Trans w/Ltr. dtd 3/1/89

NNWSI/88-12
SAIC-88/8010

Nevada Nuclear Waste Storage Investigations Project
Environmental Monitoring Program Summary For 1987

May 1988

This report addresses the information requirements
specified in Department of Energy Order 5484.1,
"Environment Protection, Safety, and Health Protection Information Reporting"
(February 24, 1981)

102.7

This document was prepared by:

The Radiological Field Programs Branch of the Technical and Management Support Services (T&MSS) Contractor (SAIC) to the DOE NNWSI Project with support from:

S. Woolfolk	SAIC/T&MSS
J. Prince	SAIC/T&MSS
G. Daer	SAIC/T&MSS
A. Colarusso	SAIC/T&MSS
C. Costa	U.S. EPA/NRAD
S. Black	U.S. EPA/NRAD
C. Liu	U.S. EPA/NRAD
D. Thome	U.S. EPA/NRAD
N. Sunderland	U.S. EPA/NRAD
L. Smith	U.S. EPA/NRAD
F. Grossman	U.S. EPA/NRAD
A. Jarvis	U.S. EPA/NRAD
and technical editing by	
C. Weiss	SAIC/T&MSS

as part of DOE Contract Number DE-AC08-87NV10576.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

NNWSI PROJECT ENVIRONMENTAL MONITORING PROGRAM SUMMARY FOR 1987

1.0 Introduction

This document provides a summary of the calendar year 1987 radiological environmental monitoring activities conducted by the Nevada Nuclear Waste Storage Investigations (NNWSI) Project in the Yucca Mountain area. Current NNWSI Project activities include meteorological and radiological monitoring activities. Other monitoring activities and expansion of existing monitoring activities are scheduled to begin in FY 88 or FY 89.

1.1 Location

The NNWSI Project site is located in southwestern Nevada on land in the Yucca Mountain area. While the size of the site is still under evaluation, the area of intensive study is shown in Figure 1-1. The site is located about 26 km north of the town of Amargosa Valley (formerly Lathrop Wells).

1.2 Work Performed

The U.S. Department of Energy (DOE) is responsible for developing the Nation's first geologic repository for permanent disposal of high-level radioactive waste and spent nuclear fuel. The Nuclear Waste Policy Act (NWPA) of 1982 specifies the process for selecting a repository site and assigns primary responsibility for site selection and repository design, construction, and operation to the DOE. Following the step-by-step process set forth in the original NWPA, the Secretary of Energy recommended three sites for extensive study ("site characterization"). On May 28, 1986, the President approved the Secretary's recommendations, establishing Yucca Mountain, Nevada, as one of three sites to be characterized. In December 1987, Congress amended the NWPA to specify that Yucca Mountain would be studied to determine whether it meets stringent standards for isolating radionuclides. All site-specific activities at the other two sites were discontinued at that time.

The NNWSI Project is guided by the DOE's Office of Civilian Radioactive Waste Management (OCRWM) and is managed locally by DOE's Nevada Operations Office (DOE/NV). The Project Office and support contractors are conducting earth science and environmental studies of Yucca Mountain during site characterization (DOE, 1988) as well as studying potential effects of the Project on the region near the site. This site characterization phase is scheduled to continue through the early 1990's. When testing is complete and if the site is found suitable, the Secretary will seek Presidential approval to submit an application to construct a repository to the Nuclear Regulatory Commission (NRC). The NRC then will decide whether the proposed site meets strict Federal regulations that prohibit a repository from posing a threat to the environment. If the NRC approves, repository construction can begin.

A very limited number of activities associated with the site characterization program are being performed at this time. The current NNWSI Project environmental monitoring activities are described in the Meteorological Monitoring Plan (SAIC, 1985) and the Preliminary Site Characterization Radiological Monitoring Plan (PSCRMP) (SAIC, 1987), and include, since late

