describes LTHMP objectives, but it does note DRI's recommendations for program improvements. Other deficiencies related to the current FUTA groundwater monitoring program as it pertains to radiological monitoring are as follows:
 - Radionuclide inventories have not been determined for each FUTA test cavity and local area (I-C-4 and I-C-10). Of concern are the fates of the specific special nuclear material used in a given device such as Plutonium-239 (Pu-239) or Uranium-235 (U-235), other radionuclides that may have been used (i.e., tritium), mixed fission product yield, and activation products (i.e., chlorine-36 (Cl-36)). This information is essential for proper pathway analysis and future risk projections. ERD has recognized this and has contracted groups from Lawrence Livermore National Laboratory and Los Alamos National Laboratory to make the needed calculations (I-C-4). There is concern, however, that the information will not be immediately declassified and this may affect DOE's credibility in future public forums (I-C-1).
 - Groundwater monitoring wells currently being sampled for LTHMP are "targets of opportunity"; few monitoring wells near the test cavities

would allow early detection of radionuclides (I-C-2, I-C-3, I-C-7 and I-C-8). Additionally, data are lacking that would characterize groundwater flow at some FUTAs. An example is the SHOAL test area, which is located at a groundwater divide. The SHOAL test area also may have a unique hydrogeologic consideration in which radiologically contaminated groundwater could be forced to the surface by saline groundwater in a nearby playa. Another example and area of concern is the characterization of radionuclides introduced into a well near the GNOME site for tracer studies.

- Most FUTAs required some degree of decontamination of surface areas during decommissioning and before release for unrestricted access. Sites typically had decontamination and decommissioning (D&D) plans, as well as release restrictions on future subsurface use, and required placement of a permanent marker at surface ground zero (D-C-49). DOE 5820.2A, "Radioactive Waste Management," has a similar sitemark requirement for low-level waste facility evacuations. A recent property inventory of FUTAs and an onsite survey by the audit team found that the sitemark at the SHOAL test area has been destroyed and removed from surface ground zero (D-C-10). Related to this concern is the lack of routine or recent radiological environmental monitoring and surveillance. Specifically, the GNOME test, which vented and produced surface contamination during reentry drilling, has not been surveyed or reevaluated since the second site D&D in 1979. Decontamination criteria (e.g., 30,000,000 picocuries per liter (pCi/l) for tritium in soil moisture) and final survey results have not been evaluated against current guidelines for cleanup of residual radioactive material required by DOE 5400.5, "Radiation Protection of the Public and the Environment."

The apparent causal factors for this finding are resources, in that DP did not allocate sufficient funds for comprehensive radiological investigations of FUTAs; the evaluation by DP of risk associated with FUTAs; and the change in regulatory requirements relating to the monitoring of inactive waste sites.

3.5 INACTIVE WASTE SITES

3.5.1 Overview

The purpose of the inactive waste sites (IWS) portion of the audit was to evaluate the inactive waste site activities associated with FUTAs. The general approach to the IWS portion included interviews with personnel from EM-452, ERD, IT, DRI, and EMSL who have direct experience and knowledge of FUTAs. In addition the evaluation included review of facility reports, letters of correspondence, and other site-related documents. A list of documents reviewed is presented in Appendix C. The regulations, requirements, and guidelines used to assess IWS compliance are presented in Table 3-1.

During the audit, team specialists in radiation and management systems were consulted to identify issues applicable to both disciplines. Site visits of FUTAs were conducted to examine any inactive waste sites and to verify documented information reviewed during the audit.

The IWS portion of the audit focused primarily on plans and activities conducted at FUTAs. The issues addressed in these plans included inactive waste site program planning, sampling and analysis, and technical assessment of the sites. The programs were also assessed to ensure that they sufficiently integrate groundwater and radiation issues, and that they represent a proactive sitewide effort to discover and assess the overall environmental conditions of FUTAs.

FUTAs were previously the programmatic responsibility of DP and were transferred to EM in November 1993. This situation has not provided sufficient time for EM to ensure that all documents have been sent to the appropriate Federal, State, and local agencies and that proper notification has been provided. Management of FUTAs is presently administered through ERD. IT is the primary contractor for conducting inactive waste site investigations, with technical support provided by DRI; groundwater monitoring activities are conducted by EMSL.

The basis for site assessment and potential cleanup is radioactivity associated with the tests, but other forms of contamination may be present at the sites. For example, mud and flare pits where hazardous materials may have been disposed are of principal concern with respect to inactive waste sites. Drums and underground storage tanks may also remain at FUTAs (I-B-10). Elevated concentrations of metals, volatile organic compounds, and semi-volatile compounds may be present and pose a threat to human health. The primary threat, however, is likely to be to the livestock and wildlife that roam in these areas and are subsequently ingested by humans.

Various EPA regions associated with FUTAs are aware of these sites, and scores DOE calculated on FUTAs, using EPA's Hazard Ranking System, are not sufficient to place FUTAs on the EPA's National Priority List (D-B-1; I-B-8). Technical reviews and assessments have been conducted and onsite activities have occurred at all FUTAs to some degree. Onsite activities include sampling and analysis of groundwater, some downhole investigations, and collection of soil samples from some mud pits for the purpose of identifying non-radiological contamination in surface soils (I-B-9). Notification of FUTAs in Alaska and Mississippi (not reviewed for this audit) has been provided to the EPA regions and the States, and remedial investigation and feasibility studies (RI/FS) are

underway at the SALMON test area; however, RI/FS studies for the remaining FUTAs in Nevada, New Mexico, and Colorado have not been initiated.

No findings were identified in the inactive waste sites portion of the audit.

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SECTION 4.0

STATE COMPLIANCE FINDINGS

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4.0 STATE COMPLIANCE FINDINGS

4.1 COLORADO UNDERGROUND TEST AREAS

The purpose of this section of the report is to provide the results of reviewing each of the test areas in Colorado against the State requirements. A list of regulations and requirements used in this review is presented in Table 4-1.

4.1.1 Projects Overview

Project RIO BLANCO was a joint government/industry experiment to determine whether nuclear explosives could be used to stimulate the production of natural gas. The experiment was designed by CER Geonuclear Corporation (CER) and Lawrence Livermore National Laboratory. CER evaluated the Equity Oil Company leases in 1970, and a project definition agreement was signed between the U.S. Atomic Energy Commission (AEC) and CER on December 18, 1970. Emplacement of three 33-kiloton nuclear devices took place on May 3, 4, and 5, 1973; then these devices were simultaneously detonated on May 17, 1973, at depths of 5,839, 6,230, and 6,690 feet, respectively. Gas production testing and project evaluation continued through June 1976. The test area clean-up and restoration planning phase began in December 1975 and was concluded with the issuance of an operational plan in May 1976. Restoration activities continued between July and November 1976, during which time all project-related wells were plugged and abandoned.

Located in Northwest Colorado, the test area is 36 miles northwest of Rifle, Colorado, and consists of access roads and graded areas returned to natural vegetation. (See Figure 4-1 for the location of the test area.) The public land surface and subsurface rights to the emplacement well and the flare stack site are administered by the Bureau of Land Management.

Project RULISON was the second nuclear gas-stimulation experiment, co-sponsored by AEC and the Austral Oil Company. It was designed to determine the potential increase in natural gas production by using a nuclear explosive in the RULISON Field, Garfield County, Colorado. On September 10, 1969, under the technical direction of Los Alamos Scientific Laboratory, a 43-kiloton fission-type nuclear explosive was detonated at a depth of 8,426 feet in an emplacement well on Colorado's western slope. Production of natural gas took place over a 7-month period. Wells were shut-in after the last production test in April 1971 and left in a standby condition. Cleanup work to remove equipment and material not needed for possible future gas production at the test area began on July 10, 1972, and was completed by July 25, 1972. In September and October 1976, wells were abandoned and plugged. Any remaining equipment was decontaminated and removed from the test area.

Located in Northwest Colorado, the test area is about 6 miles southeast of Parachute, Colorado, and 14 miles southwest of Rifle, Colorado. (See Figure 4-2 for the location of the test area.) The site consists of a 150-square-foot fenced area, with a locked gate, enclosing surface ground zero and electrical and telephone lines. Surface rights were sold to the present landowner with subsurface rights to exercise limited drilling activity below 6,000 feet controlled by the U.S. Government.

TABLE 4-1

**STATE OF COLORADO REGULATIONS, REQUIREMENTS,
AND GUIDELINES EVALUATED AS PART OF THE AUDIT**

Requirements/ Guidelines	Sections/Title	Authority
Colorado Revised Statutes (CRS) 25-8-101	Colorado Water Quality Control Act	Dept. of Health
CRS 25-15-101	Colorado Hazardous Waste Act	Dept. of Health
CRS 25-15-501	Colorado Hazardous Waste Incinerator Siting Law	Dept. of Health
CRS 25-16-101	Colorado Hazardous Waste Cleanup Acts – Hazardous Waste Sites	Dept. of Health
CRS 25-16.5-101	Colorado Pollution Prevention Act	Dept. of Health
CRS 25-17-101	Colorado Plastics Recycling Act	Dept. of Health
CRS 25-18-101	Colorado Underground Storage Tanks Law	Dept. of Health
CRS 29-22-101	Colorado Hazardous Waste Cleanup Acts – Hazardous Substance Incidents	Dept. of Health
CRS 30-20-100.5	Colorado Solid Waste Disposal Sites and Facilities Law	Dept. of Health
CRS 37-90-101	Colorado Ground Water Management Act	Division of Water Resources
CRS 13-20-701	Colorado Hazardous Waste Cleanup Acts – Actions Based on Environmental Liability	Dept. of Health
Code of Colorado Regulations (CCR), Title 5, Article 2	Colorado Discharge Permit System Regulations	Dept. of Health
CCR, Title 5, Chapter 1002, Article 3	Colorado Water Quality Control Regulations	Dept. of Health
CCR, Title 5, Article 5	Colorado Primary Drinking Water Regulations	Dept. of Health
CCR, Title 5, Article 8	Colorado Ground Water Standards	Dept. of Health
CCR, Title 5, Chapter 1002, Article 8	Colorado Water Quality Standards	Dept. of Health

TABLE 4-1 (Cont'd)

**STATE OF COLORADO REGULATIONS, REQUIREMENTS,
AND GUIDELINES EVALUATED AS PART OF THE AUDIT**

Requirements/ Guidelines	Sections/Title	Authority
CCR, Title 5, Regulation 1002-20	Colorado Pretreatment Regulations	Dept. of Health
CCR, Title 2, Regulation 410-1	Colorado Ground Water Regulations	Ground Water Commission
	Colorado Rules and Regulations Pertaining to Radiation Control	Dept. of Health
CCR, Title 6, Chapter 1007, Article 2	Colorado Waste Facility Siting Rules	Dept. of Health
CCR, Title 6, Chapter 1007, Article 3	Colorado Standards for Specific Hazardous Wastes and Facilities	Dept. of Health
CCR, Title 6, Chapter 1007, Article 3	Colorado Hazardous Waste Notification and Permit Rules	Dept. of Health
CCR, Title 6, Chapter 1007, Article 3, Parts 260-263	Colorado Hazardous Waste Management Regulations	Dept. of Health
CCR, Title 6, Regulation 1007-3, Part 268	Colorado Land Disposal Restrictions Regulations	Dept. of Health

Figure 4-1. Rio Blanco Test Area

Figure 4-2. Rulison Test Area

4.1.2 Findings

CO-1: Radiological Characterization of Groundwater

Performance Objective: According to Section 3.1.11 of the Colorado Water Quality Standards and Part C of the Colorado Ground Water Standards, radioactive materials in surface and groundwaters shall be maintained at the lowest practical level and should not exceed 20,000 picocuries per liter (pCi/l) for tritium and 8 pCi/l for strontium-90.

Additionally, Part C of the Colorado Ground Water Standards states that all radioactive materials other than tritium and strontium-90 shall be maintained at the lowest practical level.

Section 7.1.2 of the Colorado Primary Drinking Water Regulations states that except for tritium and strontium-90 the concentration of man-made radionuclides causing 4 millirem total body or organ dose equivalents should be kept to a minimum.

Finding: ERD lacks a plan for the RIO BLANCO and RULISON test areas that provides an approach to characterize groundwater for radionuclides and demonstrate compliance with Section 3.1.11 of the Colorado Water Quality Standards, Part C of the Colorado Ground Water Standards, and Section 7.1.2 of the Colorado Primary Drinking Water Regulations.

