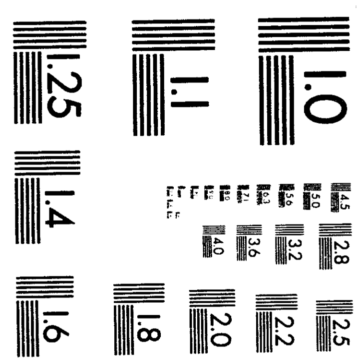
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DOE/NV10630-28 Add. 2

ADDENDUM TO ENVIRONMENTAL MONITORING PLAN NEVADA TEST SITE AND SUPPORT FACILITIES

November 1993

Work Performed Under
Contract No. DE-AC08-89NV10630

Prepared for the
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Nevada Operations Office

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FOREWORD

This 1993 Addendum to the "Environmental Monitoring Plan Nevada Test Site and Support Facilities - 1991," Report No. DOE/NV/10630-28 (EMP) applies to the U.S. Department of Energy's (DOE's) operations on the Continental U.S. (including Amchitka Island, Alaska) that are under the purview of the DOE Nevada Operations Office (DOE/NV). The primary purpose of these operations is the conduct of the nuclear weapons testing program for the DOE and the Department of Defense. Since 1951, these tests have been conducted principally at the Nevada Test Site (NTS), which is located approximately 100 miles northwest of Las Vegas, Nevada. In accordance with DOE Order 5400.1, this 1993 Addendum to the EMP brings together, in one document, updated information and/or new sections to the description of the environmental activities conducted at the NTS by user organizations, operations support contractors, and the U.S. Environmental Protection Agency (EPA) originally published in the EMP. The EPA conducts both the offsite environmental monitoring program around the NTS and post-operational monitoring efforts at non-NTS test locations used between 1961 and 1973 in other parts of the continental U.S. All of these monitoring activities are conducted under the auspices of the DOE/NV, which has the stated policy of conducting its operations in compliance with both the letter and the spirit of applicable environmental statutes, regulations, and standards.

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SECTION I

OVERVIEW

by

A. R. Latham
Reynolds Electrical & Engineering Co., Inc.

January 3, 1994

1.0 Introduction

1.1 Operations and Facilities

1.1.1 Operational Test Areas

1.1.1.1 Nevada Test Site Operations

Nuclear testing at the NTS is currently conducted in three areas: at the bottom of plugged vertical shafts drilled into (1) Yucca Flat or into (2) Pahute Mesa and in sealed tunnels mined into (3) Rainier Mesa. Nuclear safety tests were conducted in the 1950s and 1960s on the Range Complex and on the TTR. Low-level radioactive waste disposal (burial) facilities are located in Frenchman Flat and Yucca Flat. Transuranic waste is containerized and stored in Frenchman Flat pending shipment to the Waste Isolation Pilot Plant in New Mexico. Other testing facilities on the NTS include the (non-nuclear) Liquified Gaseous Fuels Spill Test Facility (LGFSTF) in Frenchman Flat, **the Treatability Test Facility located in Area 25,** and the Nevada Research and Development Area in Jackass Flats. Construction and maintenance facilities consisting of offices, shops, laboratories, and worker housing facilities are located at the NTS base camp at Mercury and the Area 12 Camp. Other construction and maintenance facilities are located in Area 3, Area 20, and at the NTS Control Point. The current operational areas and facilities are shown in Exhibit 1-2. Nuclear testing on the NTS is conducted by the NTS user organizations; Lawrence Livermore National Laboratory (LLNL), Los Alamos National Laboratory (LANL), and Defense Nuclear Agency (DNA). Private sector firms or consortiums conduct non-nuclear liquid spill tests at the LGFSTF.

2.0 Sources and Effluents

2.3 Off-NTS Continental U.S. Test Areas

No effluents are produced at these sites. At most sites, contamination is confined to the residual radioactivity remaining at the point of the underground nuclear explosion. Accidental leakage caused low levels of tritium contamination at the surface on Amchitka Island at the LONG SHOT site, and waste disposal resulted in low surface levels of tritium at the Project DRIBBLE site in Mississippi, but only residual contamination (tritium) remains at both sites. **Since 1984, a monitoring well near the project GASBUGGY ground zero (GZ) has indicated slightly elevated levels of tritium; however, these levels are well below the limits set in the Interim Primary Drinking Water Regulations.**

9.0 Summary of Operational Area Monitoring Plans

9.2 Lawrence Livermore National Laboratory Testing Areas and Facilities, NTS

This OAMP describes effluent monitoring plans for underground nuclear tests conducted in plugged vertical shafts drilled into LLNL testing areas located in Areas 2, 4, 8, 9, 10, 12, and

20 of the NTS. The Laboratory conducts no ambient environmental surveillance monitoring at the NTS. LLNL effluent monitoring is for radioactive gaseous and particulate emissions to the atmosphere from venting, seepage, device assembly, and post-test ("post-shot") drillback operations conducted to collect samples or equipment from the vicinity of the underground test. **Liquids and/or drilling muds from drilling operations are sampled at time of discharge into tanks.** There are no liquid or mud discharges to surface drainage channels or to the offsite environment. Environmental surveillance in the LLNL areas is performed by REECo.

9.7 NTS/Tonopah Test Range Nonradiological Effluent Monitoring, Reynolds Electrical & Engineering Co., Inc.

This plan contains a listing of the sources of air and wastewater discharges on the NTS, the permits required from the state of Nevada for operation of the sources, and the monitoring required to comply with the permits. Other monitoring is conducted to comply with the requirements of federal and state statutes. **Ambient air quality and stationary source monitoring has been performed to assess the compliance with federal, state, and local regulations.**

9.8 Waste Disposal and Waste Management Facilities, Reynolds Electrical & Engineering Co., Inc., NTS

This plan covers monitoring of the two sites on the NTS used for the disposal of radioactive low-level waste (LLW). The site in Area 3 consists of two adjoining surface subsidence craters used for the disposal of bulk LLW. The site in Area 5 includes facilities for various kinds of waste management such as burial of LLW, greater confinement disposal (deep borehole) of other LLW, a transuranic waste storage cell (pending shipment to the Waste Isolation Pilot Plant in New Mexico), a mixed waste management unit (Rocky Flats waste only), and a storage area for accumulation of hazardous waste that is shipped to non-NTS RCRA-permitted commercial disposal facilities every 90 days. The OAMP describes the surveillance plan as presently designed and a vadose monitoring procedure that is being considered. **The RWMS pits in Area 5 are being studied to determine if they should be classified as diffuse air sources.**

SECTION II.1

Operational Area Monitoring Plan for the Los Alamos National Laboratory Testing Areas and Facilities Nevada Test Site

by

R. W. Henderson
Los Alamos National Laboratory

January 3, 1994

1.2.2 Analytical Laboratory

The Mouse House (Bldg. 701) in Mercury houses an environmental-level radioanalytical laboratory. This facility handles air, water, and swipe samples arising during the conduct of LANL operations at the NTS. Routine radioanalytical techniques are used to assay these samples. Provision has been made at the Mouse House to utilize **a ^{137}Cs source, 1.5 curies or less,** for calibration of instruments.

3.0 Effluent Monitoring Plan

3.3 Effluent Monitoring System Design

3.3.1 Drillback Activities

The monitoring for each drillback activity is done by use of several devices as shown in Exhibits 3-2 and 3-3, one of which is a constant monitoring system. The air in the system is continuously monitored for gamma-emitting radionuclides. This system is calibrated to respond to gamma energies above 80 keV, the predominant transition energy of ^{133}Xe, which is the most abundant nuclide in the gas mix seen at the surface during most drillback operations. This radionuclide acts as an early warning, indicating there is material in the stack, and allows for remedial action before a release occurs. Detailed information is in LANL-NTS-DP-002 (Appendix II.1-C). **The monitoring of any release from the cellar during the drillback or cementback phases is done by a flow through system sampling the Auxiliary Cellar Exhaust Blower. A sample of the exhausted air is drawn through the system, and analyzed for ^{133}Xe in the Rad Lab. Detailed information is given in Draft Procedure, LANL-NTS-DP-001 (Appendix II.1-D).**

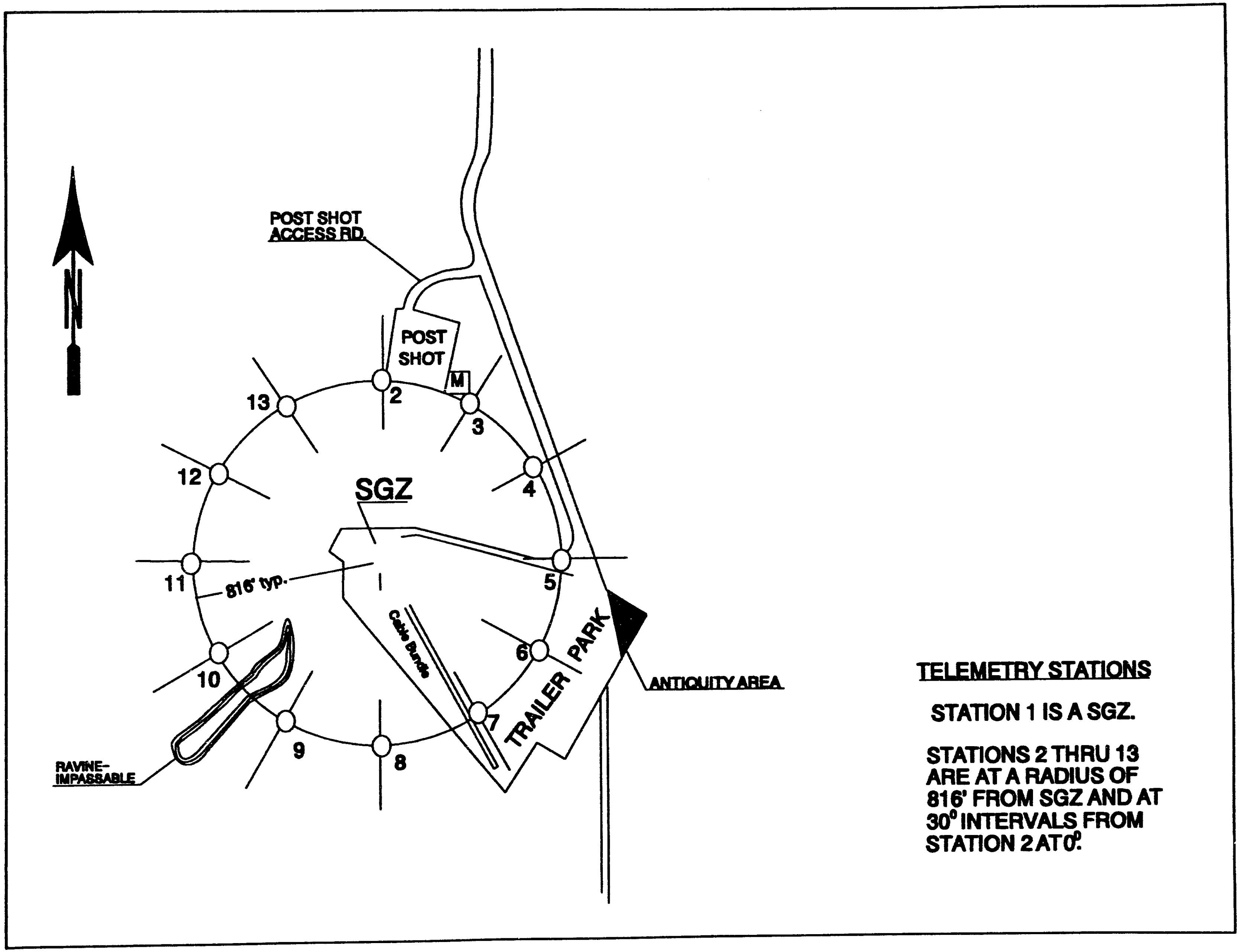

Exhibit 3-1 LANL RAMS Array for Nuclear Tests

APPENDIX II.1-C

DETAILED PROCEDURE FOR ESTIMATION OF ACTIVITY IN THE CONTAINMENT SYSTEM

FIELD TEST HEALTH PHYSICS SECTION
DETAILED PROCEDURE FOR
ESTIMATION OF ACTIVITY IN THE CONTAINMENT SYSTEM

I. PURPOSE

To document the procedures used for the estimation of quantities of radioactive material inside the containment system during drillback operations.

II. SCOPE

This procedure applies to the interpretation of results derived from the radio-metric analysis of a sample of the air drawn from the containment system into the Mobile Radiological Laboratory (Rad Lab) trailer.

III. DEFINITIONS

Containment Stack or Stack The gas field hardware mounted on the top of the well casing designed to contain the radioactive and other gasses in the chimney. This is also referred to as the "blowout preventer".

Cellar Excavated and cased area below the drill rig housing the containment stack.

Rad Lab A trailer containing analytical equipment for the analysis of various of air streams. This includes a system that analyzes the air in the containment system for both radioactive gasses and combustible gasses.

Core Off-gas Airborne radioactive material arising from solid core material brought to the surface during coring operations.

Chimney or Cavity Gas Gaseous material, very rich in xenon, which fills the void spaces of the cavity and the rubble chimney.

IV. DESCRIPTION of OPERATIONS

Following most nuclear experiments on the NTS, the recovery of solid samples of debris is required. This process is referred to as a drillback. The design of the Los Alamos National Laboratory drillback hardware is to completely contain all chimney gas. Figure 1 shows the hardware as it is configured to contain the gasses. Air is drawn from the cellar, sampled by the Rad Lab, and blown down the annulus below the containment stack.

To document the presence of any gaseous material in the containment system during this operation a sample of air in the containment system is drawn into the Rad Lab for analysis.

This analysis is for both radioactive and combustible components. The primary purpose of this sample is to document the presence or absence of such components in the system. The sampling equipment draws a sample at 80 liters per minute.

The sample is collected just after the containment air is drawn into the system. The sample is analyzed in a flow through system using standard gamma ray detection procedures and techniques. This employs an integral bias detector set to detect gamma rays with energies above 60 keV. This includes the principal gamma transition for ^{133}Xe, the principal radioactive constituent of chimney gas. Data are recorded on a semilog strip chart.

V. QUANTIFICATION OF MATERIAL

A. Rationale:

The presence of chimney gas in the air is an unexpected event. In the current political climate it is necessary to provide some estimate of the quantity of this material.

The procedures used to derive estimates of the quantity of radioactive material are derived from measurements made using National Institutes of Standards and Technologies (NIST) furnished ^{133}Xe. During that operation several vials of ^{133}Xe were released into the containment system under various operating conditions, and the response of the detector recorded. This allowed for the quantification of the response, thus calibrating the flow-through system. From these data it was determined that with the sampling system operating at 80 liters per minute, and the containment system operating at several different flow rates, the integrated activity in the system is given by the product of the integrated counts times the containment system flow rate in cubic feet per minute times 3 X 10^{-06} millicuries.

Activity (mCi) =
Counts * Flow rate (cfm) * 3 X 10^{-06} mCi/count-cfm)

B. Procedure:

Once the presence of chimney gas has been verified, the integrated count of the detector system is calculated from the strip chart. The flow rate in the containment system is determined. The ^{133}Xe activity is then determined using the function given above. Under steady state conditions, the counting rate may be used to calculate the rate of material passing through the system.

APPENDIX II.1-D

DETAILED PROCEDURE FOR ESTIMATION OF ACTIVITY FROM THE AUXILIARY CELLAR EXHAUST BLOWER

FIELD TEST HEALTH PHYSICS SECTION
DETAILED PROCEDURE FOR
ESTIMATION OF ACTIVITY FROM THE AUXILIARY CELLAR EXHAUST BLOWER

I. PURPOSE

To document the procedures used for the estimation of quantities of radioactive material released during auxiliary purging of the cellar during drillback operations.

II. SCOPE

This procedure applies to the interpretation of results derived from the radiometric analysis of a sample of the air drawn from the auxiliary cellar exhaust blower into the Mobile Radiological Laboratory (Rad Lab) trailer.

III. DEFINITIONS

Auxiliary Exhaust Blower A blower and duct system designed to remove explosive mixtures from the cellar.

Cellar Excavated and cased area below the drill rig housing the containment stack.

Rad Lab A trailer containing analytical equipment for the analysis of various of air streams. This includes a system that analyses the air in the containment system for both radioactive gasses and combustible gasses.

Chimney or Cavity Gas Gaseous material, very rich in xenon, which fills the void spaces of the cavity and the rubble chimney.

IV. DESCRIPTION of OPERATIONS

Following most nuclear experiments on the NTS, the recovery of solid samples of debris is required. This process is referred to as a drillback. The design of the Los Alamos National Laboratory drillback hardware is to completely contain all chimney gas.

During drilling operations, chimney gas, which may contain explosive components, may escape into the cellar. Before the cellar may be entered for remedial work, these mixtures must be removed. The standard practice is to contain these mixtures and return them down the annulus.

If this cannot be done in a timely manner, then the mixture will be exhausted using the auxiliary blower. The main purpose of the blower is to abate explosive gasses accumulating in the cellar from the BOP. This allows for the safe and prompt repair of the hardware in the cellar.

A sample of the exhausted air is drawn into the Rad Lab for analysis. The purpose of this sample is to document the presence or absence of ^{133}Xe in the air stream. The sampling equipment draws a sample at 80 liters per minute.

The sample is collected just before the air is exhausted from the system. The sample is analyzed in a flow through system using standard gamma ray detection procedures and techniques. This employs an integral bias detector set to detect gamma rays with energies above 60 keV. This includes the principal gamma transition for ^{133}Xe, the principal radioactive constituent of chimney gas. Data are recorded on a semilog strip chart.

V. QUANTIFICATION OF MATERIAL

A. Rationale:

The release of radioactive material is an unexpected event. In the current political climate it is necessary to provide an estimate of the quantity of this material.

The procedures used to derive estimates of the quantity of radioactive material are derived from measurements made using National Institutes of Standards and Technologies (NIST) furnished ^{133}Xe. During that operation several vials of ^{133}Xe were released into the auxiliary blower system, and the response of the detector recorded. This allowed for the quantification of the response, thus calibrating the flow-through system. From these data it was determined that with the sampling system operating at 80 liters per minute, and the blower operating at 350 cfm (single flow rate), the integrated activity in the system is given by the product of the integrated counts times the flow rate in cubic feet per minute times 3 X 10" millicuries.