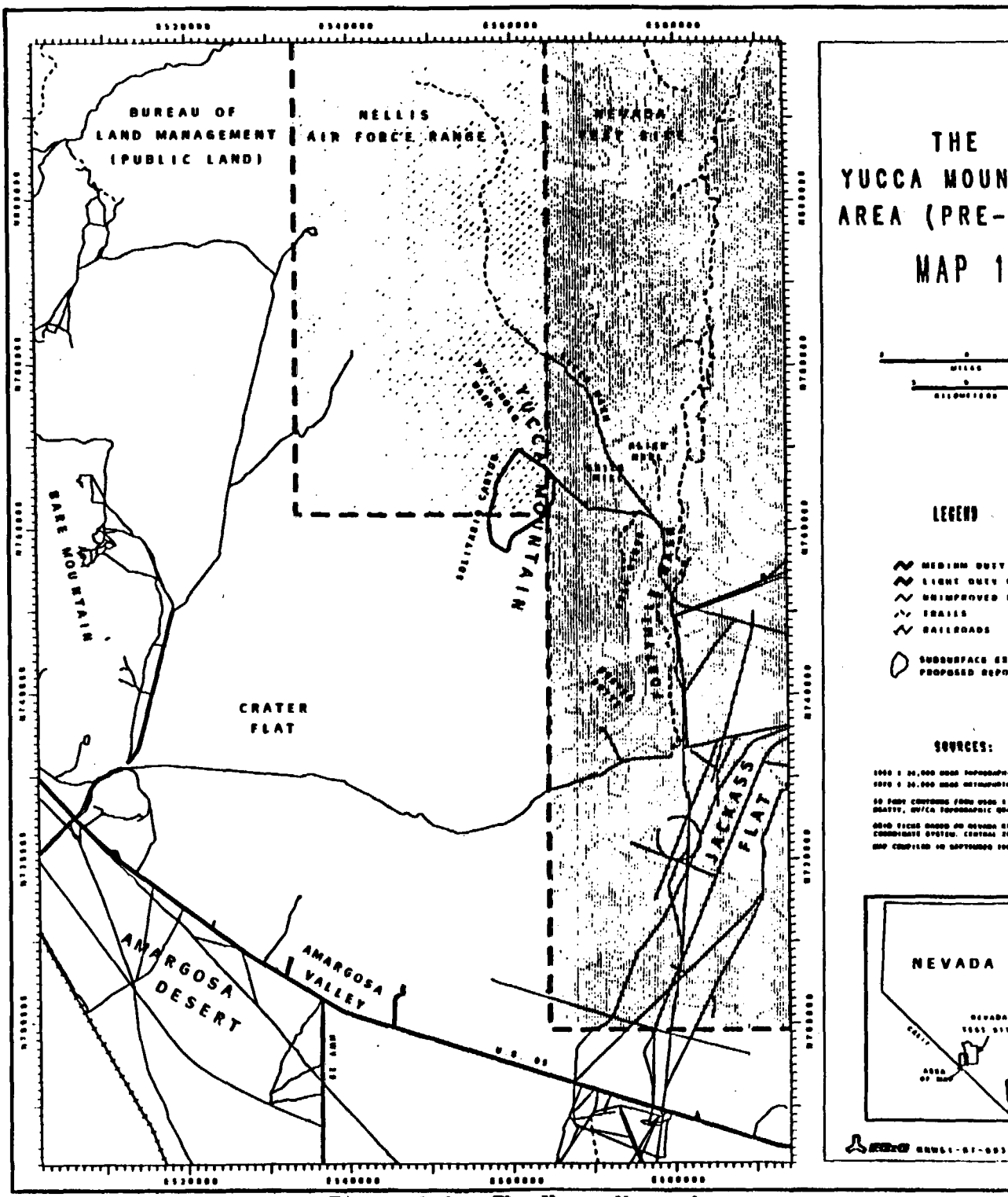


Figure 1-1. The Yucca Mountain area

March 1988, screening of water pumped from the site for tritium before disposal. The continuous radon monitoring activities discussed in the PSCRMP are still in the implementation phase. It should be noted that the PSCRMP will be replaced by the Radiological Monitoring Plan (RMP) (SAIC, 1988), which specifies the full scope of monitoring activities for the NNWSI Project (Appendix A). The RMP is planned for release in late April or early May of 1988. The NNWSI Project publishes meteorological monitoring data in quarterly and annual reports; consequently, meteorological data are not included in this report.

The radiological monitoring activities currently consist of one continuous air sampler located near the 60-meter meteorological tower (Figure 1-2), seven passive integrating radon samplers located in the Facility Area (Figure 1-2), and one passive integrating radon sampler attached to the 10-meter meteorological tower in Coyote Wash.

1.3 Environmental Setting

The NNWSI Project site at Yucca Mountain is located in southwestern Nevada, approximately 26 km north of the town of Amargosa Valley (formerly Lathrop Wells). The site, part of which includes the southeastern corner of the Nevada Test Site (NTS), is located exclusively within lands controlled by the Federal Government. Yucca Mountain lies within the Basin and Range physiographic province, a broad area of generally linear mountain ranges and intervening valleys. Figure 1-3 depicts the topography of the area in the immediate vicinity of Yucca Mountain. The climate of the area is identified with strong solar insolation, limited precipitation, low relative humidity, and large diurnal temperature ranges. Temperatures vary from highs of approximately 36°C during the summer to lows of approximately 2°C during the winter. Annual precipitation is typically 145 mm in the area. Winds from the south account for a high percentage of the summer seasonal flow. On a diurnal basis, flow from the south predominates in the summer daytime hours, while northwest and northwesterly winds dominate nighttime hours. Winter wind distributions are dominated by the northwest and north-northwesterly flows. Southerly winds during the winter are greatly reduced from those that are observed during the summer.

Land use in the region includes agriculture, mining, recreation, and private and commercial development, all on a very limited basis. The Amargosa Valley and Pahrump Valley are the primary areas of agricultural significance. All agricultural production presently is beyond 24 km of the Yucca Mountain site. Land use information is summarized in the Yucca Mountain Environmental Assessment (EA) (DOE, 1986).

1.4 Related Reports

The NTS environmental monitoring reports published by Reynolds Electrical and Engineering Co. (REECo) and by the Nuclear Radiation Assessment Division (NRAD) of the U.S. Environmental Protection Agency (EPA) also contain data relating to the NNWSI Project area.