Discussion: In a 1991 report titled "Evaluation of Groundwater Monitoring at Offsite Nuclear Test Areas," DRI's Water Resources Center questioned the effectiveness of many of the wells used for groundwater monitoring in detecting radiological contamination from the RIO BLANCO and RULISON tests. The report states that the current monitoring system is lacking because some of the sampling points are not optimally located with respect to the assumed hydraulic gradient, and most are too far from the potential source to allow the detection of anything other than large-scale migration. Additionally, tritium levels at the RIO BLANCO and RULISON test areas have been measured and found to be below the State limits, but no other radionuclides and pathway analyses have been considered to demonstrate that the radionuclides produced from the detonations result in population dose equivalents of 4 millirem per year or less to the general public.

ERD self-identified this finding and is actively pursuing development of hydrogeology characterization strategies and plans that will provide early detection of radiological and hazardous material contamination. The strategies and plans will also demonstrate conformance with State requirements by implementing an effective groundwater monitoring program designed to consider the hydrogeologic conditions at each FUTA.

The causal factors for this finding are change and resources, in that programmatic responsibility for FUTAs was transferred from DP to EM within the past year and EM has not had ample time to plan and budget all the resources necessary to meet all environmental compliance requirements.

CO-2: Permit Requirements

Performance Objective: Section 25-8-501 of the Colorado Water Quality Control Act and Section 6.4.0 of the Colorado Discharge Permit System Regulations state that no person shall discharge any pollutant, including radioactive material, into any State water from a point source without first having obtained a permit for such discharge.

Finding: ERD has not determined the need to submit permit applications to the State of Colorado for the point-source discharge of radionuclides at the RIO BLANCO and RULISON test areas.

Discussion: The point-source discharges of radionuclides and other hazardous materials as a result of Projects RIO BLANCO and RULISON have never been permitted. Although the Colorado law post-dates the detonation, radionuclides may be entering underground aquifer(s) in the immediate vicinity of the test cavity (D-A-1). In addition, a permit may have been required solely because of the planned disposal of tritium-, cesium-137-, and strontium-90-contaminated water into the deep zone in the FCG Well No. 1 at the RIO BLANCO site.

The appropriate regulatory interpretation of the Colorado Water Regulations is unclear with respect to point discharges and any residual discharges required to be permitted that pre-date the regulations. ERD has not contacted the State of Colorado to determine the need to submit permit applications for the point discharge of radionuclides at the RIO BLANCO and RULISON test areas.

The causal factors for this finding are change and resources, in that responsibility for FUTAs was transferred from DP to EM within the past year and EM has not had sufficient time to plan and budget all the resources necessary to meet all environmental compliance requirements.

CO-3: State Release Notification

Performance Objective: The Colorado Water Quality Control Act requires that the owner or operator of any process or activity that discharges pollutants into State waters establish and maintain records and report the discharge to the Division of Administration of the Colorado Department of Health.

DOE 5400.4 further requires that DOE facilities maintain appropriate contact with regulatory or oversight agencies, including DOE Headquarters, EPA regional personnel, and State and local personnel who may have jurisdiction over, or a legitimate interest in, activities being planned or taken for any DOE function, and to formally document the meetings and resulting action items.

Finding: ERD has not formally contacted the Division of Administration of the Colorado Department of Health concerning the discharge of pollutants to State waters at RIO BLANCO and RULISON test areas.

Discussion: DOE has a responsibility to inform the Division of Administration of the Colorado Department of Health, and if necessary EPA Region XIII, of the discharge of pollutants to State waters to ensure that the State is involved in planning, monitoring, and maintaining the test areas.

DOE 5400.4 requires that inactive waste sites be handled according to CERCLA processes, which require ERD to formally submit a Hazard Ranking System analysis for both sites not only to the EPA regional office but also to the State of Colorado. Documentation that can substantiate that this has been done is lacking, even though informal, verbal discussions may have occurred and copies of the monitoring reports may have been transmitted to the EPA and State officials over the past several years. In any event, there is a general lack of documentation on the discussions held with the region and State concerning these test areas.

The causal factor for this finding is change in that DP transferred responsibility for the site to EM in November 1993, and EM has not had sufficient time to develop a remediation strategy before approaching the State with information about the sites. Since this finding addresses only the notification to the State offices, it is also concluded that DOE policies concerning the handling of inactive waste sites covered by DOE Orders have not yet been fully implemented.

4.2 NEVADA UNDERGROUND TEST AREA

The purpose of this section of the report is to provide the results of a review of the SHOAL test area in Nevada against State requirements. A list of regulations and requirements used in this review is presented in Table 4-2.

4.2.1 Project Overview

Project SHOAL was part of the Vela Uniform Program, the purpose of which was to increase the understanding of characteristics of seismic waves generated by explosions. The test was conducted at a depth of 1,211 feet within the granite of the Sandy Springs Range. The project, sponsored by the Department of Defense and the Atomic Energy Commission, occurred on October 26, 1963, and had a yield of 12 kilotons. Deactivation and decommissioning activities occurred almost immediately after the event and the shaft was covered by a permanent concrete slab. All equipment and facilities were removed by January 31, 1964.

The approximately 4-square-mile test area is located in southern Churchill County, Nevada, about 30 miles southeast of Fallon, Nevada. (See Figure 4-3 for the location of the test area.) All excavations and ditches, except those required for permanent drainage, have been backfilled and returned to a natural state. The U.S. Government owns the land, and the Bureau of Land Management controls the surface rights.

TABLE 4-2

**STATE OF NEVADA REGULATIONS, REQUIREMENTS, AND
GUIDELINES EVALUATED AS PART OF THE AUDIT**

Requirements/ Guidelines	Sections/Title	Authority
Nevada Revised Statutes (NRS), Title 40, 444.440-444.620	Nevada Solid Waste Disposal Law	Dept. of Environmental Protection (DEP)
NRS, Title 40, 445.131-445.354	Nevada Water Pollution Control Law	DEP
NRS, Title 40, 459-400-459.600	Nevada Hazardous Waste Disposal Law	DEP
NRS, Title 40, 459.800-459.856	Nevada Underground Storage Tank Law	Dept. of Conservation and Natural Resources (DCNR)
Nevada Administrative Code (NAC) 444.570	Nevada Solid Waste Disposal Regulations	DCNR
NAC 444.842	Nevada Hazardous Waste Facility Regulations	DCNR
NAC 444.850	Nevada Hazardous Waste Management Regulations	DCNR
NAC 444.8752	Nevada Hazardous Waste Reduction Regulations	DCNR
NAC 445.070	Nevada Water Pollution Control Regulations	DEP
NAC 445.117	Nevada Water Quality Standards	DCNR
NAC 445.238	Nevada Pollutant Release Notification Rules	DCNR
NAC 445-244	Nevada Drinking Water Regulations	DCNR
NAC 445.422	Nevada Underground Injection Control Regulations	DCNR
NAC 459.9921	Nevada Underground Storage Tank Rules	DCNR

Figure 4-3. Shoal Test Area

4.2.2 Findings

NV-1: Hydrogeologic Characterization

Performance Objective: Nevada Water Quality Standards, Section 445.119, "Standards applicable to all waters," states that radioactive materials attributable to municipal, industrial, or other controllable sources must be the minimum concentrations, and in no case must the limits established in the 1962 Public Health Service Drinking Water Standards or later amendments be exceeded. The limit is 1/30th of the maximum permissible concentration values given for continuous occupational exposure in the "National Bureau of Standards Handbook No. 69." The concentrations in water must not result in accumulation of radioactivity in plants or animals that causes a hazard to humans or harm to aquatic life.

Finding: ERD lacks a plan for the SHOAL test area that provides an approach to characterize groundwater radionuclide migration and to demonstrate compliance with Section 445.119 of the Nevada Water Quality Standards.

Discussion: Annual groundwater sampling in the vicinity of the SHOAL test area in 1992 included one spring, one windmill, and four wells of varying depths. There is some question of representativeness of samples to detect contamination because of a lack of complete hydrogeologic information demonstrating hydraulic interconnectiveness to the SHOAL test area for these sampling locations. Although the direction of groundwater flow is not yet completely understood, the potential exists for movement of groundwater from the test cavity southeast toward Fairview Valley. Results of sampling in 1992 showed no gamma activity and tritium levels below the minimum detectable concentration, except from the Smith/James Spring, which was consistent with values obtained in previous years.

In a 1991 report titled "Evaluation of Groundwater Monitoring at Offsite Nuclear Test Areas," DRI's Water Resources Center stated that because the SHOAL device was detonated in a saturated zone, it can be assumed that the groundwater in the immediate vicinity of the test cavity is contaminated.

Although groundwater tritium levels thought to be associated with the SHOAL test have been measured and, except for one sampling location, were found to be below the minimum detectable concentration, other radionuclides have not been considered. Nor has there been a pathway analysis that would demonstrate that the radionuclides produced from the detonation are not hazardous to the general public. This consideration is particularly important at SHOAL since elevated tritium levels above the minimum detectable concentration have been detected at the Smith/James Spring and the surface above the cavity is used for cattle grazing.

A 1988 report titled "CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas," also reported that it can be assumed that the groundwater in the immediate vicinity of the test cavity is contaminated. Minor levels of radioactivity did reach the surface during drillback operations after the test but most of this release was gas that was safely channeled into filters and traps. Soil and cuttings contaminated with short-lived radioisotopes from the post-test drilling were mixed with clean soil and buried at the test area. A final radiological survey of the surface in 1964

showed no radiation levels above natural background and no radioactivity above background levels has been detected offsite.

NV self-identified this finding and is actively pursuing development of hydrogeology characterization strategies and plans that will (1) provide early detection of radiological and other hazardous material contamination and migration and (2) establish conformance with State requirements through implementation of a groundwater monitoring program designed to effectively monitor the groundwater and detect the migration of all contaminants from Project SHOAL activities.

The causal factors for this finding are change and resources, in that programmatic responsibility for the SHOAL test area was transferred from DP to EM only within the past year and EM has not had sufficient time to plan and budget all the resources necessary to meet all environmental requirements.

NV-2: Release and Reporting Requirements

Performance Objective: The Nevada Water Pollution Control Law, Section 445.221, states that it is unlawful for any person to discharge or inject any pollutant into any waters of the State, discharge from a point source a pollutant or inject fluids through a well that could be carried into the waters of the State, or allow a pollutant discharged from a point source or injected through a well to remain in a place where the pollutant could be carried into the waters of the State. In addition, Section 445.254 states "It is unlawful to discharge any radiological, chemical, or biological warfare agent or high-level radioactive waste into any waters of the State."

Section 445.4243 states "Any Class I or Class IV well under construction or in operation before July 22, 1987, must be reported by the owner or operator to the director within 30 days after that date."

Finding: ERD has not determined the need to submit State permit applications for wells or to develop well abandonment plans for the SHOAL test area.

Discussion: At a minimum, a permit may be needed for the SHOAL test area to meet the requirements of Section 445.221 because radioactive and other hazardous contaminants remaining in the cavity could migrate from the cavity into the waters of the State.

The regulatory interpretation of whether the onsite well could be considered an injection well has never formally been requested or made by ERD, and the State could rule that the SHOAL site contains an improperly abandoned injection well. Furthermore, if the State rules that the entry shaft is an injection well, DOE could be considered in non-compliance with the injection well reporting requirement of Section 445.4243. Although ERD has made informal, verbal contacts with the State of Nevada on this issue and has established a working dialog, formal documentation was not produced showing that the test area was officially excluded or "grandfathered" from the Nevada Water Pollution Control Law.

The causal factors for this finding are change and resources, in that programmatic responsibility for the SHOAL test area was transferred from DP to EM within the past year and EM has not had sufficient time to plan and budget all the resources necessary to meet all environmental compliance requirements.

4.3 NEW MEXICO UNDERGROUND TEST AREAS

The purpose of this section of the report is to provide the results of a review of each of the test areas in New Mexico against State requirements. A list of regulations and requirements used in this review is presented in Table 4-3.

4.3.1 Projects Overview

Project GASBUGGY was an experiment to investigate the feasibility of using nuclear explosives to stimulate the production of natural gas from underground reservoirs. On January 31, 1967, a contract to conduct the experiment was signed by the Atomic Energy Commission and the El Paso Natural Gas Company. A 29-kiloton device was detonated December 10, 1967, at a depth of 4,240 feet and 15 days of gas production tests were initiated. Demobilization work performed during August and September 1978 resulted in removal of all above-ground facilities (including fences) and grading, backfilling, and seeding of all disturbed areas.