Activity (mCi) =
Counts * Flow rate *(cfm) * 3 X 10^{-06} mCi/(cfm-count)

At the standard 350 cfm we have:

Activity (mCi) = Counts * 1 X 10^{-03} mCi/count

B. Procedure:

Once the presence of chimney gas has been verified, the integrated count of the detector system is calculated from the strip chart. The flow rate in the containment system is determined. The ^{133}Xe activity is then determined using the function given above. Under steady state conditions, the counting rate may be used to calculate the rate of material passing through the system.

The apparent zero time composition of chimney gas has been determined and reported in LA-3420-MS, Analysis of Underground Weapons Test Effluent Samples. The reported composition is:

^{131}I 1
^{133}I 105
^{135}I 1360

^{133}Xe 10000
^{135}Xe 50000

These data are used to infer the composition of the gas from the observed ^{133}Xe in the mixture. Table 1 is entered with the age of the mixture and the relative amounts of the other constituents determined. These relative amounts are then multiplied by the ^{133}Xe value.

Table 1

Relative Activity - Chimney Gas

Age (Days)	131-I	133-I	135-I	133-Xe	135-Xe
0.0	1.00E-04	1.05E-02	1.36E-01	1.00E+00	5.00E+00
1.0	1.05E-04	5.39E-03	1.25E-02	1.00E+00	9.17E-01
2.0	1.10E-04	2.76E-03	1.15E-03	1.00E+00	1.68E-01
3.0	1.15E-04	1.42E-03	1.05E-04	1.00E+00	3.08E-02
4.0	1.20E-04	7.26E-04	9.64E-06	1.00E+00	5.66E-03
5.0	1.26E-04	3.73E-04	8.85E-07	1.00E+00	1.04E-03
6.0	1.32E-04	1.91E-04	8.12E-08	1.00E+00	1.90E-04
7.0	1.38E-04	9.80E-05	7.45E-09	1.00E+00	3.49E-05
8.0	1.45E-04	5.03E-05	6.84E-10	1.00E+00	6.40E-06
9.0	1.52E-04	2.58E-05	6.28E-11	1.00E+00	1.17E-06
10.0	1.59E-04	1.32E-05	5.76E-12	1.00E+00	2.15E-07
11.0	1.66E-04	6.78E-06	5.29E-13	1.00E+00	3.95E-08
12.0	1.74E-04	3.48E-06	4.85E-14	1.00E+00	7.24E-09
13.0	1.82E-04	1.78E-06	4.45E-15	1.00E+00	1.33E-09
14.0	1.91E-04	9.14E-07	4.08E-16	1.00E+00	2.44E-10
15.0	2.00E-04	4.69E-07	3.75E-17	1.00E+00	4.47E-11
16.0	2.10E-04	2.41E-07	3.44E-18	1.00E+00	8.20E-12
17.0	2.19E-04	1.23E-07	3.16E-19	1.00E+00	1.50E-12
18.0	2.30E-04	6.33E-08	2.90E-20	1.00E+00	2.76E-13
19.0	2.41E-04	3.24E-08	2.66E-21	1.00E+00	5.06E-14
20.0	2.52E-04	1.66E-08	2.44E-22	1.00E+00	9.27E-15
21.0	2.64E-04	8.53E-09	2.24E-23	1.00E+00	1.70E-15
22.0	2.77E-04	4.38E-09	2.05E-24	1.00E+00	3.12E-16
23.0	2.90E-04	2.24E-09	1.88E-25	1.00E+00	5.72E-17
24.0	3.03E-04	1.15E-09	1.73E-26	1.00E+00	1.05E-17
25.0	3.18E-04	5.90E-10	1.59E-27	1.00E+00	1.92E-18
26.0	3.33E-04	3.03E-10	1.46E-28	1.00E+00	3.53E-19
27.0	3.49E-04	1.55E-10	1.34E-29	1.00E+00	6.47E-20
28.0	3.65E-04	7.96E-11	1.23E-30	1.00E+00	1.19E-20
29.0	3.82E-04	4.08E-11	1.13E-31	1.00E+00	2.18E-21
30.0	4.00E-04	2.09E-11	1.03E-32	1.00E+00	3.99E-22

SECTION II.3

Operational Area Monitoring Plan for the Defense Nuclear Agency/Sandia Testing Areas and Facilities Nevada Test Site

by

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Defense Nuclear Agency

J. H. Metcalf
Sandia National Laboratories

January 3, 1994

1.2 Operational Activities

1.2.1.1 Tunnels/Portals

Reentry operations follow device detonation by DOE. During reentry, DNA directs the recovery and retrieval of experiments and reusable material or equipment. Wastes generated outside of three cavity radii, from the detonation point, are similar to those generated during the routine mining/construction operations. However, as the reentry mining activity approaches the cavity, the solid reentry debris (e.g., rock, construction materials, stemming materials, etc.) may contain low-level radioactive waste (LLW), comprised of activation and mixed fission products, and RCRA waste. Lead shielding materials in the form of bricks, sheet, and shot are stored and reused whenever possible, and therefore do not become a RCRA-regulated waste stream.

2.0 Effluents (Emissions and Discharges)

2.1.1.1 Tunnel Discharge Water/Ponds

E and N tunnels are the only tunnels currently discharging any water. The discharge from T tunnel has been eliminated and the ponds are dry. Portal ponds located at E and N tunnels are designated as DNA-TDW/P-E1 and DNA-TDW/P-N1. These ponds receive effluents from perched, fracture water that seeps into the tunnels. N tunnel also produces construction wastewater as a result of non-nuclear testing activities. There are five evaporation/seepage ponds at E tunnel and five at N tunnel. Measurements of the radioactivity in water samples from N and E tunnel ponds are shown in Appendix II.3-C. G and P tunnels are dry tunnels and do not have ponds; however, a relatively very small amount of waste construction water may be drained to the wash below the portal from P tunnel. G Tunnel is currently inactive.

2.2 Summary of Effluent Stream Monitoring Requirements and Responsibility for Documentation

The preceding section described effluent streams attributed to DNA operational activities in Area 12. Table 2-1 gives a brief summary of the organizations responsible for preparing monitoring documentation for each effluent stream, the current monitoring requirements, and the reference source. **This table shows that the current effluent monitoring is adequate.**

2.3.1 Tunnel Discharge Water/Ponds

2.3.1.1 Radioactive Characterization

REECo's Operational Area Monitoring Plans (OAMPs II.5A and II.5b of this volume) provide information regarding the radioactive characterization of this effluent stream.

2.3.1.2 Nonradioactive Characterization

REECo's Operational Area Monitoring Plans (OAMPs II.5A and II.5b of this volume) provide information regarding the nonradioactive characterization of this effluent stream.

2.3.1.3 Review of Current Radioactive and Nonradioactive Characterization

The existing effluent monitoring systems provide an accurate characterization of the radioactive and nonradioactive constituents in the water at a reasonable frequency of sampling.

2.3.1.4 Implementation Plan and Schedule

Systems for characterization/monitoring at E, N, and T tunnels were installed **in 1991**. These systems measure discharge rates, pH, electrical conductivity, and turbidity and also acquire effluent samples for heavy metal, radionuclide, and semi-volatile and volatile organic analysis. DRI, under contract to DOE/NV, **operated** this system for one year to characterize the flow regime and to identify hazardous constituents. DRI **varied** the sampling interval to determine if temporal variability exists within the parameters of interest. DRI started sampling in early fiscal year 1991. REECo **took** over the characterization systems in fiscal year 1992. **Monitoring of these effluent streams will be continued under state discharge permits until discharges are eliminated. The discharge elimination schedule is: T tunnel, May 1994; N tunnel, November 1994; E tunnel, August 1994.**

3.0 Effluent Monitoring Plan

3.1 Rationale

The installation of isokinetic sampling systems to characterize airborne effluents and contract agreement with DRI to characterize liquid effluents **allowed** characterization results to be compared to regulatory requirements (e.g., NESHAPS, etc.). **This comparison showed that only periodic confirmatory sampling will be required**. Monitoring plans for the other effluent sources described in this plan were not modified (see Table 2-1).

3.1.1 Tunnel Discharge Water/Ponds

Monitoring results demonstrate a potential for liquid releases of radioactive materials. Tritium is the principal radioactive contaminant, and results have indicated fairly constant concentrations of tritium **(below DCGs)** throughout each year. There have been no hazardous substances found in the discharge water **during the current monitoring program.**

Airborne **radioactive** effluents may be released during evaporation of tunnel discharge water which has accumulated in the ponds. Tritium releases, in the form of water vapor, are estimated by assuming the entire tunnel water discharge evaporates. This is a very conservative method and probably over estimates the release by about fifty percent. Plans call for **eliminating** discharges from E and N tunnels and evaporating the water remaining in these pond systems. In May 1993, the liquid effluent discharges from T tunnel were eliminated and the pond system is now dry.

3.2.2 Permit Requirements

Nevada Water Pollution Control Permits are required for the liquid effluent discharged from the tunnels. A water pollution control permit for N Tunnel was issued by the state of Nevada on 15 May 1992. Permit applications for E and T Tunnels **were submitted** to the state **during the first and second quarters, respectively, of 1992** . There are no permit requirements for occasional low-level releases of airborne radioactive materials.

SECTION II.4

Operational Area Monitoring Plan for the Liquefied Gaseous Fuels Spill Test Facility Nevada Test Site

by

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EG&G Energy Measurements, Inc.

January 3, 1994

2.0 Effluents

2.1 Inventory of Effluents

Tests may involve any of the approved fluids. These are high vapor pressure materials that become gaseous on release. Test fluids are received at the site several days prior to testing, and any materials not used in tests are returned to the vendor as soon as shipping is arranged.

Table 1-1 List of Approved Chemicals

Ammonia	Methane
	Methyl trichlorosilane
Bromine	Methylamine
Butane	
	Nitrogen tetroxide
Carbon Dioxide	
Chlorine	Oleum
Chlorosulfonic Acid	
Cyclohexane	Phosgene
	Phosphorous oxychloride
Ethylene	Phosphorous trichloride
	Propane
Fluorosulfonic Acid	
	Silicon tetrachloride
Hydrazine	Sulfur dioxide
Hydrogen Sulfide	Sulfur trioxide
Hydrogen Fluoride	
Hydrogen Chloride	Titanium tetrachloride
	Trichlorosilane
LNG	
	Unsymmetrical dimethyl hydrazine
LPG	

SECTION II.5A

Operational Area Monitoring Plan for the Onsite Radiological Surveillance Program Nevada Test Site

by

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Reynolds Electrical & Engineering Co., Inc.

January 3, 1994

2.0 Effluents (Emissions and Discharges)

2.1.2 Radioactive Liquid Discharges

Liquid discharges (process water) from the TTF will be decontaminated to meet Safe Drinking Water Act (SDWA) limits and discharged into existing sewage lagoons or, if SDWA limits cannot be met, stored until they may be released to permitted containment ponds located elsewhere on the NTS.

3.0 Effluent Monitoring Plan

3.2 Monitoring System Design

3.2.1 Liquid Discharges

Liquid radioactive waste from Area 12 tunnels and the Area 6 Decontamination Facility discharges into holding ponds; **radioactive liquid discharges from the TTF will be decontaminated to levels below SDWA release limits and discharged as sanitary waste into existing sewage treatment facilities. Any TTF liquid effluent exceeding SDWA radioactivity limits will be stored in tanks until it may be discharged into permitted containment ponds located elsewhere on the NTS.**

Table 3-1 Radionuclide Concentrations in Containment Ponds (1992)

Location	Type of Radioactivity	Activity (µCi/mL)
Area 6 Decontamination Facility Pond	^{3}H	2×10^{-6}
Area 6 Decontamination Facility Pond	Beta Activity	4×10^{-8}
Area 12 T Tunnel	^{3}H	4×10^{-2}
	Beta Activity	6×10^{-7}
Area 12 N Tunnel	^{3}H	2×10^{-3}
	Beta Activity	3×10^{-8}
Area 12 E Tunnel	^{3}H	2×10^{-3}
	Beta Activity	6×10^{-8}

3.2.2.5 Area 25 Treatability Test Facility

The REECo Treatability Test Facility laboratory located at Area 25 in Building 3124 tests various physical separations technologies for removing low concentrations of

americium, plutonium, and uranium species from native soils. Concentrations of these species shall never exceed 100 nCi/g and will average approximately 500 pCi/g.

Processing likely to produce nuisance dust will be performed wet and in containments. All laboratory test bay and laboratory hood exhausts will be vented to the outside through HEPA filters. The potential for release of radioactivity to the environment is directly proportional to the laboratory sample throughput. Maximum annual sample throughput will not exceed 60 tons.

Compliance with NESHAP monitoring criteria requires a determination of the type of effluent monitoring that is necessary. The activity levels of radionuclides that may be released from this facility are such that doses to offsite individuals are expected to be <<0.1 mrem, therefore, only periodic confirmatory measurements are required followed by calculating dose (HE) for normal operations and assuming that all emission controls are inoperative.

Assuming a worst case release to the environment of the maximum annual 60 ton throughput, the average concentration of 500 pCi/g, and a respirable factor of 0.5, the maximum individual annual exposure to a member of the general public may be calculated. Using EPA's CAP88-PC computer model, the Desert Rock STAR, along with assuming that the ^{238}U was separated from its daughter isotopes and all consumption was from locally produced food, an annual dose of $< 10^{-4}$ mrem is calculated for the nearest resident (Lathrop Wells). This is negligibly small when compared to the NESHAP threshold of 0.1 mrem and limit of 10 mrem.

5.0 Analytical Procedures

5.1 Analyses Employed

Uranium analyses are required because the Treatability Test Facility is responsible for studying physical methods of removal of uranium contamination from soils consequently quantitative uranium analysis is required for determination of removal efficiencies.

SAMPLE TYPE	DESCRIPTION	COLLECTION FREQUENCY	NUMBER OF SAMPLING LOCATIONS	TYPE OF ANALYSIS
Air	Continuous sampling through Whatman GF/A glass filter and a charcoal cartridge	Weekly	52	Gamma Spectroscopy, gross beta, ^{239}Pu (monthly composite)
	Low-volume sampling through silica gel	Biweekly	17	HTO (tritium)
	Continuous, low-volume sampling	Weekly	10	^{85}Kr and ^{133}Xe
Potable Water[1] (tap water)	grab sample	Weekly	9	Gross α, Gamma Spectroscopy, gross ß, tritium,
Supply Wells (potable)	grab sample	Quarterly	10	Gross α, Gamma Spectroscopy, gross ß, tritium,
Supply Wells (non-potable)	grab sample	Quarterly	3	Gross α, Gamma Spectroscopy, gross β, tritium
Open Reservoirs	grab sample	Monthly	15	Gamma Spectroscopy, gross ß, tritium,
Natural Springs	grab sample	Monthly	7	Gamma Spectroscopy, gross ß, tritium,
Containment Ponds	grab sample	Monthly	9	Gamma Spectroscopy, gross ß, tritium,
Sewage Ponds	grab sample	Quarterly	3	Gamma Spectroscopy, gross ß, tritium,
External Gamma Radiation Levels	UD-814AS Thermoluminescent Dosimeters	Quarterly	187	Total integrated exposure over the field cycle.

(1) $^{226,228}Ra$ analysis of potable water samples occurs if gross α > 5 pCi/L and for Rn and U if gross α >15 pCi/L. All water samples are analyzed for $^{239+240}Pu$ quarterly and for ^{90}Sr annually.

Exhibit 4-6 Summary of NTS Radiological Surveillance Program

TYPE OF ANALYSIS	TYPE OF SAMPLE	ANALYTICAL EQUIPMENT	COUNTING TIME(MIN)	ANALYTICAL PROCEDURES	SAMPLE SIZE	DETECTION LIMIT-μCi/mL
^{90}Sr	**Water**	**Gas-Flow Proportional Counter**	**100**	**Precipitate hydroxides, acetates, finally carbonate. Calculate by yttrium ingrowth.**	**1000 mL**	**2×10^{-9}**
^{226,228}Ra	**Water**	**Germanium Semiconductor**	**500**	**^{228}Ra tracer, precipitate with barium sulphate, gamma count.**	**1000 mL**	**2×10^{-9}**
Uranium	**Water**	**Silicon Semiconductor**	**1000**	**Separate on ion exchange, plate on stainless planchet**	**1000 mL**	**8×10^{-11}**
Gross Beta	Air	Gas-flow Proportional Counter	20	Place filter on a 12.7 cm stainless steel planchet	10^{9} mL	2×10^{-16}
	Water	Gas-flow Proportional Counter	100	Evaporate, transfer residue to a 12.7 cm stainless steel planchet	1000 mL	1×10^{-9}
Gamma Spectroscopy	Air (particulate)	Germanium Semiconductor	20	As for gross beta, but in plastic bag	10^{9} mL	5×10^{-15}
	Air (gaseous)	Germanium Semiconductor	20	Place charcoal cartridge in plastic bag	10^{9} mL	5×10^{-15}
	Water	Germanium Semiconductor	20	Aliquot sample into Nalgene bottle	500 mL	1×10^{-9}
^{85}Kr	Air	Liquid Scintillation Counter	300	Cryogenic-gas chromatographic techniques used to collect krypton into liquid scintillation solution	3×10^{5} mL	8×10^{-12}
^{239}Pu	Air	Silicon Semiconductor	333	Filter is ashed and put in solution. Pu is purified by anion exchange resin column, then electrodeposited on a stainless steel disc	4×10^{9} mL	1×10^{-17}
	Water	Silicon Semiconductor	1000	Pu is concentrated with Fe(OH)3 and purified with anion resin column. Electrodeposited on a stainless steel disc	1000 mL	4×10^{-11}
Tritium	Air	Liquid Scintillation Counter	70	Distill the H_2O and aliquot 5 mL into a scintillation solution	1×10^{7} mL	3×10^{-13}
	Water	Liquid Scintillation Counter	70	Distill 20 mL of Sample, 5 mL aliquot into scintillation solution	5 mL	4×10^{-7}
^{133}Xe	Air	Liquid Scintillation Counter	300	Cryogenic-gas chromatographic techniques used to collect xenon into liquid scintillation solution	3×10^{5} mL	25×10^{-12}
Direct Gamma Radiation	TLD	Panasonic UD-710A TLD Reader		Automated		10 mR/quarter

Exhibit 5-1 Summary of Laboratory Analytical Procedures

SECTION II.5B

Operational Area Monitoring Plan for Nonradiological Monitoring at the Tonopah Test Range and Nevada Test Site

by

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Environmental Section
Analytical Services Department
Reynolds Electrical & Engineering Co., Inc.