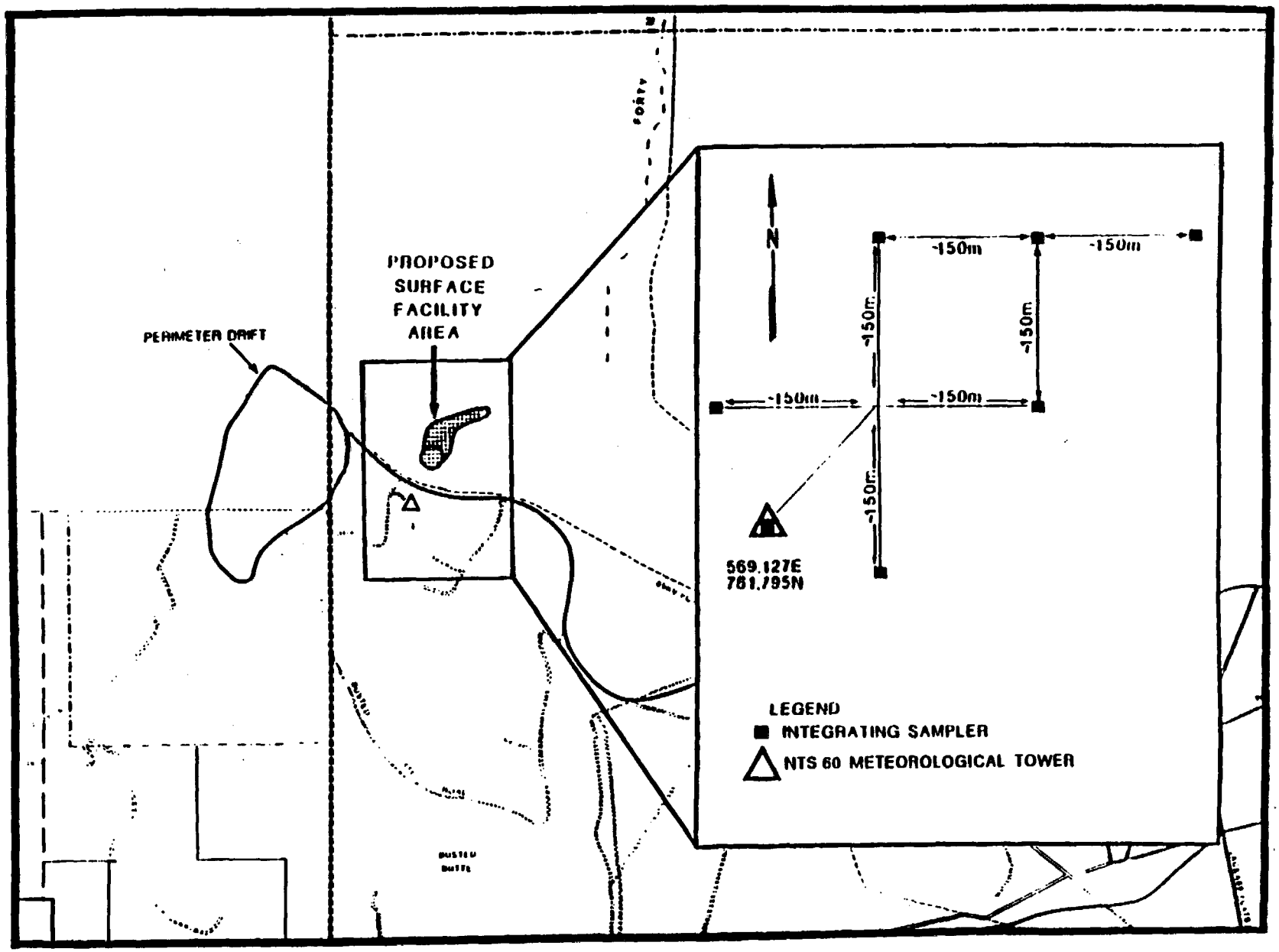


Figure 1-2. PSCRMP sampling locations

2.0 Pollutants Released in Effluents

There is currently little or no activity on the NNWSI Project site. Ambient emissions are presently zero with the exception of the resuspension of existing material by casual traffic. The data collected as part of the PSCRMP program address ambient airborne activity prior to initiation of significant site characterization activity. In addition, the data on the release of liquids pumped from wells in the area are also addressed.

2.1 Air

The air monitoring consists of two major activities: particulate and iodine monitoring using a continuous air monitor, and radon monitoring using passive integrating radon samplers (Track Etch™ detectors).

2.1.1 Continuous air monitor results

Upon receipt, the weekly particulate samples were analyzed for alpha, beta, and gamma activity and the charcoal cartridges for gamma activity. The gross alpha count results and the gross beta count results are shown in Figure 2-1 and Figure 2-2, respectively. The results of the gamma spectrum analyses for the particulate filter and charcoal cartridges are summarized in Table 2-1. Finally, the isotopic/radionuclide analyses of the composite of all particulate filters from September 11, 1987, to December 31, 1987, are summarized in Table 2-2.

2.1.2 Integrating sampler (IS) results

The results of the IS analyses for the period from September 9, 1987, to October 4, 1987, are summarized in Table 2-3. Based on these results, it was determined that the sampling period would be increased from monthly to quarterly to provide more accurate data. The QC data indicated that accurate measurement at ambient levels requires a larger integrated exposure, so the period was extended. The results from October 4, 1987, to January 5, 1988, are shown in Table 2-4. Based on the data in Table 2-4, radon concentration in the areas monitored ranged from about 0.4 to 0.7 picocuries per liter. Since only one quarter of data is available, no significant conclusions can be reached at this time.

2.2 Liquid

The projected liquid releases from NNWSI Project activities are from groundwater pumped to the surface as a result of groundwater monitoring activities. Since screening of the activity was not initiated until March 1988, no specific data are available for the 1987 calendar year. However, the tritium level in the water from two wells sampled since the screening was initiated in calendar year 1988 has been less than 8×10^{-7} microcuries per milliliter (80 picocuries per liter).