The test area is located in the northwest corner of New Mexico, about 55 miles east of Farmington, New Mexico, and 20 miles southwest of Dulce, New Mexico. (See Figure 4-4 for the location of the test area.) After site clean-up and restoration, the land was returned to the Bureau of Land Management and the U.S. Forest Service for unrestricted use of the land surface. Drilling and excavation restrictions were imposed.

Project GNOME was the first scientific experiment conducted as part of the Plowshare Program and the first underground nuclear explosion outside of the Nevada Test Site. The objectives of Project GNOME were to determine the phenomenology of nuclear explosions in salt; determine the recovery of isotopes from salt medium, including special isotope additions; determine recoverable heat from the explosion; and obtain useful information for the design of other Plowshare events. A 3.1-kiloton device was detonated December 10, 1961, at a depth of 1,216 feet. Post-test activities were completed in June 1962. Removal of contaminated debris was initiated in April 1979 and continued through August 1979, when disposal of contaminated material was terminated because the cavity created by the detonation was full. All activities at the test area were terminated on September 23, 1979.

The test area is located approximately 30 miles southeast of Carlsbad, New Mexico, in Eddy County. (See Figure 4-5 for the location of the test area.) After final cleanup, the surface and all remaining surface facilities were returned to the custody of the Bureau of Land Management. Restrictions were placed on drilling activities at any depth between the surface and 1,500 feet.

TABLE 4-3

**STATE OF NEW MEXICO REGULATIONS, REQUIREMENTS,
AND GUIDELINES EVALUATED AS PART OF THE AUDIT**

Requirements/ Guidelines	Sections/Title	Authority
New Mexico Statutes (WP) 69-25A-1	New Mexico Surface Mining and Reclamation Acts	Energy and Minerals Dept. (DEM)
AM 74-4-1	New Mexico Hazardous Waste Act	Health and Environment Dept. (DHE)
New Mexico Statutes Annotated (NMSA) 74-4C-1	New Mexico Hazardous Waste Feasibility Study Act	DHE
NMSA 74-4E-1	New Mexico Right-to-Know Act	Dept. of Public Safety (DS)
DS 74-6-1	New Mexico Water Quality Act	Water Quality Control Commission (WQCC)
NMSA 74-8-1	New Mexico Solid Waste Acts	DHE
Environmental Improvement Board (EIB)/WSR 3	New Mexico Water Supply Regulations	Environment Dept. (DE)
EIB/HWMR-7	New Mexico Hazardous Waste Management Regulations	DE
Hazardous Waste Management Regulations	New Mexico Hazardous Waste Management Regulations	EIB
NM WQCC Regulations	New Mexico Water Quality Regulations	WQCC
	New Mexico Water Quality Standards for Interstate and Intrastate Streams in New Mexico	WQCC
NM Water Supply Regulations	New Mexico Drinking Water Regulations	DE
Solid Waste Management Regulations (SWMR)	New Mexico Solid Waste Management Regulations	EIB
SWMR, Part VII	New Mexico Special Waste Requirements Regulations	EIB

TABLE 4-3 (Cont'd)

**STATE OF NEW MEXICO REGULATIONS, REQUIREMENTS,
AND GUIDELINES EVALUATED AS PART OF THE AUDIT**

Requirements/ Guidelines	Sections/Title	Authority
SWMR, Part VIII	New Mexico Remedial Action Contingency Plan Regulations	Environmental Improvement Division
	New Mexico Underground Storage Tank Regulations	Health and Environment Department
Rule 80-1	New Mexico Surface Coal Mining Regulations	Surface Mining Commission, Energy and Minerals Department
Draft	New Mexico Regulations on the Licensing of Naturally-Occurring Radioactive Materials (NORM) in the Oil and Gas Industry	Department of Hazardous and Radioactive Materials Bureau
	Superfund Memorandum of Agreement Between the State of New Mexico and the U.S. Environmental Protection Agency, undated	Environmental Improvement Division

Figure 4-4. Gasbuggy Test Area

Figure 4-5. Gnome Test Area

4.3.2 Findings

NM-1: State Notification of Contaminant Levels

Performance Objective: New Mexico Remedial Action Contingency Plan Regulation 802.A states that the Department requires written notice within 60 days of verification and acknowledgement that a contaminant is present at remedial action levels (RAL).

Finding: ERD has not notified the State of New Mexico of contaminant concentrations exceeding RAL at the GNOME and GASBUGGY test areas.

Discussion: According to New Mexico regulations, RAL is defined as 25 percent increase in the concentration levels of a contaminant above a baseline value determined by historical sampling trends of the site. Groundwater sampling was not performed prior to underground testing at GNOME and GASBUGGY test areas to determine actual baseline conditions. Natural background concentrations of tritium in groundwater are considered to be in a range of 50 to 100 picocuries per liter (pCi/l); therefore, using this as a baseline, the RAL would be 125 pCi/l. Recent monitoring of groundwater tritium concentrations at both test areas indicate that levels of tritium exceed 125 pCi/l. ERD has not notified the State of New Mexico that a contaminant is present that exceeds RAL, in accordance with New Mexico Remedial Action Contingency Plan Regulations.

The causal factors for this finding are change and resources, in that responsibility for FUTAs was transferred from DP to EM within the past year and EM has not had sufficient time to plan and budget the resources necessary to meet all environmental compliance requirements.

NM-2: Discharge Requirements

Performance Objective: Section 3-104 of the New Mexico Water Quality Regulations states "[u]nless otherwise provided by these regulations, no person shall cause or allow effluent or leachate to discharge so that it may move directly or indirectly into groundwater unless he is discharging pursuant to a discharge plan approved by the director."

Section 207 of the New Mexico Drinking Water Regulations provides maximum contaminant levels for beta particle and photon radioactivity from man-made radionuclides. Specifically, the maximum contaminant levels are given as 20,000 picocuries per liter (pCi/l) for tritium and 8 pCi/l for strontium-90.

Section 307 of the New Mexico Drinking Water Regulations Subparts b and c require quarterly sampling frequency for radioactivity in community water systems when there is reason to believe additional contamination may be present due to operations in the vicinity.

Finding: ERD has not contacted the State of New Mexico to determine the need to submit a discharge plan for the GASBUGGY and GNOME underground test areas.

Discussion: New Mexico Water Quality Regulations require approval of plans to allow effluent or leachate to discharge to groundwater. Results of the 1992 long-term hydrologic monitoring of the GNOME test site show leachate of tritium, cesium-137 and strontium-90 into groundwater at the GNOME test area and leachate of cesium-137 and tritium into groundwater at the GASBUGGY test area. ERD currently does not have a discharge plan approved by the State of New Mexico allowing those discharges to occur.

In addition, results of the 1992 long-term hydrologic monitoring at the GNOME test area show concentrations of tritium and strontium-90 well above State limits in some wells near ground zero that may have resulted from either the underground test or past injection of radionuclides by the U.S. Geological Survey, or from both activities. ERD has not notified the State of radioactive contamination of groundwater; therefore, the State could impose quarterly sampling requirements.

The causal factors for this finding are change and resources, in that responsibility for FUTAs was transferred from DP to EM within the past year and EM has not had sufficient time to plan and budget the resources necessary to meet all environmental compliance requirements.

NM-3: State Sampling Certificates

Performance Objective: Section 301 (E) of the New Mexico Water Supply Regulations requires that all compliance samples for non-transient, non-community water supply systems shall be collected by persons possessing a current Sampling Certificate.

Finding: ERD has not contacted the Secretary of the New Mexico Department of the Environment to establish the need to obtain a Sampling Certificate for water samples used to demonstrate compliance with New Mexico drinking water quality requirements.

Discussion: ERD draft strategy documents for the New Mexico underground test areas indicate that it intends to ensure that activities pursuant to both the GNOME and GASBUGGY Projects comply with all drinking water quality requirements (D-A-10).

The State of New Mexico has established provisions that require persons performing water sampling to ensure compliance with drinking water quality requirements to possess a Sampling Certificate. The requirement to obtain a Sampling Certificate is intended to provide reasonable assurance that persons sampling drinking water can demonstrate proper sampling techniques and procedures and applies to persons sampling drinking water for non-transient, non-community water supply systems. New Mexico Water Supply Regulations are unclear with respect to sampling certification requirements when an individual or organization is not a supplier of drinking water or is simply sampling to determine conformance with State water quality parameters.

New Mexico Water Supply Regulations are unclear as to the need to obtain a Sampling Certificate for individuals performing sampling intended to demonstrate conformance with State water quality standards, and since DOE is not a supplier of drinking water for non-transient, non-community water supply systems, ERD has not contacted the Secretary of the New Mexico Department of the Environment to establish the need to obtain a Sampling Certificate for anticipated confirmatory sampling activities.

The causal factor for this finding is change, in that programmatic responsibility for the New Mexico underground test areas were transferred from DP to EM in November 1993 and only now is ERD beginning to develop comprehensive plans that demonstrate compliance with all applicable regulations.

APPENDIX A

BIOGRAPHIES OF THE AUDIT TEAM

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NAME: Robert A. Crowley, P.E., P.L.S.

AREA OF RESP: Team Leader

ASSOCIATION: U.S. Department of Energy

EXPERIENCE: 19 Years

- U.S. Department of Energy, Office of Environmental Audit
 - Environmental Engineer. Provides guidance, direction, and assistance to a multidisciplinary group of professionals performing environmental surveys, Tiger Team Assessments, and environmental audits of DOE facilities.
 - Served as Special Assistant for the Paducah Tiger Team assessment; Team Leader for the Fernald and National Renewable Energy Laboratory environmental management assessments, the National Institute for Petroleum and Energy Research Tiger Team assessment, and the Component Development and Integration Facility and Coal-Fired Flow Facility environmental audits; Deputy Environmental Subteam Leader for the Brookhaven National Laboratory, Princeton Plasma Physics Laboratory, Solar Energy Research Institute, and Morgantown Energy Technology Center Tiger Team assessments; and Deputy Team Leader for the Bonneville and Western Power Administration environmental audits.
- Federal Energy Regulatory Commission, Office of Hydropower Licensing
 - Civil Engineer. Directed safety and design assessments of energy projects and ensured operational and design compliance with environmental requirements.
- Anne Arundel County Department of Public Works
 - Civil Engineer. Managed projects associated with water quality planning and surface and groundwater hydrology.

EDUCATION: Graduate Studies in Technology Management, University of Maryland
B.S., Agricultural Engineering, University of Maryland

OTHER: Registered Professional Engineer, Maryland, Virginia, and District of Columbia

NAME: Kevin R. Ensign
AREA OF RESP: Deputy Team Leader
ASSOCIATION: U.S. Department of Energy
EXPERIENCE: 7 Years

- U.S. Department of Energy, Richland Operations Office
 - Auditor. Developed program plans and provides guidance, direction, and assistance to financial auditors performing DOE Order 2200.13 financial reviews of all four Hanford management and operations contractors.
 - Served as a Special Assistant for the Environmental Management Organization and Staffing Review.
- Defense Contract Audit Agency
 - Supervisory Auditor. Supervised a staff of seven auditors providing guidance and direction necessary to complete Agency objectives.
 - Auditor. Independently planned and performed all types of contract pricing and compliance audits performed by DCAA.

EDUCATION: Graduate Studies, Business Administration, Washington State University
B.S., Accounting, Western Washington University

OTHER: Member, Institute of Internal Auditors and Institute of Management Accountants

NAME: Edward F. Maher, Sc.D., CHP

AREA OF RESP: Team Coordinator

ASSOCIATION: Arthur D. Little, Inc.

EXPERIENCE: 21 Years

- Arthur D. Little, Inc.
 - Senior Consultant, Certified Health Physicist, and Manager of the Radiation Technology and Policy Unit providing technical and managerial support for DOE assessments and audits, and various other government and commercial clients involving environmental management, health physics, environmental quality and risk estimation.
 - Participated in the routine environmental audits of the Pinellas Plant and the Hanford Site.
- United States Air Force (USAF), Armstrong Laboratory, Brooks AFB, TX
 - Chief, Bioenvironmental Engineering Division. Overall manager and director of comprehensive environmental and occupational health services support to worldwide USAF installations. Responsible for the overall management and technical content in the specialty areas of air and water quality, environmental and occupational health physics, hazardous waste and material management and environmental noise.
- USAF Occupational and Environmental Health Laboratory, Brooks AFB, TX
 - Chief, Radiation Services Division. Overall director and provider of a wide range of health physics support to worldwide USAF installations. Support included environmental and occupational radiological protection consultation and field investigations, radioanalytical laboratory services, radiation dosimetry, radioactive source permitting and transportation safety, radiological accident contingency response planning and risk assessment. Directed the Air Force's Radiation Assessment Team (AFRAT) that provided immediate and global response to nuclear weapon accidents and mishaps in concert with DOE's Accident Response Group.
- USAF Electronics Systems Division, Hanscom AFB, MA
 - Chief, Environmental Health Section. Responsible for providing comprehensive industrial hygiene, environmental engineering, public health, and radiological protection services to the base community and acquisition centers.
- USAF School of Aerospace Medicine, Brooks AFB, TX
 - Project Scientist, Laser Effects Branch. Conducted experimental-based research and modeling studies in ocular laser damage, bioeffects of ultra-short pulsed lasers and broad-band optical hazard sources, and developed laser exposure standards for adoption by the USAF Surgeon General.