January 3, 1994

NOTE: RESPONSIBILITY FOR TTR OPERATIONS HAS BEEN TRANSFERRED TO THE U.S. AIR FORCE, SO ALL REFERENCE TO TTR ACTIVITIES HAVE BEEN DELETED FROM THE EMP THIS YEAR.

1.0 Introduction

This Section documents Reynolds Electrical & Engineering Company, Inc.'s (REECo's) nonradiological effluent and environmental monitoring services for the Nevada Test Site (NTS) **provided under contract with DOE/NV. Prior to October 1, 1992, REECo also provided nonradiological effluent and environmental monitoring services at** the Tonopah Test Range (TTR). **Following this date, compliance and monitoring actions were transferred to another contractor under the administration of the U.S. Air Force.** Environmental monitoring (including ecological monitoring), permit application processing, and reporting the compliance status of user organizations at the NTS have also been assigned to REECo.

1.2 Operational Activities

The operational activities of concern to REECo cover the entire NTS and include:

- Site-wide National Environmental Policy Act (NEPA) compliance in areas involving
  - Construction, relocation, expansion, removal, or modification of facilities and/or test sites on the NTS
  - Disposal of **low-level radioactive wastes**
  - Monitoring of flora and fauna in selected areas of the NTS to detect and investigate ecological changes due to DOE activities or natural causes

2.0 Rationale

The purpose of the REECo environmental surveillance program for nonradiological substances is to examine, measure, document, and compare environmental contaminant levels with laws, regulations, standards, and/or permit requirements. The CAA mandates that asbestos removal and renovation projects be monitored and the results reported to the EPA under NESHAP requirements. The primary environmental permit areas for the NTS involve air quality, RCRA requirements, **and water pollution control.**

The purpose of the ecological monitoring on the NTS (previously performed by REECo and UCLA; and currently assigned solely to REECo) is to characterize biological changes caused by DOE activities, measure trends in biological populations, identify and monitor causes of biological problems, and to notify DOE of any biological problems discovered. DOE Order 5400.1 requires that environmental surveillance be conducted to monitor the effects, if any, of

DOE activities on onsite and offsite environmental and natural resources. NEPA and Executive Order 11514 require federal agencies to monitor, evaluate and control their agencies' activities so as to protect and enhance the quality of the environment.

2.1 Liquid Discharges

2.1.1 Domestic Sewage

Sewage discharge permits have been issued by the state of Nevada for discharges to lagoons in Areas 2, 6, 12, 22, 23, and 25 of the NTS. There are no effluent discharges from the lagoons. A variance was granted in 1990 by the Nevada Department of Human Resources, Health Division, for the Area 11 Tweezer Facility septic tank and evapotranspiration bed that is used because substandard percolation rates prohibit use of a field drain system. The active sewage discharge permits are renewed periodically and are listed in the annual site environmental report.

2.1.2 N-Tunnel Wastewater Discharge

State of Nevada water pollution control permit NEV92033 was issued for the U12n Tunnel wastewater discharge on November 2, 1992. This permit became effective on November 12, 1992. All wastewater flows covered under this permit are fully contained in impoundments. This permit requires quarterly monitoring and reporting.

2.7 Miscellaneous Sampling

Miscellaneous sampling and analyses for nonradiological substances are performed to confirm or deny the presence of RCRA hazardous wastes. Additionally, sampling and analysis is performed on NTS potable drinking water systems for compliance with primary and secondary standards of the Safe Drinking Water Act. Finally, sampling and analysis for biological oxygen demand, total suspended solids, and dissolved oxygen is performed on certain NTS sewage lagoon systems as required under the discharge permit (see section 3.1.3.1).

2.8 Ecological Monitoring

The ecological monitoring effort on the NTS includes monitoring of undisturbed control plots in the ecosystems impacted by nuclear tests to determine natural baseline conditions, monitoring of study plots in representative disturbed areas to determine the impact of the disturbance and investigate and document natural recovery processes, and monitoring of larger wildlife throughout the NTS to estimate populations and distributions and track changes in these with time. Undisturbed control plots and disturbed plots are surveyed at different frequencies for perennial and ephemeral plants, and reptiles (lizards) and small mammals. Counts are made of wild horses, and field observations and worker reports on raptors, waterfowl, lions, deer and ravens furnish knowledge of approximate densities and ranges of these species. Detailed records have been kept for many years of the desert tortoise population in the Rock Valley study enclosure on the NTS.

3.0 Effluents (Emissions and Discharges)

3.1.1 Drinking Water

Drinking-water quality monitoring is conducted through the analysis of bacteria, volatile organic compounds, inorganic constituents, and water-quality as required by the SDWA and state regulations.

To support the diverse work areas at the NTS which are not supplied by a water well and distribution system, potable water is hauled from a fill stands located in Areas 6, 12, and 23. Each load of water is chlorinated and sampled for analysis. If the sample from a water truck load **indicates the presence of** coliform bacteria, the truck is removed from service. The truck is superchlorinated, drained and refilled, then four samples are taken. In order to return the truck to service, these four samples must not indicate the presence of total coliforms.

3.2 Monitoring System Design - Air Emissions

3.2.1 Air Emissions

Air emissions were the focus of an air quality study conducted by Engineering-Science, Pasadena, California, at the NTS during August and September 1990, and a subsequent study performed by the Mark Group in March through June 1992. These monitoring programs were conducted under subcontract to REECo to determine the compliance status of the NTS with current air quality standards specified by state and federal regulations.

The emissions from four point sources were tested by Engineering-Science to assess compliance with permit conditions and applicable state and federal standards. Among the sources tested were a boiler, paint spray booth, incinerator, and tunnel exhaust. These sources are representative of equipment operated at the NTS which have the potential to emit regulated airborne pollutants. This study concluded that the emissions from these sources were within permit and state and federal standards.

The Mark Group study objectives were to: (1) identify specific sources of particulate emissions at designated facilities and operations within the NTS; (2) determine BACT to reduce particulate emissions at the specified facilities and operations; (3) provide estimated costs for the BACT; and (4) compile a list of manufacturers and vendors of dust control equipment.

Costs to retrofit equipment were compared with the costs of purchasing new equipment. Recommendations made by the Mark Group included the installation of electrostatic precipitators at the Area 1 Shaker Plant and the Area 12 P-tunnel vent; a cyclone collection system for both the Area 1 Batch Plant and the Portec Hopper (currently in Area 3, tentatively planned to be moved to the Area 1 Batch Plant) and for the Area 1 Rotary Dryer; provide tent enclosures for the Area 1 Crusher, Areas 2 and 3 stemming equipment and the Area 3 Two-part Epoxy Batch Plant. Dust from heavily-used unpaved roads may be mitigated through paving, water, or chemical surfactants. The above recommendations, along with less expensive alternatives, are under consideration.

The Mark Group study confirmed the exceedance of state requirements for particulate emissions for major NTS emission sources. Since particulate emissions provide the greatest concern for air quality environmental surveillance, **REECo Environmental Compliance Department (ECD)** personnel routinely perform scheduled and unscheduled VE surveillances of equipment and facilities which have air quality operating permits to verify compliance with particulate opacity limitations. Where VE surveillance identifies an exceedance of permit opacity limitations, corrective action is undertaken.

4.0 Environmental Surveillance

4.1 Standard Operating Procedures/Implementing Procedures

The following listing of procedures states the type of sampling and the method of collecting those samples. Environmental surveillance, effluent monitoring and ecological monitoring procedures are included.

Ecological Monitoring

AABAF.D.02.10	Perennial Plant Sampling Procedures
AABAF.D.03.10	Ephemeral Plant Sampling Procedures
AABAF.D.04.00	Tortoise Detailed Procedure
AABAF.D.05.00	Lizard Study Procedures
AABAF.D.06.00	Small Mammal Study Procedures
AABAF.D.07.00	Procedure for Studying Individual Plants and Animals

6.0 Quality Assurance and Quality Control

6.1 ACL Quality Assurance (QA)/Quality Control (QC)

Exhibit 6-1 shows the **Environmental Compliance Department (ECD)/ASD organizational chart.** The ASD has QA-implementing procedures to outline the policy for QA/QC criteria.

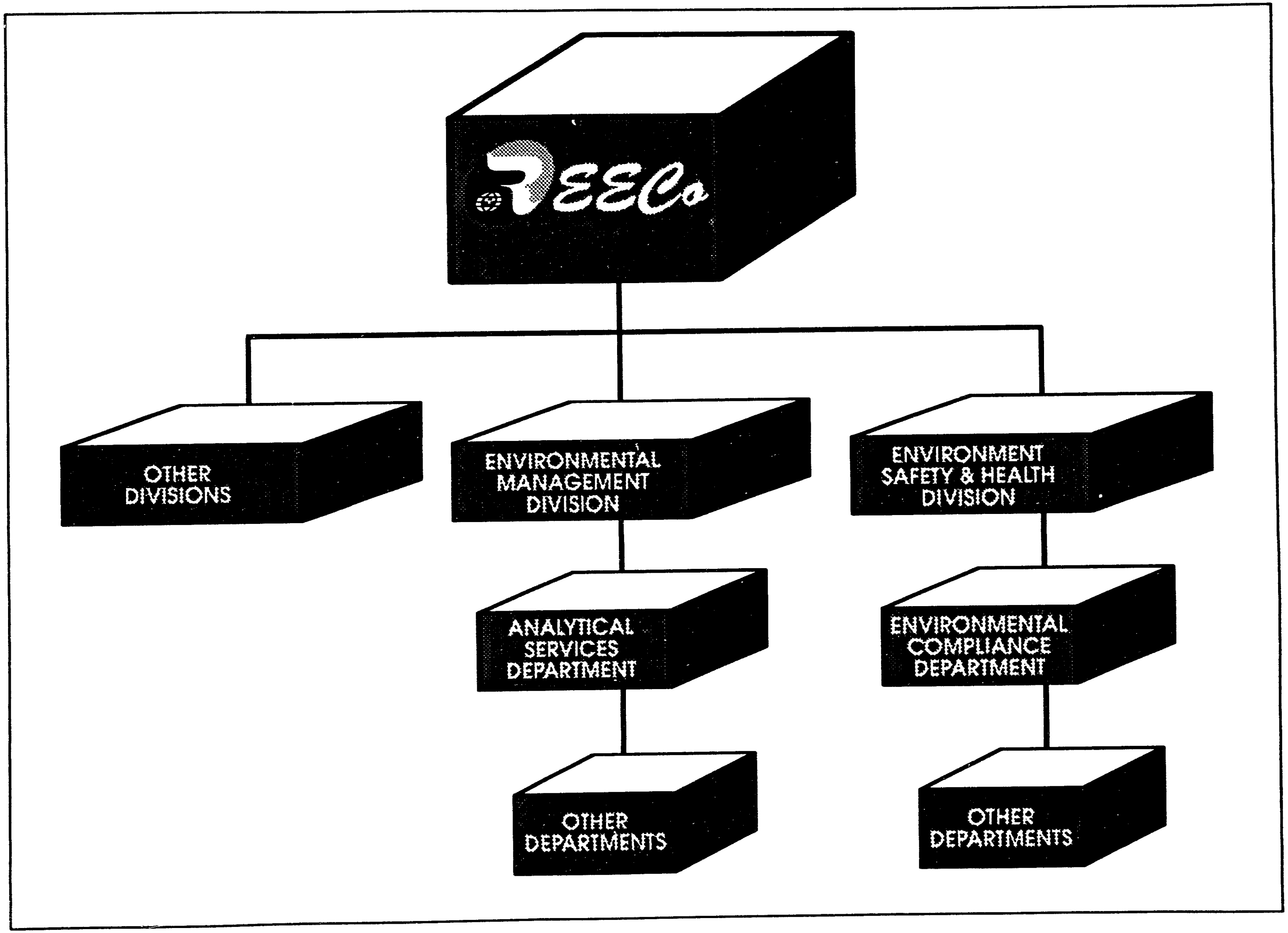

Exhibit 6-1 Location of ECD and ASD in the REECo Organization

SECTION II.5C

Operational Area Monitoring Plan for the Waste **Operations** Department Nevada Test Site

by

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Reynolds Electrical & Engineering Co., Inc.

January 3, 1994

1.0 Introduction

The Radioactive Waste Management Project was established at the NTS in January 1971. The first of six trenches was then opened for the disposal of radioactive waste materials from the NTS. Currently the Waste Operations Department (WOD) manages the Area 5 and Area 3 disposal sites.

In 1978 operations expanded to include the disposal of low-level waste (LLW) generated at other DOE facilities. In 1989 eighteen DOE waste generators were authorized to send waste materials to the NTS for disposal. Hazardous waste management operations at the NTS require the shipment of hazardous waste to licensed disposal facilities offsite. In September 1987, Nevada informed DOE/NV that it had interim status to dispose of mixed waste (MW) at the Area 5 Radioactive Waste Management Site (RWMS5). The NTS continued to receive MW under interim status **until May 1990 when** the U.S. EPA issued regulations implementing the Land Disposal Restrictions of the Resource Conservation & Recovery Act (RCRA). The potential impact of these new regulations on NTS MW operations was not known, and a unilateral decision was made by DOE to stop receiving MW at the RWMS5 until regulatory compliance requirements could be evaluated. **The DOE is pursuing several regulatory options which if successful would allow disposal of MW at the RWMS5 to begin again.**

In recent years, the DOE and Reynolds Electrical & Engineering Co., Inc. (REECo) have placed increased emphasis on environmental protection, necessitating development of a comprehensive environmental monitoring plan at the **RWMS5** and Area 3 Radioactive Waste Management Site **(RWMS3).** The REECo Analytical Services Department (ASD) provides support by way of sample collection and laboratory analysis.

The objective of environmental monitoring is to provide timely, reliable information about radiological contaminants in the environment that are associated with operations at **the RWMS5** and RWMS3. The environmental monitoring plan, in compliance with applicable regulations, provides the information that is necessary for ensuring the protection of the workers, the public, and the environment.

1.1 Objectives and Regulations

A comprehensive review of DOE orders and other applicable regulations has been conducted and is summarized in this section. The environmental monitoring plan objectives are derived from regulatory criteria found in various agencies and from a need to reassure the public **about** the potential risks associated with waste management activities.

1.2.2 Area 5 Radioactive Waste Management Site

The Frenchman basin alluvium has resulted from the erosion process on the surrounding mountains and is in excess of 1000 feet thick at the center of the basin. The basement rock is Paleozoic carbonates.

The RWMS5 is located halfway between the Massachusetts Mountain and Frenchman Playa on an alluvial fan, with a general upward slope to the north of approximately two percent to the Massachusetts Mountain, 3.6 miles to the northwest of the site. Towards the west, in the direction of the Mercury Highway, the rate of land rise is approximately three percent. Elevation at the main RWMS5 office, Building 5-7, is approximately 3185 feet. The highest elevation within the RWMS5 boundary is 3335 feet at the extreme northwest corner; the lowest is 3180 feet at the extreme southeast corner.

There are no potable water supply wells or permanent sources of surface water at the RWMS5. **Three groundwater monitoring wells were developed in 1992 to obtain hydrogeological characterization data and to be used for RCRA detection monitoring as required by 40 CFR 265. Data from these investigations are the subject of separate site characterization reports prepared by the REECo Environmental Restoration and Technology Development Department. The elevation of the water table was found to be constant at approximately 733 m (2406 ft) above sea level over the entire range of the RWMS5. The depth to water varies from approximately 235 m (770 ft) at Ue5PW-1 to 272 m (891 ft) at Ue5PW-3. Alluvium samples collected from all three monitoring wells were found to be extremely dry (e.g. less than 10% gravimetric water content) throughout the entire vadose zone. Water potential measurements indicate an upward gradient in the first 30.5 m (100 ft) and a zero gradient below. These observations indicate that liquid flow of water through the vadose zone to the water table is not occurring at this time.** Two shallow dry washes cut through the site from the northwest. An earthen dike has been constructed along the northern limit of the RWMS5 to divert water flow from this direction. Soil moisture in the unsaturated zone is typically five to seven percent by weight; the pan evaporation rate is in excess of ten feet/year, which is indicative of the extreme aridity of the site.

The nearest population center is Indian Springs, population of about 1500, 40 kilometers to the southeast. Population density within 150 kilometers of the NTS is only 0.5 persons per square kilometer versus approximately 29 persons per square kilometer in the 48 contiguous states.

The 293 hectare (732-acre) RWMS5 contains the 37 ha (92-acre) LLW management unit (LLWMU) comprised of the LLW disposal unit, the transuranic (TRU) waste storage cell (WSC), and the greater confinement disposal (GCD) unit. The mixed waste management unit (MWMU) and the hazardous waste accumulation site (HWAS) are also part of the RWMS5. Of those 37 hectares, 6.8 (17 acres) have been used for actual disposal. The remainder of the 293 ha (732 acres) is reserved for future use. The LLW disposal unit is a landfill unit used for disposal of packaged LLW from both onsite and offsite generators.

The LLWMU accepts packaged wastes from both on and offsite generators. Prior to the decision to stop receiving MW, waste had been accepted from one offsite generator. The TRU WSC is used for interim storage of TRU waste from Lawrence Livermore National Laboratory (LLNL) pending shipment to the Waste Isolation Pilot Plant (WIPP). The GCD unit is used for **disposal of LLW** unsuitable for conventional near surface disposal (NSD). The HWAS is used for less-than-90-day storage of hazardous waste pending shipment to offsite treatment, storage, and disposal facilities. The RWMS5 is operated in compliance with applicable EPA regulations and DOE Orders.

Low level radioactive wastes are accepted from generators that have received DOE/HQ and DOE/NV approval. Prior to receiving approval, generators must submit an application describing a waste characterization and certification program that meets the requirements of NVO-325 (Rev. 1), Nevada Test Site Defense Waste Acceptance Criteria,

Certification and Transfer Requirements. Approval may be granted if an audit indicates that the waste characterization and waste certification plans have been satisfactorily implemented. Approved generator programs are reviewed and audited annually.