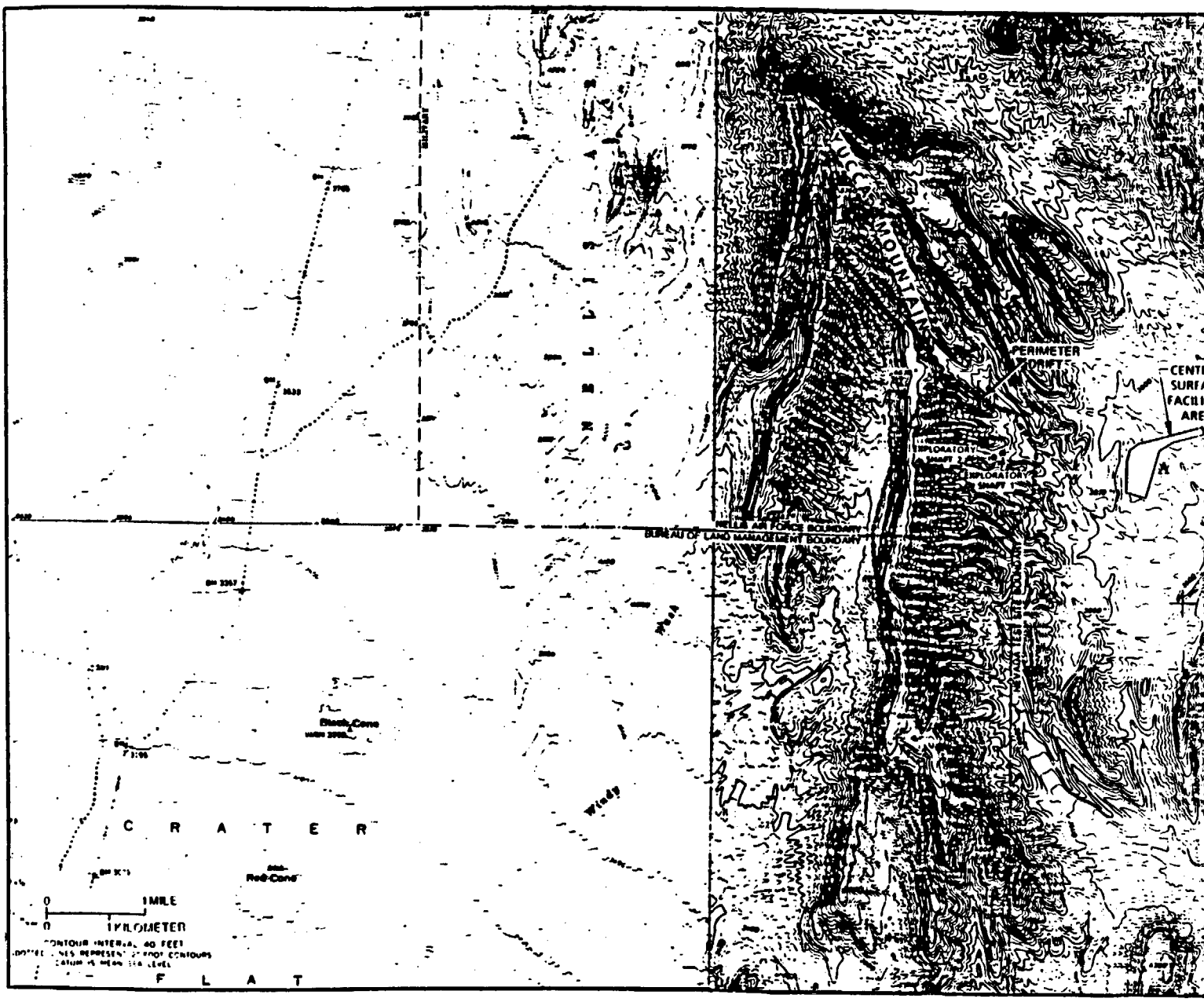
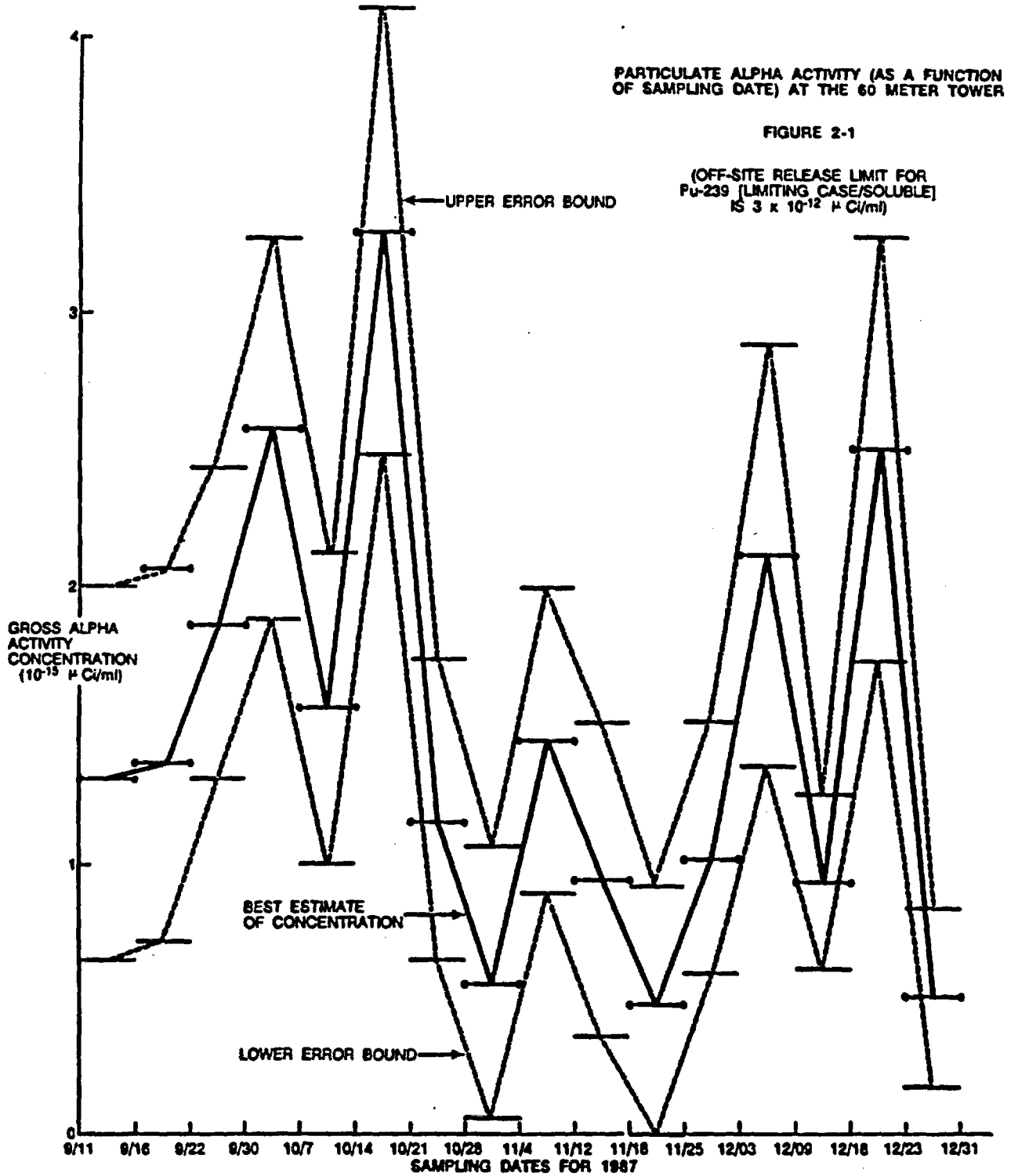


Figure 1-3. Yucca Mountain near-field topography


PARTICULATE ALPHA ACTIVITY (AS A FUNCTION OF SAMPLING DATE) AT THE 60 METER TOWER
FIGURE 2-1
(OFF-SITE RELEASE LIMIT FOR Pu-239 [LIMITING CASE/SOLUBLE] IS 3 x 10⁻¹² μ Ci/ml)
UPPER ERROR BOUND
BEST ESTIMATE OF CONCENTRATION
LOWER ERROR BOUND
GROSS ALPHA ACTIVITY CONCENTRATION (10⁻¹⁵ μ Ci/ml)
0
1
2
3
4
9/11
9/16
9/22
9/30
10/7
10/14
10/21
10/28
11/4
11/12
11/18
11/25
12/03
12/09
12/16
12/23
12/31
SAMPLING DATES FOR 1987