EDUCATION: Sc.D., Radiological Health and Protection, Harvard University
M.S., Biomedical Engineering, Worcester Polytechnic Institute
B.S., Electrical Engineering, Lowell Technological Institute

NAME: David J. Allard

AREA OF RESP: Quality Assurance; Radiation

ASSOCIATION: Arthur D. Little, Inc.

EXPERIENCE: 16 Years

- Arthur D. Little, Inc.
 - Senior Consultant and Certified Health Physicist providing technical support for DOE assessments and audits, and various other government and commercial client cases dealing with radiation protection issues, such as environmental monitoring, waste management, training, operational health physics, and radiation protection management.
 - Participated in the Tiger Team assessments of the Morgantown Energy Technology Center, Idaho National Engineering Laboratory, and Los Alamos National Laboratory; the environmental audit of the Fossil Energy Sites in Wyoming; the environmental management assessments of the Continuous Electron Beam Accelerator Facility, Fernald Environmental Management Project, Superconducting Super Collider, Argonne National Laboratory-West, Pinellas Plant, and Hanford Site; and the progress assessment of the Idaho National Engineering Laboratory. Currently a DOE mentor at the Hanford Site.
- TGM Detectors, Inc.
 - Vice President with responsibilities for facility radiation protection, gas-filled radiation detector design, testing, engineering, and business management.
- Nuclear Metals, Inc.
 - Supervisor of Health Physics with responsibilities in the areas of environmental monitoring, external and internal dosimetry, shielding, radiation surveys, waste disposal, training, and regulatory affairs regarding various uranium and thorium manufacturing operations.
- Albany Medical Center
 - Medical Health Physicist with responsibilities involving worker and patient external and internal dosimetry, laboratory radiation protection, x-ray equipment testing, quality assurance, shielding, training, surveys, and waste disposal.

EDUCATION: M.S., Radiological Sciences and Protection, University of Lowell
B.S., Environmental Sciences, State University of New York at Albany
A.A.S., Environmental Health Technology, Hudson Valley Community College

NAME: Mark Brazell
AREA OF RESP: Environmental Management
ASSOCIATION: Arthur D. Little, Inc.
EXPERIENCE: 8 Years

- Arthur D. Little, Inc.
 - Conducts and manages various environmental due-diligence assignments. Environmental investigations have included Phase I Environmental Site Assessments, peer reviews, and Phase II Subsurface Investigations, including hazardous waste characterization, assessment, and determination of remedial action alternatives.
 - Surface water/drinking water specialist for the routine environmental reaudit of Argonne National Laboratory - West.
- Previous Consulting Experience
 - Senior Consultant responsible for conducting a multi-site environmental assessment program for a major Wall Street investment bank.
 - Project Manager for the National Pollutant Discharge Elimination System permit program at Hanscom Field and Logan Airport for MASSPORT, and combined sewer overflow (CSO) program for the Boston Water & Sewer Commission.
 - Project Manager of the Best Management Practices program for the Massachusetts Water Resources Authority (MWRA) CSO Facilities Plan. Participated in the development and execution of a sampling plan for the MWRA to determine compliance regulations specific to the Federal Safe Drinking Water Act.
 - Project Manager in the Massachusetts Department of Environmental Protection's Bureau of Waste Site Cleanup Waiver Unit.
 - Performed a 3-year groundwater monitoring program at the Groveland Wells Superfund site in accordance with the site's Record of Decision.

EDUCATION: M.B.A., Northeastern University
B.S., Civil and Environmental Engineering,
Clarkson College of Technology

NAME: Scott C. Gnewuch

AREA OF RESP: Groundwater; Inactive Waste Sites

ASSOCIATION: Arthur D. Little, Inc.

EXPERIENCE: 9 Years

- Participated in Tiger Team assessment of the Stanford Linear Accelerator Center facility.
- Participated as member of a large team conducting a preliminary environmental assessment of a large natural gas field in Kazakhstan.
- Served as technical expert on a team conducting due-diligence assessments on various mining facilities in Chile.
- Assisted in a due-diligence audit for the Environmental Protection Agency with regard to a large real estate transaction in Michigan for the potential development of a research facility.
- Managed oversight of Navy RI/FS activities at the Naval Construction Battalion Center in Davisville, Rhode Island, in support of the EPA.
- Performed technical review of preliminary site assessments for real estate transactions in Massachusetts to assure compliance with State regulations.
- Managed human health risk assessment studies for various Region I Superfund sites in support of the EPA and the U.S. Army.
- Assisted in the development, and conducted the application, of a mathematical hazard ranking model based upon risks posed to human health and the environment near a hazardous waste site. Sites were also ranked using the EPA hazard ranking system.
- Managed site characterization project in New Jersey consisting of collection, analysis, and assessment of data to determine if the site could be considered clean under New Jersey (ECRA) and federal (CERCLA, SARA, and RCRA) regulations.

EDUCATION: M.S., Geophysics, Boston College
B.S. Geology, Allegheny College

NAME: Vee Richardson
AREA OF RESP: Administrator
ASSOCIATION: Development Technologies, Inc.
EXPERIENCE: 28 Years

- Development Technologies, Inc.
 - Administrative Team Coordinator providing support to the Department of Energy, Office of Environmental Audit, in conducting environmental assessments of DOE sites. Participated as Administrator for the routine environmental audits of Sandia National Laboratories, California, and the Hanford Site.
 - Provided administrative and technical support to an interdepartmental, 27-agency task force and five of its working groups, to update the National Response Plan. The Plan defines the Federal government's response to natural and manmade disasters.
- Consultant
 - Coordinated Inaugural Prayer Service: responsible for logistical arrangements in coordination with the Presidential Inaugural Committee, Secret Service, and religious leaders; for recruiting and briefing volunteers; and for supervising onsite activities.
 - Wrote information materials for national convocation attended by more than 2,000 people.
 - Served as Deputy to the Managing Director of Administration for a national celebration; coordinated and supervised set-up of headquarters operation, ensuring that facilities for more than 125 staff and volunteers were fully operational within one week; designed and managed computer system; and supervised staff.
- The Ability Group
 - Owned and managed business services bureau; managed projects, hired and trained support staff and contractors, and directed marketing programs.
- Other Experience
 - 15 years as administrative manager of law firms, staff assistant at Department of State, member of trial team during *U.S. v. AT&T*, and high-level administrative positions.

EDUCATION: Oklahoma Baptist University

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APPENDIX B

AUDIT PLAN

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**Plan for the
Comprehensive Baseline
Environmental Audit
of
Former Underground Test Areas
in Colorado, New Mexico,
and Nevada**

**U.S. Department of Energy
Office of Environmental Audit
May 16-27, 1994**

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PLAN FOR THE COMPREHENSIVE BASELINE ENVIRONMENTAL AUDIT OF FORMER UNDERGROUND TEST AREAS IN COLORADO, NEW MEXICO, AND NEVADA

1.0 INTRODUCTION

The DOE Environmental Audit Program is carried out by the Office of Environmental Audit (EH-24) within the Office of Environment, Safety and Health (EH). The program was created in 1985 with a goal to provide a continuing program of internal, independent oversight of line management's environmental performance, in support of DOE's broader goal of achieving full compliance and excellence in Environmental Protection Activities. The objectives of the program in achieving this goal include:

- Conducting comprehensive baseline environmental audits of facilities that were not addressed in the Environmental Survey and that were not assessed by a Tiger Team;
- Conducting assessments of environmental management within line programs, including adequacy of self-assessment programs;
- Conducting a continuing program of field/technical re-audits of major and other DOE facilities;
- Conducting special issue reviews to assess high priority issues at a particular site, or which cut across site and program lines; and
- Supporting line management self-assessment programs through continuing updates and automation of audit protocols, training, and other mechanisms of transferring the special auditing expertise of EH-24 to the field.

The purpose of the Comprehensive Baseline Environmental Audit of Former Underground Test Areas in Colorado, New Mexico, and Nevada during the period of May 16-27, 1994, is to provide the Secretary of Energy with information on the current environmental regulatory compliance status and associated vulnerabilities, causes for noncompliance and response actions to address identified problem areas. The audit will be conducted in accordance with the DOE/EH-0326, Protocols for Conducting Environmental Management Assessments of DOE Organizations, June 1993, and DOE/EH-0358, Performance Objective Criteria for Conducting Environmental Audits, January, 1994.

The scope of the audit is to cover comprehensively all environmental media and applicable Federal, state and local regulations, requirements and best management practices. The environmental disciplines to be addressed in this audit will include groundwater, surface water/drinking water quality assurance, radiation, inactive waste sites. To a limited degree, the audit will also address the performance of environmental management functions including the oversight of the test areas by the Office of Environmental Management (EM) and the Nevada Operations Office (NV).

2.0 COMPREHENSIVE BASELINE ENVIRONMENTAL AUDIT IMPLEMENTATION

The Comprehensive Baseline Environmental Audit will be conducted by a team consisting of a Team Leader from the DOE Office of Environmental Audit (EH-24) and Deputy Team Leader from the DOE Richland Operations office, and a Team Coordinator, a management systems specialist and technical specialists from Arthur D. Little, Inc. (ADL). The administrative support will be provided by Development Technologies, Inc. (DevTech). The names and assignments are listed below:

Robert Crowley	DOE	Team Leader
Kevin Ensign	DOE	Deputy Team Leader
Edward Maher	ADL	Team Coordinator
Mark Brazell	ADL	Management Systems
Scot Gnewuch	ADL	Groundwater and Inactive Waste Site Programs
David Allard	ADL	Environmental Radiation Protection and Quality Assurance Programs
Vee Richardson	DevTech	Administrative Support and Technical Editor

2.1 Pre-Audit Activities

Pre-audit activities for the Comprehensive Baseline Environmental Audit included the issuance of an introduction and information request memorandum, a visit to DOE/HQ, a review of state regulations, and initial review of documentation provided to the audit team by NV as a result of the information request memorandum.

The pre-audit site visit was conducted on February 9-10, 1994 by the DOE Team Leader. The purpose of the pre-audit site visit was to brief site personnel on the purpose and scope of the Audit, to become familiar with NV and its operations and environmental protection programs, to review information being supplied by NV, to request additional information, and to coordinate activities for the upcoming audit.

Interviews with EM managers, with responsibility for the former underground test areas will be conducted the week of May 9, 1994. The purpose of these interviews is to facilitate an understanding of the activities of EM with respect to effective environmental management of the underground nuclear test areas.

2.2 Onsite Activities and Reports

The onsite activities for the Comprehensive Baseline Environmental Audit will begin May 16 and continue through May 27, 1994. Onsite activities will include interviews with NV and EPA's Environmental Monitoring Systems Laboratory (EMSL) management and staff and contractor management and staff who provide technical support to NV; record and document reviews; and field inspections of selected sites and various groundwater sampling events.

The agenda for the audit (including a preliminary interview schedule) is shown in Attachment A. The interview schedule reflects the audit team's best attempt to identify relevant personnel to be interviewed. Based on past experience, these schedules will change as additional information is gathered by the audit team members and based on availability of site personnel. Modifications to the interview schedule, or other elements of the agenda, will be coordinated with the designated NV contacts. As noted on the schedule, the second week of the audit will involve visits to various offsite areas to examine the test areas and to observe field activities.

During the audit, the team will conduct debriefing sessions with the NV and EMSL management to review progress and concerns. On May 19th, a closeout briefing will be conducted at the conclusion of the onsite portion of the audit. A summary of the results, including preliminary findings, will be orally presented at that time. Draft findings will be provided to NV for review and comment prior to a factual accuracy review (FAR).

2.3 Post-Audit Activities

Following the onsite activities, EM and NV will have the opportunity to submit final comments on the draft audit report. After reviewing these comments, EH-24 will issue a final report. EM will be responsible for ensuring development of a corrective action plan that will address the findings contained in the report.