2.0 Effluents (Emissions and Discharges)

The RWMS3 and RWMS5 produce no liquid effluents. The wastes disposed of in Area 3 and Area 5 may be considered diffuse sources of airborne effluents. A diffuse source is an area source or several point sources near each other. **Tritium and ^{222}Rn are the only gaseous radionuclides present in significant quantities.** The disposal site, along with other NTS sites, will be investigated and assessed according to the requirements of DOE Order 5400.1 to determine whether or not they will be classified as effluent sources.

3.0 Effluent Monitoring Plan

Since there are no distinctly identifiable **effluent sources** from the waste packages, **an effluent** monitoring plan is not feasible. **Any diffuse airborne emissions will be detected by the environmental surveillance program.**

4.2 Ongoing Environmental Restoration & Technology Development Studies

The REECo Environmental Restoration & Technology Development Department conducts site characterization studies, groundwater monitoring and vadose zone monitoring at the RWMS5. Groundwater monitoring wells will be sampled quarterly during 1993. Samples will be analyzed for chemical constituents required by 40 CFR 265 and gross alpha, gross beta, photon emitting radionuclides, tritium, ^{90}Sr, ^{99}Tc, ^{226,228}Ra, total uranium and $^{238,239+240}$Pu. Monitoring in subsequent years will be based on the 1993 results and conditions of the treatment, storage and disposal facility permit. Results from site characterization **studies, groundwater monitoring** and vadose zone monitoring, will be evaluated as they become available and may necessitate alteration of sampling locations and/or frequencies.

4.3 Surveillance Description

Environmental surveillance sampling and analysis is briefly described below. Detailed information relevant to the collection and analysis of environmental samples is contained in DOE/NV, REECo Health Protection Department, Analytical Services Department and **WOD** standard operating procedures.

4.3.1 Air

A network of standard air samplers is maintained around the perimeter of Area 5. Exhibit 4-1 shows the location of the air samplers. Air samplers are also set up around the perimeter of the TRU WSC and at the midpoints of the east-west edges. Exhibit 4-2 shows the location of the air sampler stations in Area 3. The samplers are stationed around the perimeter of the disposal craters. All air samplers are obtained from the REECo Air Sampler Shop in Area 6 and are **calibrated quarterly**.

Air sampling is conducted **to collect** radioactive particulates and gases. Glass fiber filters and charcoal cartridges are used in a single sampling head. A tritium sampler (for collecting tritiated water) is housed in the same shelter at various Area 5 sampling stations as shown in Exhibit 4-1. No tritium sampling is conducted **at the** RWMS3 and the TRU WSC.

5.0 Pathway Analysis

The environmental compartments considered as **potentially** significant in the transport processes are indicated in Exhibit 5-1. Arrows between the boxes indicate the direction of transfer of radionuclides. The mechanistic processes responsible for these transfers are listed in Table 5-1. **A preliminary performance assessment prepared for the RWMS5 did not identify any significant pathways during the period of institutional control (Magnuson et al. 1992). The only pathway believed to be operating during institutional control is the transport of gaseous species through soil to the atmosphere.**

The RWMS5 is located in the Ash Meadows Groundwater System. The existing media between land surface at the RWMS5 and the water table consists of mixed Quaternary and Tertiary alluvium and tuff. Flow velocities for water in the vicinity of the RWMS5 are very low. The **depth of the** water table in the vicinity of the RWMS5 **ranges from 235 m (770 ft) to 272 m (891 ft). The water table has been found to be essentially flat at an elevation of 733 m (2406 ft) above sea level.** Research to date indicates that matrix effects within the soil do not allow moisture to penetrate more than about 50 cm (20 in) below the surface. **Transport of water through waste disposal cells to the groundwater is not believed to be occurring under the current climatic conditions.**

Depletion of soil moisture through transpiration has been shown to occur by **Romney et al. (1981)**, in experiments near the RWMS. **The removal of vegetation caused an increase in soil moisture when compared to an undisturbed vegetation plot.** Concurrent measurements at greater depth yielded similar, although attenuated, results. Soil moisture depletion by transpiration apparently decreased with increasing depth. Therefore, transpiration is not expected to contribute measurably to the transport process.

SECTION II.6

Operational Area Monitoring Plan for Test Support Services Nevada Test Site

by

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Raytheon Services Nevada

January 3, 1994

1.0 Introduction

The mission of RSN is to provide:

- **Project Management**

RSN and RSN subcontractors perform only one activity (photographic processing) which requires monitoring of the effluent prior to discharge to the environment.

At the NTS, spent photographic solutions are generated by the subcontractor (AWS) at the well 3 yard, Area 6, by the Engineering Records Library (ERL) in Mercury, and by the Nondestructive Testing (NDT) Laboratory in Area 11, or at the site of field measurements.

The Presentation and Engineering Graphics (PEG) group in Las Vegas also generates limited quantities of spent photographic solutions.

In each case, the waste stream consists of spent developer which requires only pH adjustment, and spent fixer which requires removal of silver and possibly pH adjustment.

2.0 Effluents (Emissions and Discharges)

2.1 NTS Facilities

2.1.2 Inventory of Surface Water Discharges

Previously identified discharges from steam cleaning activities in Area 6 have been eliminated.

Spent photographic solutions are processed for silver removal utilizing a steel wool cartridge silver recovery system by all RSN NTS generators. Solutions from the NDT are processed at the ERL. Following laboratory analyses to assure that residual silver concentration and pH meet the established criteria, discharge is made to the designated sewage lagoon.

2.2 NV Support facilities

2.2.2 Inventory of Liquid Discharges

Liquid discharges of spent photographic solutions by the PEG are made directly to the sewer system following laboratory analysis for residual silver and pH adjustment, if necessary. The procurement of a digital imaging system to satisfy the bulk of PEG's photographic requirements is expected to reduce this waste stream to less than 80 gallons per year. Discharge to the sewer system will be authorized by the Clark County sanitation district following receipt of analytical results of each batch processed. Depending upon the volume generated, batch processing may range from quarterly to annually.

3.0 Effluent Monitoring Plan

3.2 Effluent Monitoring Design Criteria

3.2.2 Spent Photographic Solutions from NTS Facilities

Spent photographic solutions from the RSN subcontractor In Area 6 are processed for silver recovery and pH adjustment. Discharge of resultant solutions is made to the designated sewage lagoon following laboratory analysis to assure compliance with criteria and coordination with the prime contractor.

Solutions generated by the NDT and the ERL are processed at the ERL In Mercury for silver removal and pH adjustment. Discharge is handled as described for Area 6 above.

In order to preserve the functioning of the sewage lagoons, the prime contractor may establish a lower silver concentration than the 5 ppm regulatory limit. Concentration of 1 ppm are achievable by the steel wool cartridge recovery system. All discharges to the sewage lagoon are coordinated with the prime contractor.

3.2.3 Spent Photographic Solutions from Las Vegas Facilities

Discharge of spent photographic solutions from the **Presentation and Engineering Graphics** Facility is constrained by Clark County **Sanitation District requirements.** Silver discharge to the sewer system is limited to concentrations of 5 mg/L (5 parts per million) or less . In addition, the solutions must exhibit a pH in the range of 4.5 to 9.0.

Data quality objectives are designed to meet the discharge criteria for concentration and pH. In order to assure compliance with the conditions of the discharge permit, all spent fixer is collected following use. Fixer is processed for silver recovery in accordance with Presentation and Engineering Graphics Operating Procedure 001. Treated solutions are analyzed by a certified analytical laboratory In Las Vegas. Results are submitted to CCSD for authorization to discharge.

6.0 Quality Assurance and Quality Control

The quality assurance and quality control of environmental and effluent data will be in accordance with the Management Quality Assurance Program. The RSN Quality Assurance Division and the RSN Environmental, Safety and Health Compliance Department will routinely audit the environmental effluent data, calculations, and reports prepared by and for the RSN Environmental Operations Department.

SECTION II.7A

Operational Area Monitoring Plan for the Offsite Radiological Safety Program Nevada Test Site

by

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and

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Environmental Monitoring Systems Laboratory
U.S. Environmental Protection Agency

January 3, 1994

1.0 Introduction

Radiological monitoring in the offsite area around the NTS is conducted by the U.S. Environmental Protection Agency (EPA) Environmental Monitoring Systems Laboratory, Las Vegas (EMSL-LV), through an interagency agreement (IAG) with DOE/NV. The objectives of this monitoring are to assure the health and safety of individuals living in the offsite area, to measure and document levels and trends of environmental radiation or radioactive contaminants in the vicinity of nuclear testing areas, and to verify compliance with applicable radiation protection standards, guidelines, and regulations. In addition to operation of routine monitoring networks, EPA EMSL-LV provides support to DOE/NV for each nuclear weapons test.

Prior to 1954, an offsite radiation surveillance program was performed by personnel from the Los Alamos Scientific Laboratory and the U.S. Army. Beginning in 1954, and continuing through 1970, this program was conducted by the U.S. Public Health Service (PHS). When the EPA was formed in December 1970, certain radiation responsibilities from several federal agencies were transferred to it. One of these was the Offsite Radiological Safety Program (OSRP) of the PHS. Since 1970, the EPA, EMSL-LV has conducted the OSRP, both in Nevada and at other U.S. nuclear test sites.

4.0 Environmental Surveillance Plan

4.1 Rationale

There are several reference levels for radiation exposure, specified by the International Commission on Radiological Protection (ICRP), DOE, and EPA, to be observed when establishing a monitoring program. Guidelines are written such that all pathways that lead to the exposures shall be routinely monitored if there is a potential for one of the following situations:

- A 1 mrem annual effective dose equivalent to any offsite individual
- A 100 person-rem annual collective effective dose equivalent per million individuals within 80 km (50 mi) of the site center
- A 5 mrem annual whole-body dose equivalent or 15 mrem to the skin of offsite individuals
- Any exposure to an offsite person of 25 mrem effective dose equivalent in any year (required to be reported to DOE Headquarters)
- Unplanned releases of radioactivity shall be monitored and quantified

All of the above shall be based on statistically significant differences between the point of measurement and the average background in the area, or other suitable control data (DOE, 1991).

The standards for exposure from routine operations, from which the above criteria were derived, are as follows:

- Air Emissions - 10 mrem/yr (0.1 mSv/yr) to any offsite person (40CFR61)
- Drinking Water - 4 mrem/yr (0.04 mSv/yr) based on drinking 2 L/day (40CFR141)
- Sum of all pathways - 100 mrem/yr (1 mSv/yr) set forth in ICRP-39

In case of emergency situations:

- **The Food and Drug Administration (FDA) Protective Action Guide (PAG) is 1500 mrem (15 mSv) to the infant thyroid or 500 mrem (5 mSv) to the whole body, bone marrow, or any other organ from ingestion of food (FDA, 1982).**
- **Recently revised EPA PAGs recommend evacuation at a projected dose of 1 to 5 rem in the early phase of a nuclear incident (EPA, 1992). Sheltering is an alternative to evacuation under certain specified conditions (EPA, 1992).**
- **Another useful guide as recommended by the ICRP is that 500 mrem (5 mSv) committed effective dose equivalent in a year is acceptable as long as the average over 70 years does not exceed 100 mrem/yr (1 mSv/yr) (ICRP-39).**

4.2.2 Radiochemistry

At concentrations greater than 10 times the MDC, precision is required to be within ± 10% for conventional tritium analyses, uranium, thorium (all media), and strontium (except in milk) and within ± 20% for enriched tritium analyses, strontium (in milk), noble gases, and plutonium. Accuracy objectives for concentrations greater than 10 times the MDC are no greater than ± 10% bias for conventional tritium analyses, plutonium, uranium, and thorium and no greater than ± 20% bias for noble gases, enriched tritium, and strontium. At concentrations less than 10 times the MDC, both precision and accuracy are not to exceed ± 30 percent for all analyses and all media types.

4.3 Network Design

4.3.1 Sample Collection Locations

The present network locations are primarily the result of historical instrument placement. A statistically based design was not used, nor were any citing criteria established, except that monitoring is done at all inhabited locations within 160 km (100 mi.) of the NTS, if possible. Availability of electric power is the primary restriction in station location, with the exception of PICs, which can operate on power produced by solar panels. At long distances from Las Vegas, station location is further restricted by the availability of an individual to service the station. Year-round station access is required, which restricts placement of stations in areas subject to frequent winter road closures.

4.3.2 Air Surveillance Network

The primary purpose of the Air Surveillance Network (ASN) is to detect airborne radioactivity that may be related to NTS activities. The ASN consists of two parts: active or continuous sampling stations and a standby air surveillance network (SASN). The ASN consists of a variable number of air sampling stations, currently **30**, located around the NTS. The SASN currently consists of **77** stations located in states west of the Mississippi River. Each sampler is equipped with a **5-cm** (2-in) diameter glass fiber filter and a charcoal cartridge to collect radioactivity as particulates or reactive gases. In case of a venting on the NTS or a suspected increase in airborne radioactivity, the SASN would be activated so that the fallout path, area, and duration can be estimated and possible inhalation exposure of the general public calculated. Also, in case of an accidental venting, portable air samplers would be deployed downwind to measure the extent and degree of contamination offsite so that remedial actions can be planned.

4.3.2.1 Continuous Air Network

In **1992** the ASN comprised **30** sampling stations distributed around the NTS at places where people were available to oversee their operation and where commercial power was available. Nineteen of the air samplers are at the CRMSs. All of the stations are displayed on the map in Exhibit 4-2.

The air samplers in use **are** manufactured by Radiation Detection Company and **are constant-volume samplers equipped with running-time meters. They are fitted with stainless steel heads that hold a glass-fiber filter and charcoal cartridge.** About **80 m^3/d (2800 ft/d)** are collected during operation. The filters are changed weekly and mailed to the EPA EMSL-LV Radioanalysis Laboratory for analysis. The operator also completes a form to mail with the filters so the running time and volume of air sampled can be calculated.

The filters and charcoal cartridges are analyzed by high-resolution gamma spectrometry. If fresh fission products are detected, radiochemical analysis of the glass fiber filters (prefilters) for radiostrontiums and plutonium is performed. In routine operation, the prefilters from **five** continuous stations are composited monthly and from **two** standby stations in each of thirteen states are composited quarterly for plutonium analysis. For trend analysis, the prefilters from all stations are analyzed for gross beta activity.

4.3.4 Milk Surveillance Network

The MSN has three components: a routine network, a standby network, and a dairy animal and population census. Milk is an important **component** of man's food chain. Because dairy animals consume vegetation that represents a large area of ground cover and because many radionuclides can be transferred to milk, analysis of milk samples may yield information on the deposition of small amounts of radioactivity over a relatively large area. In case of prompt releases of radioactivity, radioiodine concentrations in milk would be responsible for the largest early time exposure to infants and children. As in the other networks, collection locations are distributed around the NTS but are limited to those places that have family dairy cows or goats or where commercial dairies exist. The locations for milk collection in 1991 are shown in Exhibit 4-5.

4.3.4.1 Routine Network Operation

There are a variable number of milk sampling locations, usually about 25, in the near offsite areas that are visited monthly by EPA monitoring technicians to collect samples, if available. At most of these locations only a family cow or some milk goats are present, so the samples may not be collected if the animal is not lactating or not enough milk is available for various reasons. The samples are collected in 3.8-L (1-gal) plastic containers and formaldehyde is added as a preservative.

All of the routine MSN samples are analyzed by high-resolution gamma spectrometry and each quarter the samples are analyzed for tritium and ^{89,90}Sr.

4.3.4.2 Standby Milk Network Operation

Each area in the standby network is activated at least once a year to monitor trends and to ensure proper operation in case of an emergency. The standby network consists of approximately 120 dairies or processing plants in all states west of the Mississippi River. The network is activated by contacting the FDA Regional Milk Specialists who in turn contact State Dairy Regulators to enlist cooperating milk processors or producers. The samples from the standby network (described below) are also analyzed by high-resolution gamma spectrometry, and samples from two or three locations in each state are also analyzed for tritium and ^{89,90}Sr.

4.3.4.3 Milk and Population Census

The dairy animal and population census is continually updated for those areas within 400 km (240 mi) north and east of CP-1 and within 200 km (126 mi) south and west. The remainder of the Nevada counties and the western-most Utah counties are surveyed every two to three years. A full census was completed in the summer of 1992. The locations of processing plants and commercial dairy herds in Idaho and the remainder of Utah can be obtained from the State agencies dealing with milk and food regulation.

4.3.5 Pressurized Ion Chamber PIC Network

Gamma-rate recorders of various types have been deployed around the NTS for many years. Instrument field testing was completed in 1981. Beginning in 1982, a PIC was installed at each CRMS as the station was activated. The instrument is manufactured by Reuter-Stokes and comes in AC-or battery-powered models. This instrument produces readings in µR/hr recorded on paper tape, on magnetic cassette tape, and displayed on the instrument readout (which allows area residents to check the current readings); it also transmits the data via GOES to CP-1. The utility of this instrument is its rapid response. If any significant amount of radioactivity was emitted from the NTS, it would be detected and recorded by the PICs almost immediately.

At this time the PIC network consists of 27 instruments deployed around the NTS, as shown on Exhibit 4-6. Not shown on Exhibit 4-6 are 10 additional PICs, located at the Bureau of Land Management's Remote Automatic Weather Stations; data from these instruments will be incorporated into the PIC network data base beginning in 1993. Most of the network uses commercial power, but several PICs receive power from batteries charged by solar power units. The detector is an 8-L spherical aluminum chamber filled with high purity argon compressed to 25 times standard atmospheric pressure. The paper and cassette tapes are changed **biweekly**. The data are transmitted every 4 hours via GOES directly to CP-1 and from there to EPA EMSL-LV by dedicated telephone lines. If the gamma exposure exceeds the site-specific alarm threshold for two consecutive 1-minute measurements, the system transmits a string of nine consecutive 1-minute values on an average of every three minutes (typically varies between 2 and 15 minutes). The site-specific alarm thresholds are set at twice the normal background exposure.

The unit is sensitive enough to pick up increases in terrestrial radiation due to meteorological low pressure fronts passing over the sensor, to detect the decrease in rate due to snow cover in the winter, and occasionally to detect passage of trucks carrying low-level waste to the disposal site near Beatty, Nevada. The data are evaluated and reported weekly at EPA EMSL-LV as part of routine quality assurance procedures to denote trends and anomalies. Copies of the reports are sent to CRMS Station Managers for posting at the station. These reports display the current weekly average gamma exposure rate, the previous week's and previous year's average, and the maximum and minimum backgrounds in the U.S. In addition to being posted at each CRMS, report copies are sent to appropriate federal and state personnel in California, Nevada, and Utah.