PARTICULATE BETA ACTIVITY (AS A FUNCTION OF SAMPLING DATE) AT THE 60 METER TOWER

FIGURE 2-2

(OFF-SITE RELEASE LIMIT FOR Sr-90 [LIMITING CASE/SOLUBLE] IS 3 x 10^{-12} μ Ci/ml)

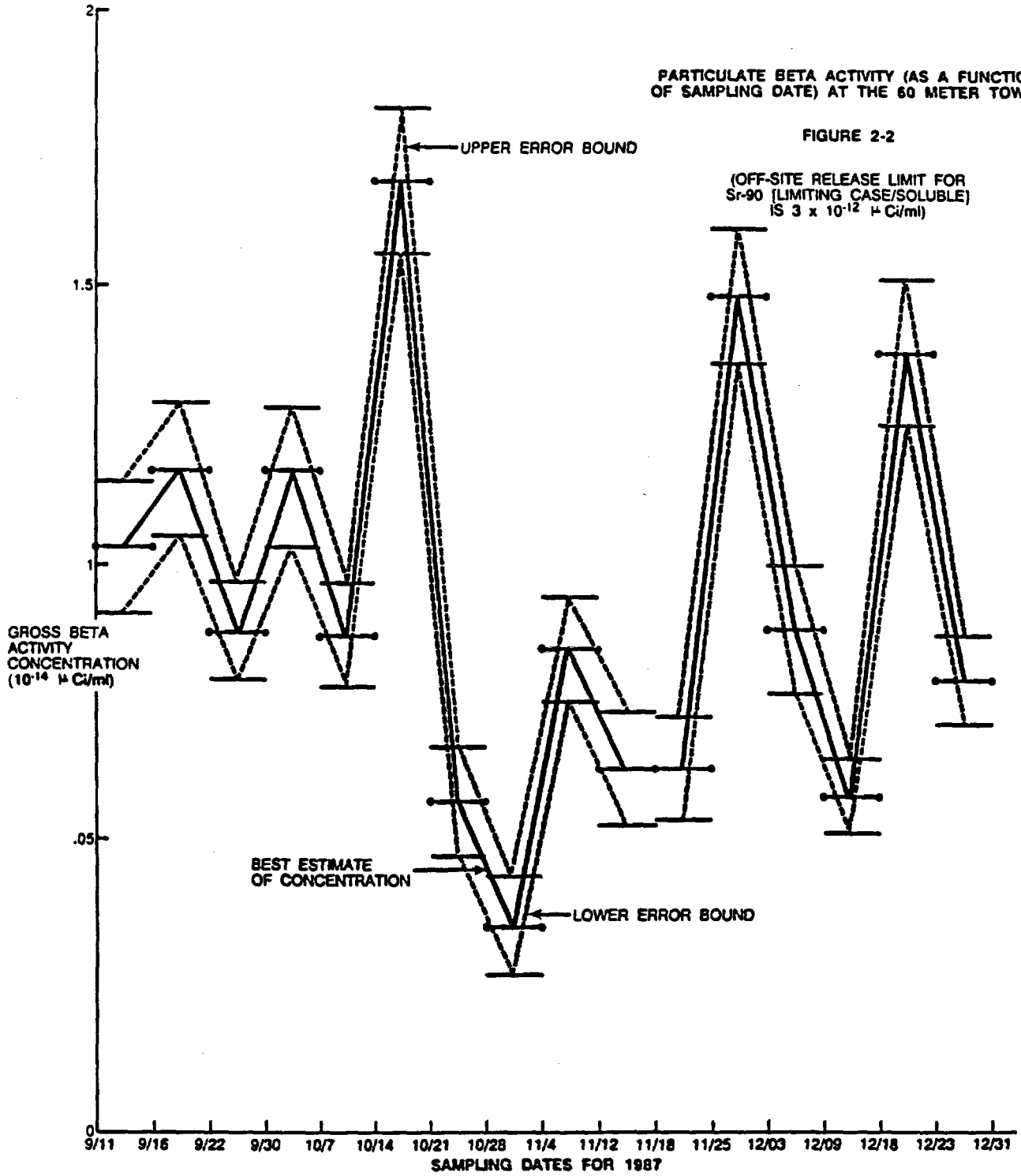


Table 2-1. Particulate and iodine gamma activity from continuous air monitor

Date (1987)	Activity (μCi/ml)[a,b]	
	Particulate	Iodine
9/11 to 9/16	MDA	MDA
9/16 to 9/22	$2.53 \pm 1.31 \times 10^{-13}$ Be-7[c]	MDA
9/22 to 12/31	MDA	MDA

[a]MDA means activity concentration is less than the minimum detectable activity.
[b]The statistical confidence level used to evaluate the uncertainty bounds is 95%.
[c]Naturally occurring radionuclide.

Table 2-2. Isotopic/radionuclide specific analyses of composite particulate filters (last quarter of 1987, September 11 to December 31)

Radionuclide	Analysis[a]	Concentration average over one quarter in $\mu Ci/ml^{b,c}$
Be-7	Gamma spectral analysis	$7.25 \pm .58 \times 10^{-14}$
Ra-226	Gamma spectral analysis	$4.7 \pm 2.4 \times 10^{-16}$
Other gamma emitters	Gamma spectral analysis	<MDA
Sr-90 and Sr-89	Wet chemistry	TBD
Th-230, Pu-238, Pu-239, Pu-240, Th-232	Wet chemistry/Alpha spectral analysis	TBD
Pu-241	Wet chemistry - beta counting	TBD
Uranium	Wet chemistry - counting	TBD
Tc-99	APD	
Po-210, Np-237, Am-241, Am-243, Cm-243, Cm-244	APD	TBD

[a]TBD means "to be determined" and indicates the analyses are ongoing. APD means the analysis process is in development.

[b]The statistical confidence level used to evaluate the uncertainty bound is 95%. MDA means minimum detectable activity.

[c]Naturally occurring radionuclide.