3.0 AUDIT STRATEGIES AND KEY ISSUES BY DISCIPLINE

3.1 Environmental Management Systems

3.1.1 Issue Identification

The audit activities for Environmental Management Systems portion of the audit will assess whether the environmental management of Nevada Field Operations Office (NV), the Southwestern Area Programs Office (EM-45), and the Nevada/Albuquerque Office (EM-452) ensures environmental protection, compliance, and excellence at the Nevada Test Site offsite areas. In particular, the audit will be designed to consider the following:

- Environmental management organization structure has clear lines of authority, well defined roles and responsibilities, and sufficient organizational structure.
- Environmental protection programs are in place to ensure compliance with Federal, state, and local environmental laws and regulations. Further, the audit will determine if NV provides for timely and correct implementation of those DOE Orders designed to protect the environment and public health.
- Internal and external communication are effectively used to share information with external organizations, such as regulatory agencies, environmental groups, and the community.
- Staff resources, training and development are sufficient to develop and implement environmental protection programs; that all personnel have

received environmental protection training commensurate with their job responsibilities.

- Environmental planning and risk management programs such as planning activities, budgeting, priority setting, and allocation of resources. Short and long-term planning will be addressed. In addition to planning, this portion of the audit will evaluate the adequacy of systems designed to identify environmental hazards and to minimize and control environmental risks.

The general approach to the management audit will include a review of documentation related to environmental management and interviews with EM-45, EM-452, NV management and staff, and contractors performing work for NV. In addition to interviews and document review, the specialists will also conduct inspections and reviews of the underground test areas which could include observations of field activities.

Areas of particular interest will include the following:

- The clarity with which the organizational structure is delineated and communicated to site staff and the degree to which actual lines of environmental management authority and responsibility are consistent with formal documents that define organizational roles, responsibilities, and authority;
- The degree to which decision-making authority related to environmental protection is assigned to the organizational levels to provide for the most timely and appropriate response;
- Understanding of applicable regulatory requirements;
- Responsibilities for program development and implementation;
- The extent to which staff members responsible for regulatory tracking are up-to-date on new, proposed, and emerging regulatory issues;
- Frequent and timely formal communication of environmental risks and protection efforts to external organizations;
- Training programs are in effect to ensure that staff obtain the appropriate environmental training necessary for their positions.
- Technical and financial planning relating to environmental management and the extent to which such planning is conducted and integrated with overall organizational planning (including mechanisms for resource allocation and priority setting and the extent to which actual resource allocation is consistent with environmental objectives); and
- Systems for assessing risks to the environment and the specific mechanisms for identifying hazards and associated risks, assessing the acceptability of identified risks, and risk mitigation actions.

Coordination with other Audit Team members will be routine and extensive. For Environmental Management Systems special attention will be paid to coordination with team members responsible for evaluation of environmental radiation protection, quality assurance, inactive waste sites (CERCLA), and groundwater quality.

3.1.2 Records Required

The following documents will be reviewed prior to and during the audit:

- Latest organization charts for each organization (EM-40, EM-452, and NV);
- Mission statements;
- Job descriptions and performance criteria for key management and operating personnel;
- Environmental Protection Implementation Plan (EPIP);
- Senior management statement of support for environmental management efforts that are included in an annual report, speeches, internal memoranda, and other documents;
- Environmental protection program plans required by DOE 5400.1;
- Environmental monitoring and surveillance plans and reports;
- Emergency response and remedial action plans;
- Reports to management or regulatory agencies;
- Program specific and general ES&H policies, procedures, and guidance manuals;
- Samples of the scope of relevant management reports and staff meeting minutes;
- Guidance documents for interpretation and implementation of environmental regulations and policies;
- Documentation of information and awareness programs for affected external parties;
- Documented requests for environmental staff;
- Strategic plans, budget documents, and capital expenditure documents;
- Descriptions of programs and reports with an emphasis on risk management; and
- Other records as determined onsite.

3.2 Groundwater Protection Programs

3.2.1 Issue Identification

The activities for the Groundwater Audit will include evaluation of the programmatic and technical status of protection and monitoring programs for groundwater at the underground test areas. The standards used to assess the offsites are the Performance Objectives and Criteria for Conducting DOE Environmental Audits (DOE/EH-0358). The performance criteria are established in DOE Orders; applicable Federal, State, and local regulations; industry guidance; and best management practices.

The general approach to the audit will include interviews of personnel with direct experience and knowledge of the offsite areas which include NV staff, IT staff, DRI staff, and EPA personnel. In addition, the approach will include review of facility reports, field logs, maps, and other site related documents.

Consultation with other audit team specialists will also be conducted to develop any common issues pertinent to other disciplines. Onsite inspections at the underground test areas where field activities are anticipated, will be conducted to examine groundwater monitoring wells, identify potential source areas of groundwater contamination, and verify documented information reviewed during the audit.

The sites will be assessed with respect to all pertinent regulations, requirements, and guidelines. The regulations, requirements, and guidelines pertinent to groundwater at the underground test areas include DOE Orders, CERCLA, RCRA, and various state regulations and requirements. The state requirements include Colorado Rules and Regulations for Water Well Construction and Pump Installation, Colorado Groundwater Standards "The Basic Standards for Groundwater," New Mexico Water Quality Regulations, and New Mexico Environmental Department procedures for plugging and abandonment of monitoring wells. The results of the audit will specifically present any compliance issues identified.

3.2.2 Records Required

Some of the documents to be reviewed for the groundwater audit include the following:

- Ground Water Monitoring Plan
- Nevada Test Site Annual Environmental Report
- CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas
- U.S. Department of Energy Environmental, Safety and Health Progress Assessment of the Nevada Test Site
- Environmental Monitoring Plan, Nevada Test Site and Support Facilities
- Groundwater Protection Management Program Plan for the Nevada Operations Office

- Scoping Plan for the Nevada Test Site Groundwater Characterization Project

Any additional documents discovered while onsite will also be reviewed and included if appropriate.

3.3 Inactive Waste Sites Programs

3.3.1 Issue Identification

The activities for the Inactive Waste Site (IWS)/CERCLA audit will include evaluation of the management of the inactive waste sites located at the underground test areas, management and conduct of studies to respond to the closure of these sites, and compliance with Federal, state, and local requirements dealing with inactive waste sites and their potential releases.

The general approach to the IWS audit will include interviews of personnel with direct experience and knowledge of the offsite areas which include management and technical staff from NV, IT, DRI, and EPA. In addition, the approach will include review of facility reports, field logs, maps, and other site related documents.

During the audit other specialists will be consulted to identify issues applicable to both disciplines. Onsite inspections will be conducted to examine any inactive waste sites or sites pertinent to CERCLA, and to verify documented information reviewed during the audit. The regulations, requirements, and guidelines used to assess IWS compliance include:

- Comprehensive Environmental Response Compensation, and Liability Act (CERCLA), and Superfund Amendments and Reauthorization Act (SARA)
- Resource Conservation and Recovery Act (RCRA)
- Emergency Planning and Notification (40 CFR 355)
- CERCLA Requirements (DOE 5400.1)
- Environmental Protection, Safety, and Health Protection Information Reporting Requirements (DOE 5484.1)
- Emergency Notification, Reporting, and Response Levels (DOE 5500.2A)
- Guidance for Conducting Remedial Investigations and Feasibility Studies Under CERCLA (EPA540 G-89 004)

The results of the audit will specifically present any compliance issues identified.

The IWS audit will focus primarily on plans and audit activities conducted at the underground test areas. The issues that should be addressed in these plans will include inactive waste site program planning, community relations plans, and administrative records. The programs will also be assessed on the basis that they are sufficiently

integrated with groundwater and radiation issues, and that they represent a proactive effort to discover and assess the overall environmental conditions at the underground test areas.

3.3.2 Records Required

Some specific documents to be reviewed for the groundwater audit include the following:

- Nevada Test Site Annual Environmental Report
- CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas
- U.S. Department of Energy Environmental, Safety and Health Progress Assessment of the Nevada Test Site
- Environmental Monitoring Plan, Nevada Test Site and Support Facilities

Any additional documents discovered while onsite will also be reviewed and included if appropriate.

3.4 Environmental Radiation Protection Programs

The activities for the Environmental Radiation assessment will evaluate whether NV has the environmental radiation protection programs in place to ensure compliance with Federal, state, and local environmental laws and regulations. Further, the audit will determine whether provisions have been made for timely and correct implementation of those DOE Orders designed to protect the environment and public health with respect to the underground test areas that are a part of this audit. The purpose of the audit will be to determine whether there is sufficient planning, oversight, and staff training regarding environmental radiation programs associated with the test areas that are included in this effort.

Based on a review of pre-audit information provided to the Audit Team, the key issues that will be addressed are the requirements of the following:

- Long-range environmental protection plan;
- Environmental monitoring plan;
- Radiological/Environmental Monitoring Program;
- Radionuclide releases and reporting;
- Radiation Dose Evaluations;
- Site D&D and Radioactive Waste Management programs;
- Environmental ALARA Program; and
- Contractor oversight.

3.4.1 Issue Identification

The general approach used in conducting the audit of the environmental radiation protection programs will consist of interviews with NV, EPA, and contractor personnel responsible for program development and implementation and review of documentation supporting those programs. Areas of particular interest will include:

- Understanding of applicable state regulatory requirements;
- Responsibilities for program development and implementation;
- Regular monitoring of offsite areas;
- Adequate characterization of groundwater samples;
- Formality of environmental radiation protection program;
- Prevention of environmental releases;
- Recordkeeping and reporting;
- Training on requirements; and
- Oversight and review of programs.

In addition to interviews and document review, the specialists will conduct inspections of several underground test areas.

3.4.2 Records Required

The following documents will be reviewed prior to and/or during the audit at NV:

- CERCLA Preliminary Assessment;
- NTS Annual Site Environmental Report 1993;
- Evaluation of groundwater at offsite nuclear test areas (DOE/NV/10845-07);
- Radiological monitoring around US nuclear test areas (EPA 600/R-93/141);
- Environmental protection program plans required by DOE 5400.1;
- Environmental monitoring and surveillance plans and reports;
- Site well inventories for routine groundwater sampling;
- State/federal compliance agreements;
- Remedial action plans;
- Environmental incident reporting procedures;

- Well maintenance and inspection procedures;
- Reports to management or regulatory agencies; and
- Other records as determined onsite.

3.5 Environmental Quality Assurance Programs

The activities for the Environmental Quality Assurance Programs portion of the audit will evaluate whether NV has the environmental quality assurance programs in place to ensure relevant programs, procedures, and practices meet regulatory and standards requirements for accurate representative, and reliable environmental data.

Based on a review of pre-audit information provided to the Audit Team, the key issues that will be addressed are the requirements for the following:

- Environmental Quality Assurance (QA) Program;
- Regular QA audits, appraisals, and surveillances;
- Formal procedures in place for environmental activities; and
- QA on laboratory and field activities.

3.5.1 Issue Identification

The general approach used in conducting the audit of environmental quality assurance programs will consist of interviews with NV, EMSL, and contractor personnel responsible for program development and implementation and review of documentation supporting the QA programs. Areas of particular interest will include:

- Formality of the QA program (protocols and procedures);
- Documentation addresses elements listed in DOE orders;
- Clearly defined responsibilities and authority;
- Training or requirements;
- Recordkeeping, reporting, and document control;
- Computer software verification and validation; and
- Oversight and review of programs.

In addition to interviews and document review, the specialists will conduct inspections of several underground test areas.

3.5.2 Records Required

The following documents will be reviewed prior to and/or during the audit at NV, EMSL, and contractors:

- Quality Assurance Plans;
- Quality Assurance and Quality Control Procedures;
- Quality Control data on instrumentation;
- Raw analytical data notebooks;
- Sample chain-of-custody forms and procedures;
- Laboratory cross-check and intercomparison testing results;
- Internal/external laboratory audit reports; and
- Other records determined onsite.