4.3.6 Thermoluminescent Dosimetry TLD Network

In the early years of nuclear testing, film badges were used to record the exposure of people and places. The principal disadvantage was that exposures had to be greater than or equal to 30 mR **(7.8 X 10^{-6} C/kg)** before they were detectable. **Presently** these functions are performed by TLDs. The advantage of this network is that the exposure period for the TLD can be long so that small and otherwise undetectable exposures can be **accumulated**, thus improving sensitivity. **Also, TLDs issued to personnel have superior tissue equivalence, which facilitates estimation of the absorbed dose equivalent, a feature critical to the dose assessment process.**

TLDs and automated readers used in this network are manufactured by Panasonic. Each **dosimeter** has 4 **elements containing various thermoluminescent phosphors behind specified attenuators.** The model UD-802 dosimeter **is** used for monitoring of offsite personnel. **This dosimeter** contains **two** elements of $Li_2B_4O_7$:Cu and **two** of $CaSO_4$:Tm phosphors behind 14, 300, 300, and 1000 mg/cm^2 of filtration, respectively. **The model UD-814 dosimeter is used for fixed environmental station monitoring. This dosimeter contains three replicate $CaSO_4$: Tm elements filtered by 1000 mg/cm^2 of plastic and lead. A fourth element of $Li_2B_4O_7$:Cu filtered by 14 mg/cm^2 of plastic is not used for purposes of environmental monitoring.** About 131 fixed locations around the NTS are equipped with **two UD-814 dosimeters deployed in specially designed holders. About 72 citizens living in the offsite area participate in the offsite resident personnel monitoring program and are issued single UD-802 dosimeters in standard holders.** The **dosimeters are deployed and processed on a quarterly exchange frequency.** The locations of the TLDs are shown on Exhibit 4-7.

The two dosimeters deployed to fixed environmental stations provide up to six replicate data points per deployment period. As noted above, the fourth ($Li_2B_4O_7$:Cu) element is not used for environmental monitoring. The average and standard deviation **of fully-corrected co-deployed $CaSO_4$:Tm element readings** are compared with the average data for the previous 4 quarters at that station to determine if any significant deviation **from**

historical trends has occurred. The **absorbed deep dose equivalents (H_d) calculated from the personnel dosimeters are** compared to the average **exposures determined at** the nearest fixed **environmental** station.

4.3.7 Internal Dosimetry Program

A whole-body counting facility has been maintained at EPA EMSL-LV since 1966. At that time, it was used to measure uptake of radioactivity by people after any accidental releases from the NTS. Because of its usefulness, in 1970 this program was converted **for routine counting of** offsite residents and their families. The program provides the **best** confirmation of the **results of the** environmental monitoring networks. It has the advantage of detecting the sum of the intakes from all pathways, if significant, even if the radioactivity in all monitored pathways is so small as to be individually undetectable. **Routine whole body counting results in a baseline data base that will be useful should any release of radioactivity from the NTS occur.**

Forty-one families in the offsite area were selected in 1970 to participate in this program (Patzer and Kaye, 1982). They were chosen to include persons who lived in areas of higher fallout from the earlier tests as well as from the areas of lower fallout shown on Exhibit 4-8. **In 1992 there** were 34 families (142 individuals), including some born prior to the start of atmospheric testing at the NTS and some born afterward. Each person was given an initial physical exam, whole-body count, and urinalysis for tritium. The whole-body **counting** and urinalysis have been continued semiannually along with physical examination every 18 months. In 1979 a phoswich detector system was added so that lung burdens of plutonium could be detected. Currently there are approximately **58** families (160 individuals) actively participating; these include **35** of the original participants as well as the CRMS Station Managers and their families. The locations of the participants, including the 34 families monitored in 1991, are shown on Exhibit 4-9.

Whole-body counts are now performed with an intrinsic germanium detector calibrated from 60 to 2500 keV **collecting** data for 2000 seconds. Lung counting for determining plutonium and americium burdens is performed with semi-planar germanium detectors calibrated from 10 to 300 keV **collecting** data for 2000 seconds. Urine samples are analyzed by the conventional method for tritium.

4.3.8 Radiological Safety

In addition to the Internal Dosimetry Program described above, whole-body and lung counting and urinalyses are used to assess the exposure status of EPA radiation workers, DOE and DOE contractor personnel, and concerned members of the general public. These evaluations are conducted on a routine basis and on request, as part of the IAG tasks. Although not technically part of the offsite environmental monitoring program, data are summarized in the annual report.

4.3.9 Biomonitoring Program

Investigation of possible radiation effects in sheep and cattle began in the early 1950s. By 1957 a beef herd was established on the NTS, principally in Area 18. It was maintained there for 25 years and then sold to the University of Nevada, Reno (Smith and Black, 1984).

Bighorn sheep, coyotes, quail, rabbits, and other species were **collected when available** and were analyzed for radioactivity.

An ongoing study of mule deer residing on the NTS that began over 35 years ago continues. The forage intake of grazing animals such as cattle and mule deer is of particular interest. These animals forage over a very large surface area, which makes them efficient fallout collectors through the concentration in their tissues of small, diffuse ingestions of radioactive material.

During the time the beef herd was maintained onsite, four animals were sampled each spring and each fall to determine the radioactivity in various organs and tissues. After the herd was **sold,** the collection of four cattle each spring and fall **was** continued by purchase of cows from herds that graze on the borders of the NTS. Also, an NTS mule deer is collected each quarter, either from a road kill or by hunting. **Since** these deer migrate offsite **they may be** a source of exposure to offsite residents. For cattle and deer, the samples taken include muscle, lung, liver, kidney, blood, urine, and bone. A third major portion of this program consists of bone and kidney samples from bighorn sheep that are donated by licensed hunters each year for analysis of radioactivity. **A** veterinarian and a technician also investigate claims of alleged radiation damage to domestic animals (Smith and Black, 1984). Finally, vegetables donated from home gardens located in the offsite area are analyzed when available.

Analyses performed on the various sample types are summarized in the following table:

Table 4.1 Biomonitoring Program Sample Types Collected and Analyses Performed

Sample Type	Analyses Performed
Soft tissues	High-resolution gamma spectrometry
Bone, liver, and vegetables	^{90}Sr, ^{238}Pu, and $^{239+240}Pu$
Blood, urine, and vegetables	Tritium (^{3}H)

4.3.10 Long-Term Hydrological Monitoring Program

4.3.10.4 Analysis

The 3.8-L (1-gal) samples collected at each sampling location are preserved with nitric acid and are analyzed by high-resolution gamma spectrometry. For the semiannual onsite collections and all offsite collections, one of the two 500-mL (1-pt) samples from one collection period is analyzed for tritium by the conventional method, and the other is used either as a duplicate or replacement sample. One of the 500-mL (1-pt) samples from each of the monthly onsite collections and from the other collection period for the semiannual onsite and offsite locations is analyzed for tritium by an enrichment method (EPA, 1979). The MDC for this method is less than 10 pCi/L.

7.0 Quality Assurance

Approximately **20%** of the workload in the radioanalysis laboratory consists of QA/QC samples. Specific sample types employed are detailed in the method SOP. In some cases, the concentration or activity of the sample is known to the analyst (QC samples); these samples permit the analyst to monitor analytical performance and implement corrective actions, as needed. **In other cases, the concentration or activity of the sample is not known to the analyst (single-blind QA samples). When the analyst neither knows the concentration or activity of the sample nor recognizes it as different from routine samples, the sample type is referred to as a double-blind QA sample. Both QC and QA** samples are used to monitor precision and accuracy of the analyses. Control charts are maintained of QA/QC sample results, as well as of calibration and blank (background) checks, to ensure the analytical system is in control.

8.2 Thermoluminescent Dosimetry Data Base

The TLD data base resides on a Digital Equipment Corp. MicroVAX II, directly connected to the two Panasonic TLD readers. Samples are tracked using field data cards and an issue data base tracking system incorporated into the reader control software. On-line QA/QC samples are processed with every group of field-deployed dosimeters. These include irradiated controls, transit controls, and processing laboratory background TLDs. Two major software packages are utilized by the TLD network. The first, a proprietary package written and supported by International Science Associates, controls the TLD readers, tracks dosimeter performance, completes necessary calculations to determine absorbed dose equivalent **for UD-802 TLDs issued to personnel (UD-814 TLDs deployed to fixed environmental stations are evaluated only to characterize ambient gamma exposure <u>not</u> absorbed dose equivalent), performs automated QA/QC functions, and generates raw data files and reports. The second, locally developed, maintains privacy act information and the identifying data, generates reports in a number of predefined formats, and provides archival storage of TLD results dating to 1971.**

SECTION II.7B

Operational Area Monitoring Plan for the Long-Term Hydrological Monitoring Program Off The Nevada Test Site

by

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January 3, 1994

2.0 Effluents

There are indications that tritium escaped from the LONG SHOT cavity soon after detonation of that test, but the concentration of tritium in water samples has been decreasing at a rate somewhat faster than would be expected from just radioactive decay, an indication of diffusion. There is no indication from groundwater monitoring that tritium is continuing to leak from the test cavity.

At the DRIBBLE site on the Tatum Salt Dome near Baxterville, Mississippi, disposal of drilling muds and fluids near surface ground zero (SGZ) resulted in tritium contamination of shallow groundwater onsite. This shallow water, between 1.2 and 3 m (4 and 10 ft) deep, and a surficial aquifer that is 9 m (30 ft) deep both consist of non-potable water, and the tritium concentration in them has decreased to less than the National Primary Drinking Water Regulations value of 20,000 pCi/L (740 Bq/L). There is no indication from ground and surface water monitoring that any radioactivity is presently escaping from the test cavity.

Since 1984 a monitoring well near the Project GASBUGGY ground zero (GZ) has yielded slightly (less than 3 percent of the Interim Primary Drinking Water Regulations) elevated levels of tritium. Due to the proximity of the well to GZ, documented evidence of communication between the test cavity and the Ojo Alamo sandstone aquifer (Peter and Bowman, 1970), and the remote possibility that fracturing around the test cavity extends to the Ojo Alamo sandstone (DOE, 1986), the possibility of effluent migration from the test cavity cannot be discounted. However, the low concentrations preclude the necessity of developing an effluent monitoring plan. No effluent release has been detected at the other test sites in recent years.

4.0 Environmental Surveillance Plan

4.2 Design Criteria

4.2.2 Data Quality Objectives

Each sample of surface and ground water consists of two parts: a 3.8-L (1-gal) sample collected in a plastic bottle for gamma spectrometric analysis and 500-Ml (1 pt) samples collected in glass bottles for ^3H analysis. The accuracy of the analytical methods is as follows:

Type of Analysis	LLD[1,2]	Accuracy @ 95% Confidence Interval[2]
Tritium Analysis		
Conventional	500	**± 30% at 600 or ± 10% at 1000**
Enrichment	10	**± 30% at 12 or ± 20% at 100**
Gamma Emitters		
Range 60 to 2000 keV	5	**± 30% at 6 or ± 20% at 50**

[1] Estimated Lower Limit of Detection.
[2] Units of 10^{-9} µCi/Ml = pCi/L.

4.3 Amchitka Island Projects, Alaska

4.3.3.2 Surveillance System Design

The original hydrologic sampling network on Amchitka was established by the Palo Alto Laboratories of Teledyne Isotopes (Essington 1971). The background or control sampling locations are shown in Exhibit 4-1 and listed in Table 4-1 together with other sites that have been sampled since the LTHMP began. Sampling locations for LONG SHOT are shown in Exhibit 4-2 and listed in Table 4-2. Those for MILROW are shown in Exhibit 4-3 and listed in Table 4-3, and for CANNIKIN are shown in Exhibit 4-4 and listed in Table 4-4.

4.6 Project DRIBBLE, Mississippi

4.6.3 Environmental Surveillance

4.6.3.1 Criteria

Groundwater monitoring is the only requirement for surveillance of this test site. The high rainfall rate in this area produces wetlands, flowing streams, and shallow aquifers that are monitored in the LTHMP. The many groundwater aquifers at the Tatum Dome Site are shown in Table 4-7. Although improbable, the four tests conducted within the dome could have opened cracks for seepage of test-produced radioactivity. Another route of escape for the radioactivity in the cavity is through the emplacement holes and post-shot holes that penetrate the cavity if the plugging activities had not produced perfect seals. In either case, the radionuclide most likely to first appear outside the cavity is tritium.

4.6.3.2 Surveillance System Design

The original sampling sites as assigned by the Hydrologic Program Advisory Group are listed in Table 4-8 and are shown on Exhibits 4-8 and 4-9, together with other sites that have been sampled since the LTHMP began.

4.8 Project SHOAL, Nevada

Project SHOAL was sponsored by the Department of Defense and the U.S. Atomic Energy Commission (AEC) as a part of the Vela Uniform Program. The objective of the Project SHOAL experiment was to determine the effects caused by detonation of a nuclear device in a seismically active area (AEC 1964b).

4.8.1 Operational Area

The Project SHOAL site is located in the southwest half of Section 34, T16N, R32E, in west-central Nevada, about 45 km (28 mi) southeast of Fallon. It is situated on a 10-km^2 (4-mi^2) area of the Sand Springs Range in the Great Basin. This is a seismically active area with tremors and strong, shallow-focus earthquakes. About 200 quakes were recorded from 1945 to 1959. At the time Project SHOAL was conducted, the nearest habitations were a ranch

Table 4-8 Water Sampling Locations for Project DRIBBLE (cont.)

Location	Sampling Depth (ft)	First Sampled	Last Sampled	Public Access
HMH-12	8	1990		YES
HMH-13	8	1990		YES
HMH-14	8	1990		YES
HMH-15	8	1990		YES
HMH-16	8	1990		YES
WELL HM-L	140	1980		NO
WELL HM-L2	--	1981		NO
WELL HM-S	25	1980		NO
WELL HT-1	1230	1972	1979	NO
WELL HT-2C	355	1972		NO
WELL HT-2M	--	1972	1974	NO
WELL HT-4	400	1972		NO
WELL HT-5	600	1972		NO
WELL PS-3	110	1978	1979	NO
POND W OF GZ	SURF	1972		YES
REECo PIT A	SURF	1980		YES
REECo PIT B	SURF	1980		YES
REECo PIT C	SURF	1980		YES
SALT DOME TIMBER WELL	--	1984		YES
TATUM DOME HUNT CLUB	--	1987		YES

about 8 km (5 mi) west and Frenchman Station **(which consisted of a bar, restaurant, garage, and motel; all now removed)** located about 13 km (8 mi) northeast of SGZ. An area map is shown in Exhibit 4-13.

4.9 Project GASBUGGY, New Mexico

4.9.2 Operational Activities

The only known effluents from this site occurred during the production test phases as summarized above. **However, slightly elevated levels of tritium observed since 1984 in one well located near GZ may be indicative of fission product migration from the test cavity. These tritium levels have been less than 3 percent of the National Drinking Water Regulations. While continued surveillance is warranted, an effluent monitoring plan is not necessary at present.**

The original hydrologic sampling network for GASBUGGY was established by Teledyne Isotopes and USGS in 1967 to provide pre-event and post-event comparison of radionuclide concentrations in surface and groundwater in the area surrounding the site (Teledyne Isotopes 1971). The original sampling sites are shown on Exhibit 4-14 and are listed in Table 4-11 together with other sites that have been sampled since the LTHMP began.

7.0 Data Management

All radiochemical data are stored in the Sample Tracking and Data Management System (STDMS), a custom-designed database management system which resides on a MicroVAX II at EPA EMSL-LV. The MicroVAX II is networked to a large cluster of other mainframe and MicroVAX computers which comprises the "EMSL VAX network". Tracking of samples is initiated with input of data from sample tags and field forms. Analysis data are entered after they have been generated and reviewed by the analyst and supervisor. Special software written in Fortran (referred to as "Chemistry Programs") is used for a majority of the radiochemical data reduction. The Chemistry Programs are used for calculating final data such as activity per unit volume, MDC, and 2 standard deviation error terms. Standard report routines permit tracking of samples awaiting analysis, lists of QA/QC samples, and sample results in various formats.

Access to STDMS is controlled by the Access Control List, keyed to user identification. Different levels of access are assigned based on the needs of a particular individual. A limited number of personnel have the access level necessary to make changes in the data base; these are primarily the personnel responsible for data entry, programmers, and the data base manager. Other personnel may access the data base in a "read-only" manner; their access permits generation of specific reports, but does not permit any changes, additions, or deletions to be made.

Once data have been entered and validated, they are transferred from a "review" data base to a permanent data base, e.g., further changes may be made only by authorized personnel. Any discrepancies noted during data validation processes are recorded on a standardized form. The form is reviewed and signed by the data base manager and Branch Chief. Actual changes are made by the data base manager or the contractor responsible for programming and maintenance of STDMS.

SECTION II.8

Operational Area Monitoring Plan for EG&G/Energy Measurements, Inc. Support Facilities for the Nevada Test Site

by

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January 3, 1994

1.0 Introduction

This Operational Area Monitoring Plan is for EG&G Energy Measurements, Inc. (EG&G/EM) which operates several offsite facilities in support of activities at the NTS under a contract with the DOE/NV. These facilities include:

Facility	Location
Kirtland Operations (KO) - **KAFB Compound** - **also Craddock Facility**	**Kirtland Air Force Base** **Albuquerque, New Mexico**
Santa Barbara Operations (SBO) - **Francis Botello Road** - **Robin Hill Road**	Goleta, California

1.1 Las Vegas Area Operations

The NLV Complex includes multiple structures totaling about 585,000 square feet . At the facility there are numerous areas of environmental interest including metal finishing operations, a radiation source range, an x-ray laboratory, solvent and chemical cleaning operations, limited pesticide and herbicide application, photography laboratories, and hazardous waste generation and accumulation.

1.2 Amador Valley Operations

The AVO in Pleasanton, California, occupies a 59,445 square-foot, two-story office/laboratory combination building. AVO is located near the Lawrence Livermore National Laboratory (LLNL) to simplify logistics and communications associated with EG&G/EM support of LLNL programs. Most of the work conducted at the AVO is performed in support of NTS underground weapons testing. **AVO also supports LLNL with optical alignment systems, a variety of mechanical and electrical engineering activities associated with energy research and development programs. Areas of environmental interest include two small chemical cleaning operations.**

AVO is a "small quantity generator" of hazardous wastes. **Hazardous waste is managed using satellite accumulation areas located close to the point of generation.** All hazardous and industrial chemical waste are transported to RCRA permitted facilities for approved treatment and/or disposal.