Table 2-3. Monthly integrating sampler results (September to October 1987)

Location		Radon concentration[a,b] (average) pCi/l
Number	Description	
1x	Coyote Wash - 10-meter tower (Exploratory Shaft Area)	0.8 ± 0.3
6x	60-meter tower	0.7 ± 0.2
7ax	Facility Area - North	0.4 ± 0.2
7bx	Facility Area - East	0.6 ± 0.2
7cx	Facility Area - South	1.2 ± 0.3
7dx	Facility Area - West	1.1 ± 0.3
QC spikes	Approximately 0.6 ± 0.2 pCi/l	1.1 ± 0.3, 1.8 ± 0.4, 2.3 ± 0.4, 1.5 ± 0.3, 1.7 ± 0.4, 2.6 ± 0.5
QC blanks	Approximately 0.0 pCi/l	1.1 ± 0.3, 1.7 ± 0.4

[a]The statistical confidence level used to evaluate the uncertainty bound is 95%.

[b]Uncertainties reflect counting statistics only and are not indicative of the uncertainty in the measurement. These uncertainty values are those provided by the vendor. Future reports will contain an evaluation of analytical uncertainty.

Table 2-4. Quarterly integrating sampler results (October to December 1987)

Location		Radon concentration[a,b] (average) pCi/l
Number	Description	
1x	Coyote Wash - 10-meter tower (Exploratory Shaft Area)	0.4 ± 0.1
6x	60-meter tower	0.5 ± 0.1
7ax	Facility Area - North	0.4 ± 0.1
7bx	Facility Area - East	0.4 ± 0.1
7cx	Facility Area - South	0.7 ± 0.2
7dx	Facility Area - West	0.4 ± 0.1
QC spikes	Approximately 27.3 ± 2.8 pCi/l	25.6 ± 2.2, 26.7 ± 2.3, 22.7 ± 2.1, 22.2 ± 2.1, 23.8 ± 2.1, 25.4 ± 2.2
QC blanks	Approximately zero	0.2 ± 0.1, 0.0, 0.0, 0.1 ± 0.1, 0.4 ± 0.1, 0.1 ± 0.1

[a]The statistical confidence level used to evaluate the uncertainty bound is 95%.

[b]Uncertainties reflect counting statistics only and are not indicative of the uncertainty in the measurement. These uncertainty values are those provided by the vendor. Future reports will contain an evaluation of analytical uncertainity.

3.0 Comparison of Effluents with Respect to Applicable Standards

Based on the data in Section 2.1.1, it is clear that the airborne radioactive material from the site is below the NRC, DOE, and EPA offsite standards. It is projected that the offsite dose from all NNWSI Project activities will be well below 1 mrem/year to the maximally-exposed member of the public and, in fact, the activity concentration in the area is essentially independent of NNWSI Project activity, which is minimal.

The radon data indicate that the ambient radon concentration is very low. There are no applicable standards for emanation of radon to the atmosphere from geological formations.

There are currently no liquid effluent release data. However, all water returned to the environment after being pumped from the groundwater system will be screened for tritium activity in excess of applicable release limits. Tritium is the best indicator of any contamination intrusion into the groundwater system at the NTS. The concentration of tritium in the groundwater screening performed on a limited number of NNWSI Project water samples is below drinking water limits established by the EPA and probably below the detection capability of the method used in the screening analysis (Section 2.2).

4.0 References

DOE (U.S. Department of Energy), 1986. "Environmental Assessment for Yucca Mountain Site, Nevada Research and Development Area, Nevada," DOE/RW-0073, three volumes, Washington, D.C.

DOE (U.S. Department of Energy), 1988. "Consultation Draft Site Characterization Plan for Yucca Mountain Site, Nevada Research and Development Area, Nevada," DOE/RW-0160, six volumes, OCRWM, Washington, D.C.

NWPA (Nuclear Waste Policy Act), 1983. "Nuclear Waste Policy Act of 1982," Public Law 97-425, 42 USC 10101-10226, Washington, D.C.

SAIC (Science Applications International Corporation), 1985. "Meteorological Monitoring Plan for Site Characterization," DOE/NV-10270-5, SAIC-84/7600.

SAIC (Science Applications International Corporation), 1987. "Preliminary Site Characterization Radiological Monitoring Plan for the NNWSI Project Yucca Mountain Site," DOE/NV/10270-14, SAIC-86/8007.

SAIC (Science Applications International Corporation), 1988. "Radiological Monitoring Plan for the NNWSI Project," DOE/NV-10576-6, SAIC-87/8000 (controlled document).

APPENDIX A

EXECUTIVE SUMMARY FOR THE RADIOLOGICAL MONITORING PLAN

The Radiological Monitoring Plan (RMP) provides a detailed description of the radiological monitoring activities to be performed during site characterization of the Yucca Mountain site in southern Nevada. Radiological monitoring activities for all Nevada Nuclear Waste Storage Investigations (NNWSI) Project phases through site closure will be detailed in subsequent revisions of the document (six revisions are currently planned).

The RMP is the controlling document for the implementation of the Technical and Management Support Services (T&MSS) Contractor's radiological monitoring activities in support of the NNWSI Project. The document replaces the Preliminary Site Characterization Radiological Monitoring Plan (PSCRMP), which addressed a few aspects of those radiological monitoring activities requiring early implementation. The RMP describes the collection of required radiological data identified in the Radiological Compliance Guide (RCG), Site Characterization Plan (SCP), (DOE, 1986b), Environmental Program Plan (EPP), and other Project documents. Procedures are issued as part of a controlled procedure manual, which is maintained in an updated, audited form by each user. The RMP complies with the requirements of the Waste Management Project Office (WMPO) Quality Assurance Program Plan (QAPP) and supporting documents, including NNWSI Project and T&MSS administrative procedures.

THE RADIOLOGICAL MONITORING PROGRAM

The RMP (Rev. 0) represents a blueprint for the radiological monitoring program during the site characterization phase. The proposed monitoring program (as detailed in Section 4 of the RMP) will collect environmental radiological information to establish existing radiological conditions and satisfy eight basic objectives:

Characterization of the worksite environment. This element will involve determining the existing radioactivity concentrations in the background environment at the site and the potential radon emission from the site. These activities are underway as described in the PSCRMP.