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ATTACHMENT
Schedule of Audit Activities

SCHEDULE OF AUDIT ACTIVITIES
Comprehensive Baseline Environmental Audit of Former Underground Test Areas

Name: Mark Brazell

Area of Responsibility: Environmental Management

	Mon May 16	Tues May 17	Wed May 18	Thu May 19	Fri May 20
am	<p>6:15 Depart Boston, MA DL 739</p> <p>10:25 Arrive Las Vegas, NV</p> <p>Hotel: Palace Station 1-800-634-3101 Confirmation numbers: Mark Brazell 65389 Dave Allard 65391 Ed Maher 65388 Scot Gnewuch 65393</p>	<p>8:00 Steve Mellington (NVO)</p> <ul style="list-style-type: none"> • Organizational Structure • Commitment • Training, Resources <p>9:45 Joe Fiore (NVO)</p> <ul style="list-style-type: none"> • Organizational Structure • Formality of Programs • Commitment 	<p>8:00 Doug Duncan (NVO)</p> <ul style="list-style-type: none"> • Organizational Structure • Formality of Programs • Commitment <p>9:30 Barb Deschler (IT)</p> <ul style="list-style-type: none"> • ER Sites Inventory 	<p>7:30 Kevin Cabbie (NVO)</p> <ul style="list-style-type: none"> • Group Interview • CO, NM, NV Sites <p>9:45 Rick Deschler (IT)</p> <ul style="list-style-type: none"> • Group Interview • Sampling in MS & CO (GET SITE TRAVEL MAP FROM RICK DESCHLER) <p>11:45 Interviews End</p>	<p>Leave for Reno, NV</p> <p>7:15 Reno Air 106</p> <p>8:25 Arrive Reno, NV</p> <p>Hotel: Hilton USA 2500 E. Second St. 1-702-789-2000</p> <p>10:00 Leave for Shoal Site</p>
pm	<p>1:00 In-briefing by NVO Staff</p> <ul style="list-style-type: none"> • Organizational Structure • Overview of Monitoring • Underground Testing Info <p>3:00 Max Davis (EPA) Deb Chaload (EPA) QA</p> <p>4:30 Team Meeting</p>	<p>1:00 Runone Wycoff</p> <ul style="list-style-type: none"> • State Agreements <p>2:30 Roxanne Dantz (NVO)</p> <ul style="list-style-type: none"> • Safety and QA <p>4:00 Interviews End</p> <p>4:30 Team Meeting</p>	<p>1:00 EM Director (NVO)</p> <ul style="list-style-type: none"> • Organizational Structure • Commitment <p>3:00 Follow-up Interviews</p> <p>4:00 Interviews End</p> <p>4:30 Team Meeting</p>	<p>12:00 Lunch</p> <p>1:00 Team Meeting (Out- brief Preparations)</p> <p>4:00 Exit Out-brief for all interested NVO members</p> <p>Ship Documents back to ADL (Cambridge) by COB</p>	<p>On-site all day at Shoal Site, NV</p> <p>Return to Hotel</p>

SCHEDULE OF AUDIT ACTIVITIES (continued)
Comprehensive Baseline Environmental Audit of Former Underground Test Areas

Name: Dave Allard

Areas of Responsibility: Environmental Radiation and Quality Assurance

	Mon May 16	Tues May 17	Wed May 18	Thu May 19	Fri May 20	
<i>am</i>	6:15 Depart Boston, MA DL 739 10:25 Arrive Las Vegas, NV Hotel: Palace Station 1-800-634-3101 Confirmation numbers: Mark Brazell 65389 Dave Allard 65391 Ed Maher 65388 Scot Gnewuch 65393	8:00 Doug Duncan (NVO) • Groundwater Monitoring 9:30 Roxanne Dantz (NVO) • MS Site • Safety & QA 10:45 Runone Wycoff (NVO) • AK Site 11:45 Lunch	9:30 DRI Staff (TBD) • Environmental Monitoring • Site Surveillance 10:45 DRI Staff (TBD) • Environmental Monitoring • Site Surveillance 11:45 Lunch	7:30 Kevin Cabbie (NVO) • Group Interview • CO, NM, NV Sites 9:45 Rick Deschler (IT) • Group Interview • Sampling in MS & CO 11:45 Interviews End	Leave for Reno, NV 7:15 Reno Air 106 8:25 Arrive Reno, NV Hotel: Hilton USA 2500 E. Second St. 1-702-789-2000 10:00 Leave for Shoal Site	
<i>pm</i>	1:00 In-briefing by NVO staff 3:00 Max Davis (EPA), Deb Chaload (EPA) 4:30 Team Meeting	4:00 Interviews End 4:30 Team Meeting	12:45 Barb Deschler (IT) • ER Site Inventory 2:00 Cheryl Prini (IT) • Sample Analysis • Quality Assurance 3:00 Document Review 4:00 Interviews End 4:30 Team Meeting	12:00 Lunch 1:00 Team Meeting (Out- brief Preparations) 4:00 Exit Out-brief for all interested NVO members Ship Documents back to ADL (Cambridge) by COB	On-site all day at Shoal Site, NV Return to Hotel	

SCHEDULE OF AUDIT ACTIVITIES (continued)
Comprehensive Baseline Environmental Audit of Former Underground Test Areas

Name: Scot Gnewuch

Areas of Responsibility: Inactive Waste Sites and Groundwater Protection

	Mon May 16	Tues May 17	Wed May 18	Thu May 19	Fri May 20
am	6:15 Depart Boston, MA DL 739 10:25 Arrive Las Vegas, NV Hotel: Palace Station 1-800-634-3101 Confirmation numbers: Mark Brazell 65389 Dave Allard 65391 Ed Maher 65388 Scot Gnewuch 65393	8:00 Frank Maxwell (NVO) • NEPA 9:45 Doug Duncan (NVO) • Hydro and Ground Monitoring 11:45 Lunch	8:00 Paul Weedon (EPA) • Environmental Sampling 11:45 Lunch	7:30 Kevin Cabbie (NVO) • Group Interview • CO, NM, NV Sites 9:45 Rick Deschler (IT) • Group Interview • Sampling in MS & CO 11:45 Interviews End	Leave for Reno, NV 7:15 Reno Air 106 8:25 Arrive Reno, NV Hotel: Hilton USA 2500 E. Second St. 1-702-789-2000 10:00 Leave for Shoal Site
pm	1:00 In-briefing by NVO Staff • Organizational Structure • Overview of Monitoring • Underground Testing Info 3:00 Max Davis (EPA), Deb Chaload (EPA) 4:30 Team Meeting	1:00 Bobby McClure (NVO) • Documentation 2:15 Steve Mellington NVO) • NEPA 4:00 Interviews End 4:30 Team Meeting	3:00 Follow-up Interview (TBD) 4:00 Interviews End 4:30 Team Meeting	12:00 Lunch 1:00 Team Meeting (Out- brief Preparations) 4:00 Exit Out-brief for all interested NVO members Ship Documents back to ADL (Cambridge) by COB	On-site all day at Shoal Site, NV Return to Hotel

SCHEDULE OF AUDIT ACTIVITIES (continued)
Comprehensive Baseline Environmental Audit of Former Underground Test Areas

	Sat May 21	Sun May 22	Mon May 23	Tue May 24	Wed May 25	
am	No Scheduled Activities	7:20 FLT CO 692	7:30 Leave Hotel for Gnome, NM Site	6:40 FLT MESA 701	7:55 FLT UA 7567	
	Day Off or Use to Complete Findings and Overviews	Leave Reno, NV for Carlsbad, NM	Onsite all day at the Gnome, NM Site	Leave Carlsbad, NM for Farmington, NM	Leave Farmington, NM for Grand Junction, NM	
				8:42 Arrive Farmington, NM	8:35 Arrive Grand Junction, NM	
				Hotel: Holiday Inn 600 E. Broadway Farmington, NM 1-505-327-9811	Hotel: Grand Junction Hotel 743 Horizon Drive Grand Junction, NM 1-303-241-8888	
				10:00 Leave Hotel for Gasbuggy Site	10:00 Leave Hotel for Rulison & Rio Blanco, CO Sites	
pm		3:00 Arrive Carlsbad, NM	Return to Hotel	On-site all day at Gasbuggy Site	On-site all day at Rulison & Rio Blanco, NM Sites	
		Hotel: Holiday Inn 601 S. Canal Carlsbad, NM 1-505-327-9811		Return to Hotel	Return to Hotel	

SCHEDULE OF AUDIT ACTIVITIES (continued)
Comprehensive Baseline Environmental Audit of Former Underground Test Areas

	Thu May 26	Fri May 27	Sat May 28	Sun May 29	Mon May 30	
am	Findings Development and Completion Day or Early Departure Date to Boston	7:20 FLT DL 591 Leave Grand Junction, NM for Boston, MA	No Scheduled Activities	No Scheduled Activities	No Scheduled Activities	
pm		4:05 Arrive in Boston, MA	Have a Safe Memorial Day Weekend!			

SCHEDULE OF AUDIT ACTIVITIES (continued)
Comprehensive Baseline Environmental Audit of Former Underground Test Areas

	Tue May 31	Wed Jun 1	Thu Jun 2	Fri Jun 3	Sat Jun 4
am	8:30 Meeting in Cambridge to Complete Findings	8:30 Finish Findings and Overviews FEDEX Draft Findings and Overviews to NVO	Depart for Las Vegas (E. Maher Only)	8:30 FAR Meeting with interested NVO Staff	
pm				Return to Boston, MA Draft Audit Report Due Out On or Before 6/11/94	

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APPENDIX C

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM

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LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM

Document #	Title/Description	Author	Organization	Recipient	Document Date
MARK BRASELL - ENVIRONMENTAL MANAGEMENT					
D-A-1	CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas	Water Resources Center	Desert Research Institute (DRI)	-	April 1988
D-A-2	U.S. Department of Energy Environmental, Safety, and Health Progress Assessment of the Nevada Test Site	-	DOE	-	August 1992
D-A-3	Nevada Test Site Annual Environmental Report - 1992, Volume I	-	Reynolds Electrical & Engineering Co., Inc. (REECo)	-	September 1993
D-A-4	Formerly Used Nuclear Sites, An Addendum to the Nevada Real Property Inventory	Office of the Asst Mgr for Environment, Safety, Security and Health	Nevada Operations Office (NV)	-	May 1993
D-A-5	Offsite Environmental Monitoring Report: Radiation Monitoring Around United States Nuclear Test Areas, CY 1991	-	EPA's Environmental Monitoring Systems Laboratory (EMSL)	-	January 1992
D-A-6	Nevada Test Site Annual Environmental Report - 1992, Volume I	-	REECo	-	September 1993
D-A-7	Nevada Test Site Annual Environmental Report - 1992, Volume II	-	REECo	-	September 1993
D-A-8	Thirteenth Quarterly Compliance Action Report for the Period of October 1-December 31, 1993	-	NV	-	-
D-A-9	Twelfth Quarterly Compliance Report for the Period of July 1-September 30, 1993	-	NV	-	-
D-A-10	Nevada Environmental Restoration Project - Strategy for Evaluating the Off-Site Nuclear Testing Locations (Draft)	-	NV's Environmental Restoration Division (ERD)	-	November 1993

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-A-11	General Management Inspection of the Department of Energy's Nevada Field Office	Office of Inspector General	DOE	-	May 1992
D-A-12	NV Organizational Chart	-	NV	-	December 1992
D-A-13	NV Mission Statement	-	NV	-	December 1992
D-A-14	NV Functional Descriptions	-	NV	-	December 1992
D-A-15	NV Roles and Responsibilities	-	NV	-	December 1992
D-A-16	Office of the Assistant Secretary for Environmental Management (EM-1) Organizational Chart	EM-1	DOE	-	-
D-A-17	EM-1 Mission Statement	EM-1	DOE	-	-
D-A-18	EM-1 Functional Descriptions	EM-1	DOE	-	-
D-A-19	EM-1 Position Descriptions	EM-1	DOE	-	-
D-A-20	EM-1 Roles and Responsibilities	EM-1	DOE	-	-
D-A-21	Office of the Deputy Assistant Secretary for Environmental Restoration (EM-40) Organizational Chart	EM-40	DOE	-	-
D-A-22	EM-40 Mission Statement	EM-40	DOE	-	-
D-A-23	EM-40 Functional Descriptions	EM-40	DOE	-	-
D-A-24	EM-40 Position Descriptions	EM-40	DOE	-	-
D-A-25	EM-40 Roles and Responsibilities	EM-40	DOE	-	-
D-A-26	Progress Assessment information	-	NV	-	July 1992