1.3 Kirtland Operations

KO at KAFB and in Albuquerque, New Mexico, consist of a 56,000-square-foot complex of prefabricated metal buildings located on 39.5 acres at KAFB and a 35,000-square-foot industrial facility called the Craddock Facility located near the Albuquerque International Airport. The KO provide technical support to Sandia National Laboratories (SNL), the DOE, the U.S. Department of Defense (DOD), and other federal agencies. In conjunction with DOE work, KO provide significant support to a variety of ongoing safeguards and security programs. KO is also responsible for operation of the System Control and Receiving Station (SCARS), a part of the DOE Remote Seismic Test Network (RSTN). **Areas of environmental interest include small solvent cleaning operations and various metal finishing activities.**

1.4 Los Alamos Operations

The LAO reside in a facility of approximately 65,000 square feet. It is a two-story combination engineering/laboratory/office complex located near the Los Alamos National Laboratory (LANL) to provide local support for LANL's programs. The work performed includes direct support of the LANL Testing Program, the DOE Research and Development (R&D) Program, and miscellaneous DOE cash order work. LAO primary activities are twofold: (1) the design, fabrication, and fielding of data acquisition systems used in underground nuclear testing diagnostics and (2) the analysis of data from underground and high-altitude experiments. In addition, two LAO operations build and field CORRTEX III recorders. **Areas of environmental interest include small solvent cleaning, alodining, and metal machining operations and a small photography laboratory.**

1.5 Santa Barbara Operations

SBO occupies two facilities located in Santa Barbara, California. The Robin Hill Road Facility (50,000 ft^2) includes a mercuric iodide crystal laboratory and a specialized radiation research building that houses the DOE-EG&G/EM linear accelerator (LINAC) with accompanying laboratories. Located at the Francis Botello Road Facility (12,174 ft^2) is a small machine shop, a laboratory building, and a source range.

In support of the DOE/NV, the SBO was established for R&D work in nuclear instrumentation and measurements with emphasis on radiation detectors, data acquisition systems, and fast pulse electronics. Through the years its facilities have been adapted to a wide range of R&D tasks. SBO also supports LLNL with optical alignment systems, fast-streak camera fabrication, and a variety of mechanical and electrical engineering activities associated with energy R&D programs. Fields of specialized experience represented at SBO include the design and fabrication of cathode-ray tubes for use in the weapons test program. The SBO also describes and assesses the potential ecological impacts of various DOE projects on ecological systems of interest. Activities of environmental interest include a mercuric iodide laboratory (where mercuric iodide crystals are grown), minor solvent operations, and several fume hoods.

SBO is a "small quantity generator" of hazardous wastes. Hazardous waste is managed by using satellite accumulation areas located close to the point of generation and the facility waste accumulation pad for temporary storage. All hazardous and industrial chemical wastes are transported to RCRA permitted facilities for approved treatment and/or disposal.

1.6 Special Technologies Laboratory

The STL, located in Santa Barbara, California, consists of approximately 36,000 square feet of secure combination office/laboratory area used primarily for engineering and electronic research to develop a suite of sensor systems for testing and field deployment in support of DOE Headquarters and DOE/NV. **Areas of environmental interest include a small printed circuit board operation and a small vapor degreaser.**

1.8 Woburn Cathode Ray Tube Operations

WCO in Woburn, Massachusetts, are comprised of a 14,000-square-foot facility which is used to develop and manufacture advanced cathode-ray tubes and oscilloscopes in support of the DOE/NV LANL test operations for use in the weapons test program. **Areas of environmental interest include small chemical cleaning operations, several laboratory hoods, and one injection well for returning uncontaminated non-contact cooling water to the ground.**

2.0 Effluents

2.1 Inventory of Effluents

All effluents from each EG&G/EM operation have been inventoried and are listed in a table that accompanies each of the operational areas listed in the following section. There are no radioactive air emissions; radioactive or nonradioactive surface water/liquid discharges; subsurface discharges through leaching, leaking, seepage into the soil column; well disposal; or burial at any of the EG&G/EM operations. Use of radioactive materials primarily involves sealed sources. **However, facilities which use sealed sources or radiation producing equipment are: SBO during operation of the LINAC; STL while the neutron generator is operational; RSL at Nellis Air Force Base; WAMD at Andrews Air Force Base and the LVAO, NLVF, A-1 Source Range, and High Intensity Source Range. Sealed sources are tested periodically to ensure there is no leakage of radioactive material.** Documentation of this assessment is found in the EG&G/EM Radiation Protection Records.

3.0 Effluents and Monitoring Plan

3.1 Monitoring Requirements for EG&G/EM Operations

3.1.1.1 Radiological Monitoring

As indicated in section 2.1 there are currently no operations at any EG&G Energy Measurement facilities that produce effluents of radionuclides and is therefore not subject to the requirements in 40 CFR 61 "National Emission Standards for Hazardous Air Pollutants" for monitoring of radioactive effluents. For the sources of direct radiation identified in section 2.1 of this plan, a surveillance screening program was conducted to determine the need for an environmental radiation exposure monitoring program. The data gathered from this screening process revealed that there are no EG&G/EM operations which expose the public or the environment to radiation levels approaching 100 mrem. **However, EG&G/EM has established an Environmental Radiation Exposure Monitoring Program to measure and control direct radiation from EG&G/EM facilities. The program requirements are published in Standard Operating Rule No. 34-027.A. Program design considerations will be documented in the 1994 revision of the Environmental Monitoring Plan.**

3.1.3 Effluent Monitoring System Design

The procedures described above are prepared pursuant to Policy No. 11-20.E, "Procedure System," which defines the system by which EG&G/EM publishes policies, standard operating procedures, organizational operating procedures and organizational operating rules. Furthermore, Manual 31, Environment, defines the EG&G/EM policies for environmental protection and monitoring of regulated effluents which drives the requirement for developing procedures for monitoring regulated effluents and specifies the elements that must be included in each procedure.

3.2.2 Monitoring Design Criteria

Wastewater effluent from the RSL is discharged to the CCSDs POTW. The District has adopted Resolution No. 83-012 to regulate industrial users. Permit No. CCSD-032 was issued which establishes action levels and the standards and criteria for designing the monitoring system for this effluent. A copy of this permit can be found in Appendix II.8-B.

Wastewater from the NLV facility is discharged into the NLV POTW. The city has adopted ordinance number 730 to regulate industrial users. Permit No. 87-2 was issued with specific monitoring requirements for the printed circuit board and anodizing shop effluents. This permit establishes action levels and the standards and criteria for designing the monitoring system for these effluents. A copy of this permit and the associated conditions can be found in Appendix II.8-B.

3.2.3.1 Wastewater Monitoring Systems

The two regulated wastewater effluents at LVAO [required to be monitored pursuant to permit conditions] are NLVF anodizing shops and the photography laboratory effluent at the RSL.

Untreated rinse waters from the anodizing shop are discharged directly to the sewer. All process baths are handled as hazardous waste. Only compliance monitoring, as specified by permit conditions, is conducted on this wastewater effluent and reported to the City of NLV semi-annually.

3.3 Amador Valley Operations

3.3.1 Effluents

An inventory of effluents for the AVO facility is contained in Table 2. **AVO no longer has any industrial wastewater effluents and most of the air effluents have been eliminated due to facility downsizing. The remaining effluents from AVO are minimal, and discontinuous.**

3.3.2 Monitoring Design Criteria

The general goals, standards, and criteria for effluent monitoring are stated in Section 3.1.2. **The only air pollution sources requiring permits are the vapor degreaser with a 10 gallon annual freon use rate and a solvent wipe cleaning operation with a 40 gallon annual freon use rate. A copy of this permit can be found in Appendix II.**

3.3.3 Effluent Monitoring System Design

The effluent monitoring system for regulated effluents and at AVO must comply with permit conditions and address the general conditions stated in section 3.1.3. **Permit conditions require the monitoring of solvent use rates and recordkeeping. There are no other effluent monitoring requirements for AVO.**

3.4 Kirtland Operations

3.4.1 Effluents

An inventory of effluents and their source characterizations for the KO facility is contained in Table 3. KO has both air and wastewater effluents. **However, the effluents from KO are minimal, and discontinuous and are unregulated therefore no monitoring is required or needed.**

3.4.2 Monitoring Design Criteria

The general goals, standards, and criteria for effluent monitoring are stated in Section 3.1.2. **There are no effluents at KO that require monitoring. Should any new or existing effluents become regulated and monitoring requirements imposed, then those requirements will serve as the criteria and standards for designing the effluent monitoring system.**

3.6 Santa Barbara Operations

3.6.1 Effluents

An inventory of effluents and their source characterizations for the SBO facility are contained in Table 5. Based on the amounts of chemicals used, no air pollution control permits are required. SBO has two wastewater discharge permits issued by the Goleta Sanitation District; one for the 130 Robin Hill Road Facility and one for the 820 Francis Botello Road facility.

3.6.2 Effluent Monitoring Design Criteria

The general goals, standards, and criteria for effluent monitoring are stated in Section 3.1.2. SBO has two wastewater discharge permits issued by the Goleta Sanitation District. Industrial wastewater discharge Permit No. III-330 is for 130 Robin Hill Road Facility which includes the batch-treated wastewater from a mercuric iodide crystal process (see Table 5). Industrial wastewater discharge Permit No. AII-204 is for the 820 Francis Botello Road facility which essentially has no industrial wastewater discharge. These permits establish the action levels, standards, and criteria for designing the monitoring system for this effluent. A copy of these permits can be found in Appendix II.8-B.

3.6.3 Effluent Monitoring System Design

The effluent monitoring system at SBO must comply with permit conditions and address the general conditions stated in Section 3.1.3. Although there is a limit to the concentration of mercury that can be discharged to the sanitary sewer, no monitoring requirements are specified in Permit No. III-330. SBO does collect a sample from each treatment batch from the mercuric iodide crystal growing process to be picked up the Goleta Sanitation District (GSD) and analyzed for mercury at a GSD selected laboratory.

3.7 Special Technologies Laboratory

3.7.1 Effluents

An inventory of effluents and their source characterizations for the STL facility is contained in Table 6. STL has one air pollution control permit issued by the County of Santa Barbara, Air Pollution Control district for a vapor degreaser, and one industrial wastewater discharge permit for the STL facility.

3.7.2 Effluent Monitoring Design Criteria

The general goals, standards, and criteria for effluent monitoring are stated in Section 3.1.2. The criteria for designing effluent monitoring systems are the conditions of the permits issued to STL for regulated effluents. Permit to operate No. 8477 was issued for a small vapor degreaser which includes requirements for monitoring solvent use rates, recordkeeping and annual reporting. Industrial Wastewater Discharge Permit No. II-225 was issued for facility industrial wastewater. However, there are no monitoring requirements associated with this permit. A copy of these permits can be found in Appendix II.8-B.

3.7.3 Effluent Monitoring System Design

The effluent monitoring system for regulated effluents at STL must comply with permit conditions and address the general conditions stated in section 3.1.3. Presently the GSD analyzes the PC board rinse water at approximately annual intervals and assumes responsibility for compliance monitoring. Solvent use monitoring, recordkeeping, and annual reporting for the regulated vapor degreaser is managed by the site safety officer.

3.9 Woburn Cathode Ray Tube Operation

3.9.1 Effluents

An inventory of effluents and their source characterizations for the WCO facility is contained in Table 7.

3.9.3 Effluent Monitoring System Design

The effluent monitoring system for regulated effluents at WCO must comply with permit conditions and address the general conditions stated in section 3.1.3. No effluent monitoring is required for the trichloroethane degreaser, but if the annual use increases or a different solvent is used, then monitoring may be required.

The wastewater **from the sink used for chemical cleaning** passes through a limestone chip tank for pH adjustment, and samples for pH measurement must be taken before mixing with any other streams. Wastewater effluent flow rates are estimated semi-annually and samples taken and analyzed for pH. Reports of monitoring activities are submitted semi-annually.

Effluent monitoring for the injection well is conducted in direct compliance with permit conditions which includes monthly effluent monitoring and reporting for flow, temperature and pH.

6.0 Quality Assurance and Quality Control

The EG&G/EM general quality assurance program for all EG&G/EM operations and activities (except for those programs or projects which are specifically excluded by the DOE) which is intended to comply with DOE/NV Order 5700.6C is described in EG&G/EM Quality Assurance Program Manual, PR-110. The EG&G/EM policies and procedures for quality assurance are found in Manual No. 14, Quality Assurance, Management: Policies and Standard Operating Procedures. A description of the implementation of the EG&G/EM quality assurance program requirements for environmental monitoring of regulated effluents is presented in Appendix II.8-D.

Quality Assurance (QA) is a system for ensuring that information, data, and resulting decisions completed under a specific task are technically sound, statistically valid, and properly documented. Quality Control (QC) comprises the controls implemented to ensure data quality.

The quality objectives for the existing effluent monitoring scheme are to demonstrate compliance and resolve issues of noncompliance through periodic sampling, emission calculations, reporting, and corrective actions for regulated effluents. Pursuant to: EG&G/EM MANUAL NO. 14, QUALITY ASSURANCE, MANAGEMENT: POLICIES AND STANDARD OPERATING PROCEDURES; EG&G/EM MANUAL NO. 15, QUALITY ASSURANCE PROGRAM REQUIREMENTS; EG&G/EM MANUAL NO. 31, ENVIRONMENT, ENVIRONMENT, SAFETY AND HEALTH: POLICIES AND STANDARD OPERATING PROCEDURES; and the direction provided in the DOE/NV document, GUIDANCE FOR PREPARATION OF OPERATIONAL AREA MONITORING PLANS BY NTS CONTRACTORS, USERS AND SUPPORT AGENCIES, February 29, 1990, the general quality assurance procedures for data collection and management for monitoring regulated effluents are described below.

6.1 Quality Assurance Management

The design of specific QA procedures for environmental monitoring is the responsibility of the Environmental Compliance Section at LVAO. The Safety Officer at each operation other than LVAO is responsible for the implementation of applicable QA procedures. For LVAO the Environmental Compliance Section is responsible for this implementation. The EG&G/EM Environment, Safety and Health (ES&H) Director has the primary oversight for the Environmental Compliance Programs including environmental monitoring activities for EG&G/EM. See Appendix II.8C for organizational structures.

6.2 Data Management and Reports

This topic is covered in Sections 7.0 and 9.0 of this plan.

6.3 QA Program Assessment

QA program assessment is the responsibility of EG&G/EM Office of Quality Assurance. They set the schedule for performing periodic management and program audits which would include environmental monitoring activities. Their reports are sent to management.

6.4 Personnel Qualifications and Training

Personnel qualifications for purposes of performing environmental monitoring activities is addressed in SOP No. 30-015.A, Qualifications of ES&H Management and Prof. Personnel. Persons involved in environmental monitoring activities other than the individuals authoring the procedures noted in section 3.1.3 of this plan, must be trained in the applicable environmental monitoring procedures.

6.5 Laboratory Services

QA requirements are specified for all laboratory contracts pursuant to EG&G/EM, Standard Operating Procedure No. 14-041.A, establishing Procurement Quality Assurance. Furthermore, contract laboratories must be vendor qualified in accordance with EG&G/EM Standard Operating Procedure No. 14-072.A, Supplier Qualification.

6.6 Data Collection and Management

This section includes the data collection procedures to assure the quality goals are achieved. Environmental data collection activities include:

- Sample point selection
- Sampling method
- Documentation of samples and sampling activity
- Laboratory analyses, practices and procedures
- Emission calculations

The following quality assurance procedures are patterned after EPA guidance provided in the "Handbook for Sampling Water and Wastes."

6.6.1 Sample Point Selection

Unless otherwise specified in the permit conditions, the point at which the most representative sample of the regulated effluent can be taken shall be selected as the sampling point.

6.6.2 Sampling Method

6.6.2.1 Sampling Frequency

The minimum sampling frequency for regulated effluents will be that specified in the effluent permit conditions.

6.6.2.2 Type of Sample

There are basically two types of samples that can be taken, each with their own list of variations. They are grab and composite samples.

A grab sample is defined as an individual discrete sample collected over a period of time not exceeding 15 minutes. It can be taken manually, using a pump, scoop, vacuum, or other suitable device. The collection of a grab sample is appropriate when it is desired to:

- Characterize water quality at a particular time
- Provide information about minimum and maximum concentration
- Allow collection of variable sample volume
- Corroborate composite samples
- Meet a requirement of a discharge permit

A composite sample is defined as a sample formed by mixing discrete samples taken at periodic points in time or a continuous proportion of the flow. The number of discrete samples which make up the composite depends upon the variability of pollutant concentration and flow. Types of composite samples are:

- Continuous: constant pumping rate over a period of time
- Continuous flow proportioned: pumping rate is proportional to stream flow
- Periodic: constant sample volume, constant time interval between samples
- Periodic flow proportioned: constant sample volume, time interval between samples proportional to stream flow

The sample type selected must always be that which is specified in the permit. However, if the permit does not specify the sample type, then consider the following guidelines when selecting the sample type. A grab sample should be used when:

- The stream does not flow continuously such as batch dumps
- The water or waste characteristics are relatively constant
- The parameters to be analyzed are likely to change with storage such as dissolved gasses, residual chlorine, soluble sulfide, oil and grease, microbiological parameters, organics, and pH

A composite sample should be used when:

- Determining average concentrations
- Calculating mass/unit time loading

The ultimate goal is to secure a sample that is representative of the effluent. In addition, samples should be of sufficient volume to allow duplicate analyses and quality assurance testing (split or spiked samples) by the analytical laboratory. The required sample volume is a summation of that required for the analysis of each parameter of interest plus QC analyses. Sampling shall also be conducted in such a manner as to protect the integrity of the sample and prevent the inadvertent introduction of contaminants or foreign material.

6.6.2.3 Sample Management

Sample size, containers, handling, preservation, and holding times shall be consistent with the requirements in 40 Code of Federal Regulations (CFR) Part 136, Test Procedures for the Analysis of Pollutants for wastewater effluent monitoring, unless otherwise specifically allowed by the appropriate regulatory authority, and Test Methods For Evaluating Solid Waste: Physical/Chemical Methods, SW 846 for monitoring solid wastes as defined by the Resource Conservation and Recovery Act.