Characterization of the radiological impact of Nevada Test Site (NTS) activities on the repository site. This element will involve determination of ambient airborne radionuclide concentrations in the Yucca Mountain area, evaluation of radioactivity concentrations in the groundwater, performance of soil and driftwall sampling in surface and underground work areas, biota sampling, and surface and sedimentation analyses of the Fortymile Canyon/Wash ephemeral stream.

Facility design and preparation of the Safety Analysis Report. This element will require ambient radiation data, radon exposure data, and soil and driftwall sampling data. Results from evaluation of these data will be used in the design of the facility's ventilation system, airborne radioactivity monitoring systems, and safety analysis activities.

Monitoring of site characterization impacts. This element will include soil sampling, water sampling, and radon monitoring.

Verification of the feasibility of monitoring the environment for appropriate radionuclides. This element will involve quantification of existing conditions at the site using various environmental samples and an indicator species. An indicator species is an animal which can be used to indicate the presence or absence of unsuspected sources of radioactivity (release pathways).

Planning of facility decontamination and decommissioning. This element will involve soil, biota, and water sampling. Archiving of these samples in the Sample Management Facility will be required.

Verification of compliance with DOE Orders and NTS requirements during site characterization. The program will monitor water samples for tritium. Soil columns will not be used to remove radioactive material from liquids. Groundwater characteristics will be verified as safe before release of any such water to the surface-water system.

Preparation of the Environmental Impact Statement (EIS). Specific data and collection activities for the EIS will be identified during the EIS scoping process. Data collected for site characterization activities will also be used to supplement the data collected specifically for the EIS radiological baseline.

The radiological monitoring program will evaluate various ways in which an individual can be exposed to radioactivity (exposure pathways to man): direct exposure to radiation, inhalation of resuspended (or airborne) radioactive particulates, worker and equipment contamination, and indirect pathways (such as ingestion of contaminated foodstuffs or fauna). The program will gather environmental radiological data to satisfy these evaluation needs as well as many others. Approximately six years are needed to establish an environmental data base (barring unplanned releases at the NTS). Characterization of the radon baseline requires much less time: two years of data collection are desirable, but only one year of data may be collected because of Project schedule constraints.

The radiological monitoring program's sampling activities are directed toward monitoring release pathways and the exposure pathways to man in two areas: a circular area measuring 168-kilometers across and centered on Yucca Mountain (the program sampling area), and the City of Las Vegas. This arrangement meets all regulations and requirements for model pathways. There are five basic types of sampling described in the RMP: airborne monitoring, water sampling, soil and drift surface sampling, biota sampling, and ambient radiation monitoring.

Airborne monitoring. Airborne monitoring is the foundation of the radiological monitoring program activities and involves the monitoring of radioactive particulates, radioiodine, tritium, and inert gases. These four categories account for most of the radioactive materials released from any site. C-14 (CO_2) will also be monitored. Air sampling will be conducted to evaluate potential doses to offsite inhabitants from inhaled radionuclides, direct radiation, or ingestion of contaminants. Both far-field (beyond a

15-kilometer radius of the site) and near-field (within a 15-kilometer radius of the site) air samplers will be used. Radon/radon daughter product sampling activities will be restricted to the near-field area. Only seven new far-field stations are being added to the current NTS network; data from existing U.S. Environmental Protection Agency (EPA) stations will be used, and NNWSI Project stations will be installed at some existing Reynolds Electrical and Engineering Co. (REECo) air sampler locations. Data from the REECo air monitoring program will also be available.

Particulate sample analyses will be performed by the EPA Nuclear Radiation Assessment Division (NRAD) Laboratory. For tritium and inert-gas (non-radon) sampling, equipment both currently in use and being evaluated by the NRAD will be used by the radiological monitoring program. The tritium and inert-gas samples will also be analyzed by the NRAD Laboratory. Radon monitoring will involve the use of time-integrating samplers supplemented by continuous radon monitors. The radon monitoring network is intended to establish a baseline and measure the future changes in the radon levels near the exploratory shaft. Underground air in the main drifts and near the working face will be sampled for radon and its daughter products. The monitoring of C-14 will be based on the C-14 content in flora.

Water sampling. In general, the principal exposure pathways from waterborne radionuclides to individuals are ingestion of drinking water and consumption of aquatic species or irrigated crops. Potential water pathways at Yucca Mountain include ephemeral streams, catch basins, groundwater, airborne deposition to the Amargosa River or streams, and reservoirs or ponds supplied from groundwater sources.

Surface-water samples will be collected routinely at a representative unaffected control location to provide background data for comparison with data from affected locations. Ephemeral stream samples will be collected at four stations located in Fortymile Wash just east of Yucca Mountain. Water sampling will rely to a large extent on existing EPA water samplers and locations. A representative sampling of water from catch basins within the near-field will be made, and sediment samples will be taken at all surface-water and ephemeral stream locations.

Grab samples of drinking water will be collected from nearby communities. Lake Mead water will be included in this activity and is currently being sampled by the NRAD. EPA water sampling data available for several sampling locations will be also be used.

Monitoring of groundwater will be conducted near the proposed repository facility and in areas downgradient from other facilities or activities. To facilitate the assessment of potential sources of radionuclides, at least two wells will be selected for evaluation. Where available, existing NNWSI Project and NTS wells and planned NNWSI Project wells will be used. Water samples will be obtained (if possible) from U.S. Geological Survey (USGS) or other test wells in the near-field area as they become available. Most of the near-field samples will be archived.

Surface-water samples will be taken from beneath the water surface to avoid floating debris, while ephemeral streams will be sampled by installing a large-volume passive container in the stream bed. Sediment samples from

surface-water sampling locations will be usually be collected using hand-held equipment or a core sampler.

Water typically will be sampled annually. Sediment samples also will be taken annually, following the first significant waterflow in the spring. Ephemeral stream sampling will be conducted each time a significant waterflow occurs in the stream being evaluated.