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-A-27	Quality Assurance Program Plan (QAPP), Revision 0, Environmental Support Services for the U.S. Department of Energy	Environmental Restoration Program	NV	-	July 1993
D-A-28	Environmental Monitoring Plan Nevada Test Site and Support Facilities, Volume I	H.B. Gillen; J.W. Kesler	REEC Co	-	November 1991
D-A-29	Environmental Monitoring Plan Nevada Test Site and Support Facilities, Volume II	H.B. Gillen; J.W. Kesler	REEC Co	-	November 1991
D-A-30	Environmental Restoration and Waste Management Five-Year Plan for Fiscal Years 1993-1997	-	DOE	-	August 1991
D-A-31	Environmental Restoration and Waste Management AMEM Manual	-	NV	Environmental Restoration & Waste Management (ER)	April 1993
D-A-32	Quality Assurance Description Manual	-	NV	ER	1993
D-A-33	FY 1994 Mid-Year Review	-	ERD	Environmental Restoration Office of Southwestern Area Programs (EM-452)	April 27-28, 1994
D-A-34	Activity Data Sheets FY 1996	-	ERD	EM-452	April 15, 1994
D-A-35	Technical Strategy Plan (Draft)	-	ERD	EM-452	May 1994
D-A-36	Quality Assurance Program Description	-	ERD	DOE	June 1992
D-A-37	Project Management Plan	Stephen Mellington, Environmental Restoration Project	ERD	-	March 1994
D-A-38	Project Plan	-	-	-	November 1993

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-A-39	Review of Environmentally Sensitive Resources at Off-Site Locations	-	International Technology Corp. (IT)	NV	March 1993
D-A-40	Memorandum re: Approval of Real Property at the Tatum Test Site, Lamar County	Donald W. Pearman, Acting Associate Deputy Secretary for Field Management	-	Manager, NV	April 26, 1994
D-A-41	Various position descriptions	-	ERD	-	-
D-A-42	Environmental Restoration Division FTE Priority List	Stephen Mellington	ERD	-	1994
D-A-43	Site Specific Plan, Fiscal Years 1994-1998	-	ERD		January 1993
D-A-44	IDP Training Handbook	-	NV	NV	-
D-A-45	Environmental Restoration and Waste Management Program Fact Sheets	-	NV	Community	-
D-A-46	Memorandum Acceptance of Formerly Used Nuclear Test Sites	R.P. Whitfield	DOE/Dep. Asst. Secy for Environmental Restoration	EM-1	November 1993
SCOTT GNEWUCH - GROUNDWATER, INACTIVE WASTE SITES					
D-B-1	CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas	Water Resources Center	DRI	DOE	4/88
D-B-2	Annual Site Environmental Report- Nevada Test Site	-	DOE	DOE	1992
D-B-3	Evaluation of Groundwater Monitoring at Off-site Nuclear Test Areas	J.B. Chapman; S.L. Hokett	DRI	DOE	1991
D-B-4	The Application of Borehole Logging to Characterize the Hydrogeology of the Faultless Site, Central Nevada Test Area	J.B. Chapman, et al.	DRI	DOE	1992

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-B-5	Long Term Hydrologic Monitoring Program, Project Shoal Site, Sand Springs Range, Churchill County, NV	-	DOE	DOE	1984
D-B-6	Site Disposal Report Fallon Nuclear Test Site (SHOAL)	-	Atomic Energy Commission (AEC)	NV	1970
D-B-7	Project Gasbuggy Site Restoration Final Report	-	DOE	NV	July, 1983
D-B-8	Project Gasbuggy Radiation Contamination Clearance Report	-	Eberline Inst. Corp.	DOE	June 27, 1979
D-B-9	Long Term Hydrologic Monitoring Program, Gnome Site, Eddy County, NM	Environmental Branch, Health Physics Div.	NV	DOE	1982
D-B-10	Shoal Site Hydrology - A Chemical and Isotopic Analysis Letter Report For FY 1991	J.B. Chapman, S.L. McKay	DRI	DOE	1992
D-B-11	The Application of Borehole Logging to Characterize the Hydrogeology of the Faultless Site, Central Nevada Test Area	J.B. Chapman, et al.	DRI	DOE	1993
D-B-12	Survey of Hazardous Materials Used in Nuclear Testing	Bryant and Fabryka-Martin	Los Alamos National Lab	DOE	1991
DAVID ALLARD - QUALITY ASSURANCE; ENVIRONMENTAL RADIATION					
D-C-1	CERCLA Preliminary Assessment of DOE's Nevada Operations Office Nuclear Weapons Testing Areas	Water Resources Center	DRI	-	April 1988
D-C-2	U.S. Department of Energy Environmental, Safety, and Health Progress Assessment of the Nevada Test Site	-	DOE	-	August 1992
D-C-3	Nuclear Weapon Tests: Prohibition or Limitation?	-	Stockholm International Research Institute	-	1988
D-C-4	Amchitka Radiobiological Program Progress Report, January 1975 to December 1975	-	University of Washington	-	May 1976

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-C-5	Amchitka Radiobiological Program Progress Report, March 1972 to December 1972	-	University of Washington	-	June 1972
D-C-6	Nevada Test Site Annual Environmental Report - 1992, Volume I	-	REECo	-	September 1993
D-C-7	Nevada Test Site Annual Environmental Report - 1992, Volume II	-	REECo	-	September 1993
D-C-8	Evaluation of Groundwater Monitoring at Offsite Nuclear Test Areas	Water Resources Center	DRI	-	March 1991
D-C-9	The Application of Borehole Logging to Characterize the Hydrogeology of the Faultless Site, Central Nevada Test Site Area	J.B. Chapman S.L. McKay	DRI-Water Resources Center	-	December 1993
D-C-10	Formerly Used Nuclear Sites, An Addendum to the Nevada Real Property Inventory	Office of the Asst Mgr for Environment, Safety, Security and Health	NV	-	May 1993
D-C-11	Offsite Environmental Monitoring Report: Radiation Monitoring Around United States Nuclear Test Areas, CY 1991, USEPA Report 600/R-93/141	-	EMSL	-	January 1992
D-C-12	Thirteenth Quarterly Compliance Action Report for the Period of October 1-December 31, 1993	-	NV	-	-
D-C-13	Twelfth Quarterly Compliance Report for the Period of July 1-September 30, 1993	-	NV	-	-
D-C-14	Nevada Environmental Restoration Project - Strategy for Evaluating the Off-Site Nuclear Testing Locations (Draft)	-	ERD	-	November 1993
D-C-15	Offsite Environmental Monitoring Report: Radiation Monitoring Around United States Nuclear Test Areas, Calendar Year 1991	-	EMSL	-	January 1992
D-C-16	Evaluation of Groundwater Monitoring at Offsite Nuclear Test Areas	J.B. Chapman; S.L. Hokett	DRI	-	March 1991

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-C-17	Long-Term Hydrologic Monitoring Program Project Shoal Site Sand Springs Range, Churchill County, Nevada	Environmental Branch, Health Physics Dept.	NV	-	May 1984
D-C-18	Onsite and Offsite Environmental Monitoring Report: Radiation Monitoring Around the Tatum Salt Dome, Lamar County, Mississippi	D.J. Thorne, et al.	EMSL	-	April 1990
D-C-19	Final Report of Offsite Surveillance, Vela Uniform, Project Shoal, Fallon, Nevada	-	Southwest Radiological Health Laboratory	AEC	September 1964
D-C-20	Site Disposal Report Fallon Nuclear Test Site (Shoal), Churchill County, Nevada	-	AEC	-	May 1970
D-C-21	Tritium and Chlorine-36 Migration from a Nuclear Explosion Cavity	T.J. Burbey; S.W. Wheatcraft	DRI-Water Resources Center		April 1986
D-C-22	Project Gasbuggy Site Restoration Report	-	Holmes and Narver, Inc.	NV	July 1983
D-C-23	Project Gasbuggy Radiation Contamination Clearance Report	-	Eberline Instrument Corp.	NV	June 1979
D-C-24	FY-92 Report on the Isotope Hydrology Characterization of the Faultless Test Site, Nye County, Nevada	M.L. Davidson, et al.	Lawrence Livermore National Laboratory	DOE, Nuclear Chemistry Division	February 1994
D-C-25	Field Investigation at the Faultless Site Central Nevada Test Area	J.B. Chapman, et al.	-	-	-
D-C-26	NV Organizational Chart	-	NV	-	December 1992
D-C-27	NV Mission Statement	-	NV	-	December 1992
D-C-28	NV Functional Descriptions	-	NV	-	December 1992
D-C-29	NV Roles and Responsibilities	-	NV	-	December 1992

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-C-30	Office of the Assistant Secretary for Environmental Management (EM-1) Organizational Chart	EM-1	DOE	-	-
D-C-31	EM-1 Mission Statement	EM-1	DOE	-	-
D-C-32	EM-1 Functional Descriptions	EM-1	DOE	-	-
D-C-33	EM-1 Position Descriptions	EM-1	DOE	-	-
D-C-34	EM-1 Roles and Responsibilities	EM-1	DOE	-	-
D-C-35	Office of the Deputy Assistant Secretary for Environmental Restoration (EM-40) Organizational Chart	EM-40	DOE	-	-
D-C-36	EM-40 Mission Statement	EM-40	DOE	-	-
D-C-37	EM-40 Functional Descriptions	EM-40	DOE	-	-
D-C-38	EM-40 Position Descriptions	EM-40	DOE	-	-
D-C-39	EM-40 Roles and Responsibilities	EM-40	DOE	-	-
D-C-40	T.T.A. Issues in New Mexico	-	Los Alamos National Laboratory	-	-
D-C-41	Grand Junction Environmental Audit and SERI T.T.A. findings pertaining to regulations of the State of Colorado.	-	-	-	-
D-C-42	Progress Assessment information	-	NV	-	July 1992
D-C-43	Sandia National Laboratory Environmental Audit Findings	-	-	-	-
D-C-44	Quality Assurance Program Plan (QAPP), Revision 0, Environmental Support Services for the U.S. Department of Energy	Environmental Restoration Program	NV	-	July 1993

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-C-45	Long-Term Hydrologic Monitoring Program Gnome Site, Eddy County, New Mexico	Environmental Branch, Health Physics Dept.	NV	-	-
D-C-46	Hydrologic and Geologic Studies for Project Gnome, Preliminary Report	-	U.S. Geological Survey Office	AEC, Plowshare Program	May 1962
D-C-47	Earth Deformation from a Nuclear Detonation in Salt - Final Report	R.B. Hoy; R.M. Foose	Stanford Research Office	AEC, Plowshare Program	July 1962
D-C-48	The Environment Created by a Nuclear Explosion in Salt - Final Report	D. Rawson, et al.	Lawrence Radiation Laboratory	AEC, Plowshare Program	April 1965
D-C-49	Project Gnome Decontamination and Decommissioning Plan	-	NV	-	May 1962
D-C-50	Technical Letter: Gnome-13, Post-Shot Monitor Wells USGS Test Holes 6 and 7, Project Gnome	J.B. Cooper	U.S. Geological Survey	NV	May 1962
D-C-51	Gnome Site Decontamination and Decommissioning Project, Radiation Contamination Clearance Report, March 28, 1979-September 23, 1979	-	REECo	-	August 1981
D-C-52	Radiation Monitoring On and Around the Tatum Salt Dome, Lamar County, Mississippi	D.J. Thome, et al.	EPA-EMSL	-	April 1991
D-C-53	Gnome Potshot Temperature and Radiation Studies - Preliminary Report	W.P. Bennett, et al.	Lawrence Radiation Laboratory	AEC, Plowshare Program	June 1962
D-C-54	Evaluation of the Project Gnome/Coach Site Carlsbad, New Mexico for Disposition, Including Identification of Restrictions, Part I	-	Palo Alto Laboratories	AEC	April 1970
D-C-55	Long-Term Hydrologic Monitoring Program Rulison Event Site, Grand Valley, California	Environmental Branch, Health Physics Division	NV	-	January 1984
D-C-56	Rulison Site Cleanup Report	-	AEC	-	July 1973

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-C-57	Project Rulison Final Operational Radioactivity Report Production Tests	-	AEC	-	February 1972
D-C-58	Final Report Fawn Creek Government No. 1: Project Rio Blanco	Engineering & Energy Management Division	NV	-	August 1986
D-C-59	Radioactivity in Water--Project Rulison	W.E. Nork; P.R. Fenske	Teledyne Isotopes Palo Alto Laboratory	AEC	February 1970
D-C-60	Project Rio Blanco Site Restoration Final Report	Energy Research Projects Branch	NV	-	January 1978
D-C-61	Environmental Monitoring Plan Nevada Test Site and Support Facilities, Volume I	H.B. Gillen; J.W. Kesler	REECo	-	November 1991
D-C-62	Environmental Monitoring Plan Nevada Test Site and Support Facilities, Volume II	H.B. Gillen; J.W. Kesler	REECo	-	November 1991
D-C-63	Environmental Restoration and Waste Management Five-Year Plan for Fiscal Years 1993-1997	-	DOE	-	August 1991
D-C-64	Compliance Assessment of the Nevada Test Site	Environment, Safety, and Health	DOE	-	January 1990
D-C-65	FY 1993 Application of the DOE Environmental Restoration Priority System	-	NV	-	April 1991
D-C-66	Offsite Environmental Monitoring Report: Radiation Monitoring Around United States Nuclear Test Areas Calendar Year 1990	D.J. Chaloud, et al.	EMSL	-	March 1992
D-C-67	Offsite Environmental Monitoring Report: Radiation Monitoring Around United States Nuclear Test Areas Calendar Year 1989	C.F. Costa, et al.	EMSL	-	May 1990
D-C-68	Environmental and Waste Management - Site Specific Plan FY 93-94	-	NV	-	January 1993
D-C-69	Environmental Protection Implementation Plan 11/9/91	Latham, et al.	NV	-	November 1993