6.6.2.4 Wastewater Sampling Equipment

When wastewater sampling equipment is needed for composite sampling it shall be equipped with a variable speed peristaltic pump or an ISCO type periodic sampler, capable of taking composite samples of volumes not less than 2.5 gallons per 24 hours at remote locations. The wastewater sampling equipment must be rinsed before and after each sampling event with uncontaminated water. Care must be taken to insure the sampling equipment is compatible with the media being sampled and that it does not introduce contaminants into the sample.

6.6.2.5 Quality Control Procedures for Sampling

Various types of control checks should be randomly used to verify the sample collection and handling process has not affected the quality of the samples and validate the analytical laboratory's practices and procedures.

The two types of Quality Control blanks that can be periodically utilized are: trip blanks and equipment blanks. A trip blank is used to estimate sample contamination from the container and preservative during transport and storage of the sample. A cleaned sample container is filled with uncontaminated water; any preservative used in the sample is added to the blank in the same proportions as the real sample ; the blank is then stored, shipped, and analyzed with its group of samples. This blank is more useful when samples are not analyzed for several days or weeks because leaching of the material from the container can become significant. Contaminants found in the trip blanks could be attributed to: (1) interaction between the sample and container; (2) contaminated rinse water; (3) handling procedures that alter the sample analysis results or; (4) laboratory practices.

Equipment blanks are used to estimate incidental or accidental contamination of a sample during sample collection. To ensure that the non-dedicated sampling device has been effectively cleaned (in the laboratory or field), the device must be triple rinsed with deionized water. The final rinse water is collected in an appropriate container and shipped with the sample to the laboratory for analysis. Proper sample preservation and holding times must be observed.

Split samples can be used to validate the laboratory's analytical data. The original sample is split into two samples using identical containers and preservatives and should be shipped together to the laboratory under different identification numbers or to a different laboratory.

6.6.3 Documentation of Samples and Sampling Activity

6.6.3.1 Sample Container Labels

To adequately identify the sample, a sample container labels shall be filled out with indelible ink and include the following information:

- Name of sample point
- Date and time of collection
- Preservative used
- Unique sample identification number
- Analysis requested

6.6.3.2 Sample Container Seals

Whenever monitoring is being conducted to resolve discrepancies, issues of noncompliance, or gather evidence for pending litigation, sample container seals must be used in conjunction with a chain of custody record. Samples must be sealed immediately after collection. Gummed paper seals are acceptable, as long as they only come into contact with the sample container and not the sample. Seals must be attached in such a way that they must be broken in order to open the sample container. The seal must include the following information, recorded with indelible ink:

- Sample ID Number
- Signature of the collector
- Date of sample

6.6.3.3 Sample Logs

A sample log shall be kept and include the following sampling information and recorded in indelible ink:

- Unique sample identification number
- Date and time of sample (on and off times)
- Description of the sample (include name, location and sample type) and method of sampling (grab or composite)
- Type of sample preservation used and holding times
- Name of the laboratory doing the analysis, the parameters of interest, and the analytical methods
- Name of collector
- Pertinent field data, e.g., pH
- Chain of custody used (yes or no)
- Field analysis

These records must be kept in a bound, paginated notebook. Errors made in entering information must not be erased or blotted out, but corrected by drawing a single line through the error and recording the correct information. Initialize and date the correction.

6.6.3.4 Chain of Custody Record and Procedures

Chain of custody procedures and records shall not be required for routine effluent monitoring activities for permit compliance. Chain of custody procedures and records shall be used when effluent monitoring activities are conducted to resolve discrepancies, issues of noncompliance, or gather evidence for pending litigation. This process is designed to establish the documentation necessary to trace sample possession from the time of collection through the laboratory analysis. When transferring the possession of the samples, the transferee shall sign and record the date and time on the chain of custody record. Custodial transfers should account for each individual sample, although samples may be transferred as a group. Every person who takes custody of a sample shall fill in the appropriate section of the Chain of Custody Record. As few custodians as possible should be in the chain of possession. Laboratory personnel are responsible for the care and custody of the sample once it is received by them. They should be prepared to testify that the sample was in their possession, in view, or secured in the laboratory at all times from the moment it was received from the custodian until time the analyses are completed. A sample is in someone's custody if it is in a person's actual physical possession, or first in a person's physical possession then kept within that person's view, or locked up, or kept in a secured area restricted to authorized personnel.

The field custodian is responsible for proper packaging and delivering samples to the appropriate personnel for shipment to the analytical laboratory. This responsibility includes completing the appropriate portion of the Chain of Custody Record and signing it.

All packages shipped to the analytical laboratory shall be accompanied by the Chain of Custody Record and other pertinent forms. A copy of each form should be retained by the facility of origin.

Mailed packages shall be registered with return receipt requested. If packages are sent by common carrier, receipts must be retained as part of the permanent chain-of-custody documentation. Procedures shall be developed to ensure the above documentation requirements are implemented.

Samples to be shipped must be packed to prevent breakage and the package sealed or locked, so that any evidence of tampering may be readily detected. Procedures shall be developed to ensure the samples are packaged and shipped accordingly.

6.6.4 Laboratory Practice, Analysis and Certification

6.6.4.1 Laboratory Practice

Upon receiving the sample, the laboratory should verify the integrity of the sample. The sample should be inspected to see that:

- The sample is clearly marked and dated
- The sample was collected in an appropriate container
- The sample is properly preserved
- There is sufficient sample volume to perform all of the required analyses
- The sample is received in good condition and the custody seal (if used) is intact
- Chain of Custody Records match the number and description of samples
- Samples are analyzed within the proper holding times
- Samples requiring refrigeration are stored appropriately until the analysis is performed

6.6.4.2 Analytical Procedures

Any laboratory performing analysis of compliance samples must follow approved EPA analytical procedures as specified in the references noted at the end of this plan, or unless otherwise allowed by the regulatory agency requiring the analysis.

6.6.4.3 Laboratory Certification and QA/QC Programs

Contract laboratories performing compliance analyses shall be appropriately certified by the state of residence or otherwise approved by the regulatory agency requiring the analysis. It must also have a QA/QC program in place that is acceptable to the state or agency issuing the certification. Each laboratory must ensure the following actions are completed:

- Calibration of laboratory instruments to within acceptable limits according to EPA or manufacturer's specifications before, after, and during use. Reference standards must be used when necessary. Records of calibrations must be available

- Periodic inspection, maintenance, and servicing (as necessary) of all laboratory instruments and equipment

- The use of reference standards and quality control samples (e.g., checks, spikes, laboratory blanks, duplicates, or splits), as necessary, to determine the accuracy and precision of procedures, instruments, and operators

- The use of adequate statistical procedures (e.g., quality control charts) to monitor preci... and accuracy of the data and to establish acceptable limits

- A continuous review of results to identify and correct problems within the measurement system (e.g., instrumentation problems, inadequate operator training, inaccurate measurement methodologies)

- Documentation of the performance of systems and operations

- Regular participation in external laboratory evaluations to determine the accuracy and overall performance of the laboratory. This should include performance evaluation, inter-laboratory comparison studies, and formal field unit/laboratory evaluations anu inspections

6.6.5 Air Emission Calculations

If air emission calculations are required as a condition of a permit, then they may be done using any combination of the following methodologies: operational data provided by the process supervisor or operator of the emission unit, emission factors, or analytical data from source testing. Allowable emission factors are those derived from Material Safety Data Sheets, manufacturer factors for process equipment and efficiency ratings of air pollution control equipment, EPA emission factors and emission fa... provided by the regulatory authority.

6.7 Discrepancies and Corrective Action

The analytical laboratory performing analyses on samples taken for compliance monitoring shall be responsible for resolving its own discrepancies and taking corrective action when predetermined limits for data analytical data acceptability are exceeded.

Each operation shall be responsible for resolving its own discrepancies and taking corrective action as a result of environmental appraisals, QA audits, or quality control checks. Procedures for addressing discrepancies shall be included in the required effluent monitoring procedures (see section 3.1.3 of this plan).

6.8 Independent Data Verification

Guidance on independent data verification will be provided by DOE/HQ.

8.0 Dose Estimation

As noted in section 2.1 of this plan, there are no effluents of radionuclides or environmental exposures to direct radiation at any of the EG&G/EM operations. **Fence line exposures to**

direct radiation are assessed quarterly in accordance with EG&G/EM Standard Operating Rule No. 34-027.A, "Environmental Radiation Exposure Monitoring Program". Additionally, the non-radiological effluents from EG&G/EM operations are so small that offsite impacts are negligible.

SECTION III

Groundwater Monitoring Plan for the Nevada Test Site

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1.0 Introduction

As part of the GPMP, a Groundwater Monitoring Plan (GMP) for the NTS is also required by DOE Order 5400.1. According to this order, "The plan shall identify all DOE requirements and regulations applicable to groundwater protection and include monitoring strategy." The general requirements for the groundwater monitoring program are listed below:

- Obtain data for the purpose of determining baseline conditions of groundwater quality and quantity
- Demonstrate compliance with and implementation of all applicable regulations and DOE orders
- Provide data to permit the early detection of groundwater pollution or contamination
- Provide a reporting mechanism for detected groundwater pollution or contamination
- Identify existing and potential groundwater contamination sources and maintain surveillance of these sources
- Provide data upon which decisions can be made concerning land disposal practices and the management and protection of groundwater resources

Groundwater monitoring is conducted on and near the NTS, as well as offsite, for compliance with environmental laws and regulations in accordance with DOE Order 5400.1, Chapter 111.4.a(2) and in support of responsible resource management (DOE, 1993). At the present time, groundwater monitoring is conducted by several different programs. It is the responsibility of the Hydrology Program Manager to eventually coordinate the monitoring programs within the DOE/NV. The objective is to provide " the most comprehensive and technically defensible network given the available sampling locations." (DOE, 1993). To obtain this objective, it is expected that existing wells will be added to the network, that the present sampling and analysis strategy will be modified, and that the resultant data will be more accessible.

This document, in accordance with DOE order 5400.1, will describe each of the existing groundwater monitoring programs, including applicable regulations, the elements of the monitoring program (sampling , analysis and data management), and the rationale for selecting these elements.

3.1 Groundwater Protection

The primary mission of DOE/NV operations at the NTS is the underground testing of nuclear devices. Fulfillment of this mission has resulted in groundwater contamination, of both radiologic and non-radiologic origin. Exhibit 3-1 shows areas of known and potential groundwater contamination at the NTS. DOE groundwater policy reflects a balance between successful mission accomplishment and minimization of groundwater impacts (DOE, 1993). This involves a comprehensive groundwater protection program.

Groundwater protection activities include, evaluating device emplacement-hole locations for potential impacts on groundwater, establishing environmental regulatory compliance of surface facilities, and incorporating waste minimization and pollution prevention awareness into daily activities. NTS-SOP-5417 defines five criteria for protection of groundwater during the siting of underground nuclear tests. Before an emplacement hole is drilled or an emplacement drift is mined, compliance with the criteria must be demonstrated by the sponsoring user and verified by a DOE review. Several environmental regulatory compliance programs including, Clean Water Act discharge permitting; Safe Drinking Water Act monitoring of water-supply wells, and implementing of a Wellhead Protection Program; RCRA permitting of new waste management activities, operating existing waste management facilities, and closure of other waste management facilities; and, performing CERCLA characterization and remediation activities to provide groundwater protection from surface operations.

3.2 Description of Existing Onsite Groundwater Monitoring Programs

3.2.1 Environmental Surveillance Program

The environmental surveillance program is conducted by REECo, the operating contractor at the NTS. It includes both radiological and non-radiological component. Both programs use a network that varies with the extent of NTS operations but presently consists of 7 springs, 14 water-supply wells and 9 drinking-water consumption points. The water-supply wells are indicated on Exhibit 3-2.

3.2.1.1 Radiological Monitoring Program

Rationale

This effort is related to compliance with the SDWA, state of Nevada drinking water regulations, and with the DOE Orders in the 5400 series dealing with radiation protection of the public and the environment.

Sampling Plan

The wells and springs are sampled for radiological substances in accordance with the schedule presented in Table 3-1. In addition, drinking-water consumption points are sampled weekly to provide a constant check of the end-use activity and to allow frequent end-use activity comparisons to the radioactivity of the water in the supply wells. Frequency of collection is determined on the basis of a preliminary radiological pathways analysis. The water-supply wells have submersible pumps installed in the wells and are sampled by pumping. Sampling occurs at the nearest available outlet after fluid has reached the surface. The samples are taken in one-liter glass containers (DOE, 1991).

Analysis

All samples are analyzed for gross beta, tritium (conventional method), and gamma-emitting radionuclides. Plutonium analyses are performed on a quarterly basis and strontium analyses annually. Samples of potable water are also analyzed for gross

Table 3-1 REECo's NTS Sampling Schedule of Potable and Nonpotable Water-Supply Wells and Natural Springs

Area	Sample Location	Radiological	Nonradiological	Comments
5	Water Well 5C	a,b,c	d	
5	Well UE-5c	a,c,e		
5	Water Well 5B	a,c,e		Well shut down (DOE, 1992)
5	Cane Spring	a,c,e		
6	Water Well 4	a,b,c	d	
6	Water Well C	a,b,c	d	
6	Water Well C-1	a,b,c	d	
7	Reitmann Seep	a,c,e		
12	Captain Jack Spring	a,c,e		
12	Gold Meadows	a,c,e		
12	White Rock Spring	a,c,e		
15	Well UE-15d	a,b,c		
16	UE-15d	a,b,c	d	
16	Tippipah Spring	a,c,e		
18	Water Well 8	a,b,c	d	
19	Well UE-19c	a,c,e		
20	Water Well U-20	a,c,e		
22	Army Well #1	a,b,c	d	
25	Water Well J-12	a,b,c	d	
25	Water Well J-13	a,b,c	d	
29	Topopah Spring	a,c,e		

Sampling Schedule

a. Monthly
- * Tritium Activity, conventional
- * Gross Beta Activity
- * Gamma Activity

b. Quarterly
- * Gross Alpha Activity
- * Plutonium 238, 239 & 240
- * Radium 226
- * Tritium Activity, Enriched

c. Annually
- * Strontium 90

d. Annually
- * VOC's
- * Inorganics & metals

e. Quarterly
- * Plutonium 238, 239 & 240

alpha, for tritium by the enrichment method, and for ^{226}Ra on a quarterly basis. The analysis activity is summarized in Table 3-1. Radiological analyses is performed by following standard procedures, which are documented in the Annual Site Environmental Report (DOE,1991).

Data Management

Results of sample analysis are used to help document the radiological characteristics of the NTS groundwater system. These results are reported in the ASER. In addition, data are maintained in a data base so that long-term trends in water quality can be evaluated and studied.

3.2.1.2 Non-Radiological Monitoring Program

Non-radiological environmental monitoring of NTS operations involves only onsite monitoring because there are no non-radiological discharges to the offsite environment.

Rationale

Water sampling is conducted for analysis of bacteria, volatile organic compounds (VOCs), inorganic constituents and water quality for compliance with the SDWA and state of Nevada drinking-water regulations. In addition, data collected under this program are also used for CERCLA and RCRA compliance by demonstrating the quality of water used in drilling characterization and monitoring wells.

Sampling Plan

Onsite drinking-water distribution systems are monitored for bacteria once a month if serving less than 1000 people and twice a month if serving 1000 to 2500 people. Residual chlorine and pH levels are determined at the collection points by using colorimetric methods approved by the state. In addition, annual samples are taken from each of the nine potable water wells on the NTS for water quality parameters and to check for the presence of metals, VOCs and inorganic constituents. (DOE, 1991).

Analysis

Chemical analysis for organic and inorganic compounds is conducted in accordance with Nevada Administrative Code (NAC) 445 and 40 CFR 141. VOCs are sent to an EPA- and state-approved laboratory. Samples for inorganic compounds and water quality are sent to the state of Nevada laboratory for analysis (DOE, 1991). Table 3-2 lists the inorganic constituents and water quality parameters analyzed in the samples.

Data Management

Results of sample analysis are presented in the ASER. In addition, data are maintained in a data base so that long-term trends in water quality can be evaluated and studied.

3.2.2 Site Characterization and Performance Assessment - Area 5

Rationale

Sampling and analysis at the Radioactive Waste Management Site (RWMS) is in compliance with RCRA requirements in support of a RCRA Part B permit application. This effort also supports low-level waste performance assessments required by DOE

Table 3-2 Inorganic Constituents Analyzed In NTS Potable Water-Well Samples Collected by REECo

Sample Location:

Army Well #1	Water Well C	Water Well 4
Water Well 5C	Water Well C1	Water Well 8
Water Well J-12	Water Well J-13	Well UE-16 D

Constituents:

T.D.S	Nitrate	Zinc	Cadmium
Hardness	Alkalinity	Barium	Calcium
Chromium	Bicarbonate	Boron	Lead
Magnesium	Carbonate	Silica	Mercury
Sodium	Arsenic	Cooper	Selenium
Potassium	Iron	Turbidity	Silver
Sulfate	Manganese	Ph	Color
Chloride	Fluoride	Elect. Conduct.	MBASs

Order 5820.2a and is in accordance with DOE Order 5400.1 and orders in the 5400 series dealing with radiation protection of the public and the environment. In addition, the data will be integrated into the CERCLA Remedial Investigation/Feasibility Study (RI/FS) for the underground test areas (DOE, 1993). Sampling for this program is conducted by REECo.

Sample Plan

At the present time, three pilot wells have been completed. Initial aquifer testing has characterized direction of groundwater flow. It is anticipated that one or more of these wells will become monitoring wells for the RCRA facility. Other monitoring wells will be placed as required in the final RCRA permits. When possible, the groundwater monitoring sampling plan is designed and implemented in accordance with 40 CFR Part 264, Subpart F, or 40 CFR Part 265, Subpart F. As the existing groundwater monitoring programs on the NTS are coordinated and integrated by the office of the Hydrology Program Manager, full compliance will be achieved.

Sampling and analysis of groundwater from the pilot wells have been conducted on two separate occasions. The initial stage of sampling was conducted during aquifer testing. The second stage was performed after well completion. It is anticipated that preliminary monitoring will take place quarterly. Based on results of this interim monitoring, a long-term monitoring plan for regulatory compliance will be implemented (B. Dozier, pers. comm.).

Analysis

Groundwater is analyzed for water-quality parameters, and organic, inorganic and radiological constituents. Samples analyzed for RCRA regulated contaminants are sent

to a laboratory certified under the Contract Laboratory Program (CLP). Radionuclide constituents are analyzed by REECo and Lawrence Livermore National Laboratory (LLNL) (B. Dozier, pers. comm.).

Data Management

Results from the first two stages of sampling are being published in a data report to DOE. It is anticipated that results of the quarterly monitoring will be presented in the ASER. In addition, data will be maintained in a data base so that long-term trends in water quality can be evaluated and studied (B. Dozier, pers. comm.).

3.2.3 Underground Test Area Remedial Investigation/Feasibility Study (UGTA RI/FS)

Rationale

According to the DOE GPMP, the NTS has not been listed on the EPA's National Priorities List. However, activities are being conducted in accordance with CERCLA requirements in compliance with DOE order 5400.4. This program is being put into place by International Technology (IT) Corporation. According to written communication from that organization, the objectives of the monitoring strategy include the following:

- To ensure that appropriate and adequate data are collected in a cost-effective manner
- To propose a technically-defensible, decision-making process to guide initial characterization and monitoring planning
- To refine the initial approach over the next five years to establish a monitoring program

Sampling Plan, Analysis and Data Management

As stated above, the UGTA RI/FS is in the beginning stages of its implementation. Some of the wells have been completed, others are in various stages of construction or completion. Some wells are recompletions or modifications of existing wells. Appendix A lists the wells and comments on their status. Sampling and analysis of groundwater from these wells are conducted on two separate occasions. The initial stage of sampling is conducted during aquifer testing. The second stage occurs after the well is completed. Groundwater is analyzed for water-quality parameters, and organic, inorganic and radiological constituents. Based on these results, a long-term monitoring plan for regulatory compliance and a data management plan will be implemented.

3.2.4 U.S. Geological Survey (USGS) Water-Level Monitoring

Rationale

The water-level network maintained by the USGS Water Resources Division is in compliance with DOE Order 5400.1 which states that groundwater monitoring programs shall be conducted to determine baseline conditions of groundwater quality and quantity. Other support for this activity comes from an interagency agreement between

DOE and the National Park Service. Data from the water-level network is used to support the UGTA RI/FS and the Hydrologic Resources Management Program (D. Duncan, pers. comm.).

Objectives of the program are to collect and compile data to aid in characterizing the regional and local groundwater flow systems underlying the NTS and to provide accurate representation of groundwater in maps and models (DOE, 1993).

Sample Plan

Depth-to-water measurements are made at 58 wells and boreholes on and in the vicinity of the NTS. The data collection network consists of two parts, short-term test holes and long-term observation wells and test holes. Depth to water is measured in all accessible test holes that penetrate the saturated zone according to the schedule presented in Table 3-3. These measurements are made until measured depth to water stabilizes or the hole is destroyed or becomes inaccessible. The majority of test holes are short-term holes and the opportunity to measure depth to water is limited to a few weeks or month, which is often not sufficient for stabilization of water depth. Most of the existing observation wells and test holes available for long-term observation were not drilled for the direct acquisition of hydrologic data. It is often not possible to monitor fluctuations in water depth that represent local or regional aquifer conditions. Wells or test holes that exhibit minor fluctuations in water depth are typically measured annually. Wells or test holes that exhibit large fluctuations in water depth are monitored more frequently; typically weekly, quarterly or even continuously. Currently, depth to water is measured with a wire-line device, which is calibrated with a steel tape (Wood, 1992).

In addition to the water-level monitoring, water samples are collected from 14 test holes at the NTS, as listed in Table 3-4, and are analyzed for tritium. Raw, unfiltered samples are collected in 500-mL acid-rinsed glass bottles. A bailer is used to collect water samples from below the water surface in the test holes (Wood, 1992).

Analysis

Samples are analyzed for tritium by the U.S. EPA's Environmental Monitoring Systems Laboratory in Las Vegas (EMSL-LV).

Data Management

Water-level data have been collected, compiled, verified and stored in the Ground-Water Site Inventory data base. Historical records are kept to indicate long-term water-level fluctuations and to provide a record of all reported completion depths or open intervals for associated wells and test holes (Wood, 1992).

3.2.5 EPA Long Term Hydrological Monitoring Program (LTHMP)

Rationale

EPA EMSL-LV operates this program. The LTHMP was instituted because the Atomic Energy Commission (AEC, later DOE/NV) acknowledged its responsibility for obtaining and disseminating data acquired from all locations where nuclear devices have been tested (DOE, 1991). The objectives of this program are the following:

Table 3-3 Wells Monitored for Water Levels by the USGS on the NTS

Area	Well	Sampling Schedule	Area	Well	Sampling Schedule
1	UE-1a	S	7	U-7cd	W
1	UE-1b	S	7	U-7cd-1	W
1	UE-1C	S	7	UE-7nS	B
1	UE-1h	S	11	UE-11a	M
1	UE-1L	S	12	ER-12-1	*
1	UE-1q	*	12	U-12s	Q
2	UE-2ce	B	12	E-12t 6	Q
3	TW-7	M	14	UE-14b	S
3	U-3cn 5	M	16	UE-16-f	S
3	U-3mi	Q	17	TW-1	Q
3	UE-3e 4-1	B	17	UE-17a	S
3	UE-3e 4-2	B	18	UE-18r	S
3	UE-3e 4-3	B	18	UE-18t	S
4	TW-D	Q	19	U-19bh	M
4	U-4u PS 2A	M	19	U-19bj	M
4	UE-4t 1	B	19	U-19bk	M
4	UE-4t 2	B	19	UE-19CWW	*
5	RNM-2S	M	19	UE-19h	*
5	TW-3	S	20	PM-1	M
5	UE-5n	M	20	NT-2	S
5	UE-5PW-1	W	20	U-20bq	M
5	UE-5PW-2	W	20	U-20n PS 1dd-H	Q
5	UE-5PW-3	W	20	UE-20bh 1	M
5	WW-5A	M	20	UE-20n 1	Q
6	TW-B	Q	27	TW-f	S
6	UE-6d	Q	of	PM-3-1	*
6	UE-6e	Q	of	PM-3-2	*
6	WW-4	M	of	WW-2	*
6	WW-4	M	of	WW-3	*
6	WW-4A	M			

W = Weekly B = Biweekly M = Monthly
Q = Quarterly S = Semiannually * = When requested

Table 3-4 Test Holes Sampled for Tritium by USGS

U-2gh	U-20aw
U-3kv	U-20ax
U-3mi	U-20az
U-4au	U-20bb
U-12s	U-20bc
U-19au	U-20bd
U-19az	U-20be

- Assure public safety

- Inform the public, news media, and scientific community about any radiological contamination

- Document compliance with existing federal, state, and local antipollution requirements

The LTHMP monitoring network was gradually developed out of existing wells. The location of these wells reflects their initial purpose as exploratory holes, hydrologic test wells and water-supply wells.

Sampling Plan

The onsite monitoring network includes locations on the NTS or immediately outside its borders. The locations of the these wells are shown in Exhibit 3-3. The sampling schedule is shown in Table 3-5. The offsite locations are shown in Exhibit 3-4. These are mostly public and private water supplies for residents in the area. These sampling sites include 22 wells, seven springs, and two surface-water sites. They are sampled monthly, except for Penoyer Wells 7, 8, and 13, which are sampled whenever the wells are in operation. The thirteen water-supply wells common to the LTHMP and the Environmental Surveillance Program described in Section 3.2.1 have submersible pumps and are sampled by pumping. The remainder of the wells are sampled with a truck-mounted sampling rig. The standard operating procedure is to collect three samples from each source. Two of these samples are collected in 500-mL glass bottles to be analyzed for tritium. The remaining sample is collected in a 3.8 liter plastic container (Cubitainer) for gamma spectrometry.

Analysis

Monthly samples are analyzed by gamma spectrometry and by the enrichment method for tritium. For the semi-annual samples, one set is analyzed for tritium by the enrichment method and one set by the conventional method. When a new well is added to the network, the first sample collected is analyzed for $^{89,90}Sr$, ^{226}Ra, and plutonium and uranium isotopes by radiochemistry as time permits. Other analyses, for constituents such as anions, nitrates, ammoniacal nitrogen, and silica are conducted by special request (DOE, 1991).

Data Management

Results of sample analysis are presented in EPA documents and the ASER. The data are maintained in a data base so that long-term trends in water quality can be evaluated and studied.

3.2.6 Hydrologic Resources Management Program (HRMP)

Rationale

This program investigates the effects of underground testing on the hydrogeology, groundwater chemistry and radiochemistry beneath and around the NTS. The objectives as listed in the GPMP (DOE, 1993), are:

- To provide hydrologic information and methodologies for protecting groundwater resources in and around the NTS

Table 3-5 US EPA's NTS Sampling Schedule of Wells and Natural Springs

Area	Sample Location	Radiological	Comments
1	UE-1C	b	
2	Water Well 2	b	Well shut down throughout 1991
3	Water Well A	b	
3	Test Hole #7	b	
3	U-3cn #5	b	Well shut down throughout 1991
4	Test Well D	b	
5	Water Well 5C	a	
5	Well UE-5C	b	
5	Water Well 5B	b	Well shut down (ASER 1992)
6	Water Well 4	a	
6	Water Well C	a	
6	Water Well C1	b	
6	UE-6d	b	
6	UE-6e	b	
6	Test Well B	b	
7	UE-7nS	b	Last sampled Sept. 1987
7	UE-UT #1	b	
15	Well UE-15d	b	
16	UE-16D	b	
16	UE-16f	b	
17	USGS HTH #1	b	
17	UE-17a	b	
18	Water Well 8	a	
18	UE-18c	b	
18	UE-18t	b	
19	Well UE-19c	b	
20	Water Well U-20	b	
20	PM-1	b	
22	Army #1 Water Well	a	
25	Water Well J-12	a	
25	Water Well J-13	a	
27	USGU HTH "F"	b	
of	Army Well 6A	b	
of	GL Well 3	To be determined	
of	GL Well 4	To be determined	
of	GL Well 5	To be determined	
of	GL Well 6	To be determined	
of	Ash Meadows: Crystal Pool	c,d	
of	Ash Meadows: Fairbanks Spring	c,d	
of	Ash Meadows: Spring 17S-50E-14cac	c,d	
of	Ash Meadows: Well 18S-51E-7db	c,d	

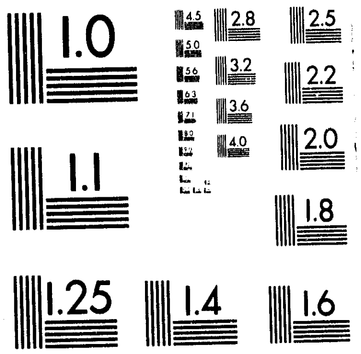
Sample Schedule

a. Monthly
* Tritium Activity, Enriched
* Gamma Activity

b. Semi-Annually
* Tritium Activity, Enriched
* Gamma Activity

c. Monthly
* Gamma Activity

d. Semi-Annually
* Tritium Activity, Enriched Once
* Tritium Once


1.0
4.5
5.0
5.6
6.3
7.1
2.8
3.2
3.6
4.0
2.5
2.2
2.0
1.1
1.8
1.25
1.4
1.6

2 of 2

- To provide expertise in radionuclide migration in groundwater for the weapons testing program

- Long-range hydrologic research

These objectives support DOE Order 5400.1. HRMP activities are conducted by agencies with the scientific expertise to fulfill the above objectives. These include LLNL, Los Alamos National Laboratory (LANL), the USGS and the Desert Research Institute (DRI).

In general, data generated from HRMP activities are research oriented and extremely variable, both temporally and spatially. Data produced by these investigations are essential in producing and refining groundwater flow and contaminant transport models for the NTS. This is necessary for proper design of an integrated and technically defensible monitoring network. Much of the sampling and analysis occurs at wells which are not in the present NTS monitoring network. Often, these wells contain more radionuclides than those in the present network, because they were more closely associated with weapons testing activities. It is anticipated that, in the future, some of these wells will be added to the Environmental Surveillance Program or the EPA LTHMP effort.

Sampling Plan and Analysis

Because of the nature of the program, there is no routine sampling plan. However, there is a wide variety of studies presently being conducted by the program participants. These include:

- "Cradle-to-grave" hydrologic evaluation of a testing area, using a hydrologic characterization well in Area 20. This well will likely be used for monitoring in the near future

- Monitoring for fluid levels and radionuclides as part of the investigation of the high hydraulic pressure zone in Yucca Flat

- Monitoring at the site of the CAMBRIC nuclear test in Frenchman Flat (Area 5) for radionuclide migration away from the cavity

- Tracer testing for existence of a perched water table at Pahute Mesa

- Well validation and testing studies to quantify the movement of groundwater beneath the NTS and help develop a technically defensible monitoring strategy for the NTS

Sample analysis is dependent on the objective of the study.

Data Management

Data management is dependent on the study objective. In most cases, data are stored in a data base, so long-term trends can be evaluated. One data reporting project is to compile an inventory of tritium data from the NTS, and to generate a map showing regions of elevated tritium in the groundwater. Collected data are also used to calibrate regional groundwater flow models, as well as radionuclide migration models. These models are being used to better understand the hydrologic system underlying the NTS and to aid in monitoring network design and implementation. For more information on these projects see the ASER, or refer to the published reports of the participating agencies (e.g. Marsh, 1992; Helken, 1987; and others).

3.3. Description of the Offsite Groundwater Monitoring Program

Rationale

Under the LTHMP effort conducted by the EPA, groundwater is monitored at nuclear test sites in the United States. This effort is in compliance with DOE Order 5400.1 and has the same objectives as the onsite portion of the LTHMP, presented in section 3.2.4. These include assuring the public safety, documenting compliance with regulations, and disseminating information relating to the effects of nuclear testing to the public. The offsite portion of the LTHMP is composed primarily of pre-existing local supply wells rather than wells which were designed specifically for monitoring. DRI conducted a critical evaluation of offsite monitoring and concluded that the "holes of opportunity" system is not the optimum monitoring network design (Chapman and Hokett, 1991). DOE is committed to maintain and upgrade the monitoring network at these offsite areas, to more closely fulfill the stated objective of the program. In addition, DOE plans to initiate CERCLA activities, including RI/FS projects at each of the remote testing locations. This work will be done sequentially, beginning with the Tatum Dome Site in Mississippi. This effort is being supported by the DOE Environmental Restoration Program (D. Duncan, pers. comm.).

Sampling Plan

Annual sampling is conducted at all the remote sites, except for Amchitka Island, Alaska, where the sampling occurs biennially. The sampling procedure used is similar to that described in Section 3.2.4, except that a second Cubitainer is collected to be used as a backup, or as a duplicate sample. Specific details for each of the remote sites is listed below. The reader can refer to Chapman and Hokett (1991) or the latest ASER for figures showing the location of the sampled wells.

Fallon Nuclear Test Site - Project SHOAL: This site is in a sparsely populated area southeast of Fallon, NV. Routine sampling locations include one spring, one windmill and four wells of varying depths. One of the wells was refurbished in 1992, and a new pump installed.

Central Nevada Test Area - Project FAULTLESS: This area is in south central Nevada. Routine sampling locations include one spring and five wells of varying depths. In 1992, the cavity monitoring well was sampled in addition to the routine sampling points.

Project GASBUGGY: This project is in the San Juan Basin of northwestern New Mexico, approximately 70 miles east of Farmingham. There are four springs, eight wells and one surface sampling point currently being sampled on an annual basis.

Project GNOME: The test was conducted near Carlsbad, NM in a salt formation. The monitoring network is composed of nine monitoring wells, the municipal water-supply wells for the towns of Loving and Carlsbad, New Mexico, and the Pecos River Pumping Station Well.

Project RULISON: This project is located near Rifle, CO. Routine sampling locations include the municipal water-supply well for the nearby town of Grand Valley, water-supply wells for five local ranches, and three other sites in the vicinity of Ground Zero. The analysis conducted by Chapman and Hokett (1991) indicate that none of these locations are likely to detect migration of radionuclides from the test cavity.

Project RIO BLANCO: This site is also located near Rifle, CO. Sampling sites include two domestic water-supply wells, six surface water sites, three springs and three monitoring wells in the vicinity of the test cavity.

Tatum Dome (Salmon) Site - Project DRIBBLE: This site is located in southern Mississippi near Baxterville. At the request of the property owner, the name was changed to the Salmon Site. This site has the most extensive monitoring network of the remote testing areas; there are 104 routine sampling sites. In addition to the monitoring wells in the immediate vicinity of Ground Zero, most private drinking-water-supply wells in the area are included in the network. Because of the high rainfall in the area, the standard sampling procedure, described in Section 3.2.4 is somewhat modified for onsite shallow wells. Following collection of the first sample, the well is pumped for a set period of time or permitted to refill and a second sample is collected. The second sample is thought to be more representative of the formation water (DOE, 1991). The Tatum Dome/Salmon Site is the location of the first CERCLA activities conducted at the remote testing areas. The RI/FS was begun this year (1993).

Amchitka Island - Projects LONG SHOT, MILROW, and CANNIKIN: Amchitka Island is in the Aleutian Island chain of Alaska. Sampling is conducted here every two years. The sites were sampled in July of 1993 and samples were collected from all locations in the routine sampling network (D. Chaloud, pers. comm.). This network includes 12 background sites, 12 sites at LONG SHOT, 15 sites at MILROW, and 9 sites at CANNIKIN.

SECTION IV

Meteorological Monitoring Plan of the Weather Service Nuclear Support Office for the Nevada Test Site

by

D. Randerson
Weather Services Nuclear Support Office
National Oceanic Atmospheric Administration

January 3, 1994

2.0 Meteorological Monitoring

2.3 National Weather Service Systems

2.3.2 Satellite Weather Information System

WSNSO operates three SWIS systems. One is located in the main forecast office in the Las Vegas DOE building, one is at CP-1 in Area 6 on the NTS, and the third one is at the Desert Rock (DRA WSMO). The SWIS in Las Vegas and at DRA are used for routine daily operations and are monitored 24 hours daily. The system at CP-1 is used to support nuclear test operations.

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