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-C-70	Addendum to EMP	-	REEC Co	NV	November 1992
D-C-71	Environmental Protection Implementation Plan	Allen	NV	-	November 1992
D-C-72	Environmental Protection Implementation Plan	Elle	NV	-	November 1993
D-C-73	Addendum to EMP	-	REEC Co	NV	November 1993
D-C-74	Groundwater Protection - Management Program Plan	-	NV	-	February 19, 1993
D-C-75	Review of Environmentally Sensitive Resources at Offsite Locations		IT	NV	March 1993
D-C-76	SALMAN Test Site Radiological Monitoring	Carson	MS, DOH	NV	March 25, 1994
D-C-77	Pilot Study Risk Assessments for Selected Problems at NTS	Daniels, et al.	Lawrence Livermore National Laboratory	NV	June 1993
D-C-78	Tritium Migration at the GASBUGGY SITE	Chapman	DRI	NV	September 21, 1992
D-C-79	LTHMP Field SOP	-	EPA	NV	April 13, 1994
D-C-80	QA Program Plan	-	EPA	-	August 1987
D-C-81	Radiochemical Analysis Procedures for Environmental Samples	-	EPA	-	March 1979
D-C-82	Procedures for Measurement of Radioactivity in Drinking Water	-	EPA	-	August 1980
D-C-83	Preprint of Book "Elements of Controversy," Chapters 9 and 10	Hacker	Lawrence Livermore National Laboratory	-	March 1994

LIST OF SITE DOCUMENTS REVIEWED BY THE AUDIT TEAM (continued)

Document #	Title/Description	Author	Organization	Recipient	Document Date
D-C-84	AMEN Manual	-	NV	-	-
D-C-85	NV Work Breakdown Structure	-	NV	-	February 16, 1993
D-C-86	Self Assessment Program	-	NV	-	June 15, 1992

APPENDIX D

LIST OF CONTACTS AND INTERVIEWS CONDUCTED BY THE AUDIT TEAM

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LIST OF CONTACTS AND INTERVIEWS CONDUCTED BY THE AUDIT TEAM

Ref. #	Date	Auditor	Organization	Topic
MARK BRAZELL — ENVIRONMENTAL MANAGEMENT				
I-A-1	5/16/94	M. Brazell	Nevada Operations Office (NV) Environmental Restoration Division (ERD)	In-briefing
I-A-2	5/16/94	M. Brazell	EPA's Environmental Monitoring System Systems Laboratory (EMSL) Nuclear Radiation Assessment Division (NRD), Office of R&D	Offsite area groundwater sampling and analysis
I-A-3	5/16/94	M. Brazell	EMSL-NRD, Office of R&D	Offsite area groundwater sampling and analysis
I-A-4	5/17/94	M. Brazell	ERD	Organization structure commitment, training, resources
I-A-5	5/17/94	M. Brazell	NV-Office of Environmental Restoration and Waste Management	Organizational structure, training
I-A-6	5/17/94	M. Brazell	NV	Community relations, interagency coordination, agreements in principle
I-A-7	5/17/94	M. Brazell	Desert Research Institute (DRI)	Communication, environmental planning, training and development
I-A-8	5/18/94	M. Brazell	NV-Office of Environmental Restoration and Waste Management	Organizational structure, internal/external communication, budgeting, training
I-A-9	5/18/94	M. Brazell	ERD	Cost and schedule baseline, project control
I-A-10	5/18/94	M. Brazell	ERD	Strategic project planning
I-A-11	5/18/94	M. Brazell	NV-Human Resources Division	Training
I-A-12	5/18/94	M. Brazell	NV-Office of Environmental Restoration and Waste Management	Training
I-A-13	5/19/94	M. Brazell	ERD	Cost and schedule, planning, technical discussion of offsites
I-A-14	5/19/94	M. Brazell	International Technology Corporation (IT)	Technical discussion of offsites

LIST OF CONTACTS AND INTERVIEWS CONDUCTED BY THE AUDIT TEAM (continued)

Ref. #	Date	Auditor	Organization	Topic
I-A-15	4/5/94	M. Brazell	DOE Albuquerque Laboratory and Nevada Programs Division (EM-452)	Project planning, transition, organizational structure, communication
I-A-16	4/5/94	M. Brazell	EM-452	Project planning, transition, organizational structure, communication
I-A-17	4/5/94	M. Brazell	EM-452	Project planning, transition, organizational structure, communication
I-A-18	4/5/94	M. Brazell	DOE Office of Defense Programs (DP-20)	Transition of sites to EM-452
I-A-19	4/5/94	M. Brazell	DP-20	Transition of sites to EM-452
SCOTT GNEWUCH -- GROUNDWATER, INACTIVE WASTE SITES				
I-B-1	5/16	S. Gnewuch	EMSL-NRD, Office of R&D	Groundwater/inactive waste sites
I-B-2	5/16	S. Gnewuch	EMS-NRD, Office of R&D	Groundwater/inactive waste sites
I-B-3	5/17	S. Gnewuch	ERD	Groundwater/inactive waste sites
I-B-4	5/17	S. Gnewuch	ERD	Groundwater/inactive waste sites
I-B-5	5/17	S. Gnewuch	ERD	Groundwater/inactive waste sites
I-B-6	5/17	S. Gnewuch	DRI	Groundwater/inactive waste sites
I-B-7	5/18	S. Gnewuch	DRI	Groundwater/inactive waste sites
I-B-8	5/18	S. Gnewuch	ERD	Groundwater/inactive waste sites
I-B-9	5/19	S. Gnewuch	ERD	Groundwater/inactive waste sites
I-B-10	5/19	S. Gnewuch	IT	Groundwater/inactive waste sites
DAVE ALLARD -- QUALITY ASSURANCE; ENVIRONMENTAL RADIATION				
I-C-1	5/16/94	D. Allard	NV	In-briefing
I-C-2	5/16/94	D. Allard	EMSL-NRD, Office of R&D	Offsite area groundwater sampling and analysis
I-C-3	5/16/94	D. Allard	EMSL-NRD, Office of R&D	Offsite area groundwater sampling and analysis

LIST OF CONTACTS AND INTERVIEWS CONDUCTED BY THE AUDIT TEAM (continued)

Ref. #	Date	Auditor	Organization	Topic
I-C-4	5/17/94	D. Allard	NV	Offsite area source terms, site cleanup, long-term hydrological program
I-C-5	5/17/94	D. Allard	NV	Quality assurance of offsite area projects
I-C-6	5/17/94	D. Allard	NV	Federal facility agreements, project planning
I-C-7	5/17/94	D. Allard	DRI	Offsite area projects
I-C-8	5/18/94	D. Allard	DRI	Offsite area projects
I-C-9	5/18/94	D. Allard	IT	Environmental restoration, project quality assurance program
I-C-10	5/19/94	D. Allard	NV	Environmental monitoring and surveillance of offsite areas
I-C-11	5/19/94	D. Allard	IT	Environmental support services for offsite areas

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APPENDIX E

DEFINITIONS OF CAUSAL FACTORS

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DEFINITIONS OF CAUSAL AND CONTRIBUTING FACTORS

Causal Factor	Definition
Policy	Evaluate if ineffective, outdated, or nonexistent policies contributed to the finding.
Policy Implementation	Ascertain if written policies reflecting Federal, state, and local laws and regulations, codes, and standards were appropriately disseminated, implemented, and updated.
Risk	Evaluate if the site personnel responsible for a situation contributing to a finding have assessed and were aware of the relative degree of risk involved in the action.
Procedures	Identify if written procedures that have been prepared to effectively implement site policy, DOE Orders, and Federal, state, and local laws and regulations were a contributing factor to the finding. Determine if unfamiliarity with, or unavailability of those procedures contributed to the finding.
Personnel	Identify if the educational and work experience backgrounds for personnel holding responsible positions contributed to the finding. Determine if the level of personnel knowledge about the technical and environmental aspects of their jobs contributed to the finding.
Resources	Ascertain if the number of personnel or extramural resources available to a job were a contributing factor to the finding. Evaluate if inadequacies in facilities and equipment were a contributing factor to the finding.
Training	Identify if adequate personnel training on implementing site policy, DOE Orders, and Federal, state, and local laws and regulations was a contributing factor to the finding.

DEFINITIONS OF CAUSAL FACTORS (continued)

Causal Factor	Definition
Change	Evaluate if changes in site mission, function, operation, and established requirements, which rendered existing policies or procedures inadequate or inappropriate, were contributing factors to the finding. Evaluate if the timeliness and effectiveness of changes to site and DOE policy, and the implementing procedures, were a contributing factor to the finding.
Appraisals/Audits/Reviews	Determine if ineffective or insufficient appraisals/audits/reviews or oversight were contributing factors to the finding. These factors should only be used as <i>secondary</i> contributing factors to the finding.
Design	Evaluate if inadequate design of a system was a contributing factor to the finding.
Human Factors	Ascertain if human factors, such as fatigue or deliberate circumvention of a safety system, were contributing factors to the finding.
Barriers and Controls	Determine if inadequacies in established barriers and controls, both administrative and physical, including operational readiness, routine inspections, and preventive maintenance, and/or a lack of these controls contributed to the finding.
Supervision	Identify if ineffective supervisory controls for implementing policies, procedures, standards, laws, etc., were a contributing factor to the finding.
Quality Assurance/ Quality Control	Identify if inadequacies in the quality assurance/quality control program were causal factors to the identified finding. This includes inadequate followup to previously identified findings.

APPENDIX F

GLOSSARY OF ACRONYMS AND ABBREVIATIONS

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GLOSSARY OF ACRONYMS AND ABBREVIATIONS

Acronym	Definition
ADS	Activity Data Sheet
AEC*	U.S. Atomic Energy Commission (now U.S. Department of Energy)
ALARA	As Low As Reasonably Achievable
ANSI	American National Standard Institute
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CER	CER Geonuclear Corporation
CFR	Code of Federal Regulations
D&D	Decontamination and Decommissioning
DOE*	U.S. Department of Energy
DQO	Data Quality Objectives
DP*	Office of Defense Programs
DRI*	Desert Research Institute
EH*	Office of Environment, Safety and Health
EH-1	Office of the Assistant Secretary for Environment, Safety and Health
EH-24*	Office of Environmental Audit
EM*	Office of Environmental Management (formerly Office of Environmental Restoration and Waste Management)
EM-40	Office of Deputy Assistant Secretary for Environmental Restoration
EM-45	Office of Director of the Southwestern Areas Programs
EM-452*	Albuquerque Laboratory and Nevada Programs Division
EMP	Environmental Monitoring Plan
EMSL*	EPA, Environmental Monitoring Systems Laboratory
EPA*	U.S. Environmental Protection Agency
ERD*	NV Environmental Restoration Division
FTE	Full-Time-Equivalent
FUTA*	Former Underground Nuclear Test Area
GW	Groundwater

* These commonly-used acronyms are spelled out only on first reference in each section. All others are spelled out on first reference in each subsection.

GLOSSARY OF ACRONYMS AND ABBREVIATIONS (continued)

Acronym	Definition
IC	Internal and External Communication
IT *	International Technology Corporation
IWS	Inactive Waste Sites
LTHMP	Long-Term Hydrological Monitoring Program
mrem	Millirem
NCP	National Oil and Hazardous Substances Contingency Plan
NRD	EMSL, Nuclear Radiation Assessment Division
NTS *	Nevada Test Site
NV *	Nevada Operations Office
OSHA	Occupational Safety and Health Act
PHS	Public Health Service
pCi/l	picrouries per liter
QA	Quality Assurance
RAD	Radiation
RAL	Remedial Action Levels
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation and Feasibility Study
SARA	Superfund Amendments and Reauthorization Act
U.S.C.	United States Code
USGS	U.S. Geological Survey
WM	Waste Management

* These commonly-used acronyms are spelled out only on first reference in each section. All others are spelled out on first reference in each subsection.