Soil and drift surface sampling. Soil sampling will be used to assess deposition of radionuclides from site activities, evaluate the long-term accumulation trends of radionuclides, and estimate environmental radionuclide inventories. Soil samples will be collected at air sampling locations, and a set of representative samples will be taken throughout the indicator species sampling area. The latter will allow characterization of the conditions to which the indicator species is exposed. Representative soil samples will be taken from all environmental sampling locations and areas where major activities are planned. These samples will be archived for possible use in future evaluations or activities. An annual sampling frequency is planned to assess long-term trends.

Driftwall samples are directed towards characterizing natural radon emissions. During underground mining and operation, driftwall sampling will be used to characterize the uranium and thorium sources which produce the radon/radon daughter products emanating from the mine.

Biota sampling. Biota sampling involves sampling of milk, crops, game, and animal produce from livestock. These samples provide the most direct means for assessing the radiation dose to man from ingestion of contaminants (the food pathways to man). Many details of the biota sampling activities cannot be presented until a detailed survey is conducted of the agricultural and cultural activities within the program sampling area. This information will be collected over the next two years. For now, the biota samples collected in the program will include the indicator species and items representing both direct and indirect pathways to man.

Direct pathways to man are represented by food items. Sampling may include milk, crops intended for human consumption, beef, poultry, and eggs. Milk sampling of all dairy cattle herds in the sampling area is already performed by the NRAD for the NTS. Data from the NRAD program should be sufficient for the radiological monitoring program. To monitor iodine-129, cattle thyroids will be collected each fall when grazing activities end. Crop samples will include those produced for human consumption as well as for livestock feed. Meat, poultry, and egg samples may be obtained from commercial producers and local family farms. Domestic animal produce will be sampled annually at the time of the slaughter or harvest. Poultry and eggs may be sampled quarterly. Field surveys of game bird species will be conducted quarterly.

Indirect pathways to man include cattle and deer forage. Native cattle forage samples will be taken from eight locations established on lands where cattle are grazed within the program sampling area. Three forage species will be chosen for monitoring. Three samples from each species will be collected at each location. A total of 72 samples will be collected over a two-year period. Cattle forage sampling will not be initiated before 1989.

The food habits of mule deer will be studied by analyzing scat samples collected from Yucca Mountain. Results will determine which deer forage species should be collected for analysis. Three forage species will be chosen for monitoring. Three samples from each species will be collected at twenty designated sampling locations. All twenty locations will be sampled at least twice during the site characterization phase.

Indicator species assist in detecting inadvertent releases of radioactivity and in monitoring any long-term radionuclide accumulation in the local environment. Small mammals (mice and rats) will be used by the radiological monitoring program as indicators of radionuclide concentrations in the biosphere. Merriam's kangaroo rat and the long-tailed pocket mouse are the designated indicator species for the program because they are typically the two most abundant and ubiquitous small mammal species on Yucca Mountain. Eight small mammal monitoring locations will be established in the vicinity of Yucca Mountain. At each location, trap lines will be arranged. The trap lines will be operated four times a year. Samples for radioanalysis will be collected two of the four times. The other two times, animals will only be marked. Lagomorphs (rabbits) were not included as an integral part of the radiological monitoring program because of their relative rarity on Yucca Mountain; however, systematic transect surveys will be conducted semiannually to collect data which will enable the program to determine when population densities are sufficient to permit sampling. To evaluate the feasibility of incorporating predators (coyotes, bobcats, etc.) into the program, scent-station surveys assessing the presence, relative abundance, and general distribution of predators will be performed four times a year.

Ambient radiation monitoring. Ambient radiation monitoring involves the monitoring of external radiation exposures. The radiological monitoring program will use integrating dosimeters, specifically thermoluminescent dosimeters (TLDs), to monitor any incremental changes in external radiation doses to key population groups in the program sampling area. The dosimeters will be placed at all environmental sampling stations. In addition to these locations, other TLD locations have been added to provide an accurate representation of current site conditions. Where TLDs are used, at least three will be provided for each location to permit averaging of the data and detection of faulty dosimeters. Quarterly exchange periods are planned. Various exposure rate instruments will also be used for continuous monitoring of the exposure rate as a function of time. An Aerial Measurements System (AMS) aerial survey is also being arranged for the Yucca Mountain area. An AMS survey provides detailed data analysis of gamma radiation levels in and around nuclear facilities. The AMS is operated for the DOE by EG&G, Inc. In situ gamma spectral analyses at most sampling locations will also be included as part of the ambient radiation monitoring of the radiological monitoring program. Current data from the NTS public monitoring program will also be available for the ambient radiation monitoring activity.

Other aspects of the radiological monitoring program's monitoring and data-gathering activities--the rules and regulations involved in their development; the assessment methodologies used to understand and categorize their data; the quality assurance procedures followed to ensure their accuracy and validity--are detailed in other sections of the RMP.

The primary participants in the radiological monitoring program will be the DOE Nevada Operations Office (DOE/NV) Waste Management Project Office (WMPO), the EPA NRAD, and the T&MSS Contractor (Science Applications International Corporation). Other involved groups will include the DOE/NV Health Physics and Environmental Division, EG&G/Energy Measurements (Santa Barbara Operations), the EPA Office of Radiation Programs, REECo, DOE/NV, and the State of Nevada. All activities in the program will have the approval of the WMPO and the concurrence of the DOE/NV.

ORGANIZATION OF THE RADIOLOGICAL MONITORING PLAN

The RMP has eight major parts and eleven appendices. Section 1 provides introductory remarks and establishes the framework of the document. Section 2 provides a general discussion of the regulatory and control framework for the document. Section 3 provides a detailed discussion of the technical requirements and guidance mandating completion of the radiological monitoring activities discussed in the document. The manner in which the document implements data collection in support of issue resolution for the issues hierarchy as discussed in the SCP and the EPP is also addressed in Section 3. Section 4 provides details of the radiological monitoring activities and the activities related to the requirements in Section 3. Section 5 sets forth the radiological analytical techniques used in collection of data for resolution of the issues in the issues hierarchy. Section 5 also addresses how these techniques fit within the regulatory framework described in Sections 2 and 3. Section 6 identifies non-monitoring data required to support resolution of the issues and discusses how these data will be collected. Section 7 addresses quality assurance, and Sections 8 and 9 address administrative concerns and their resolution within the program. Appendix A provides a description of NNWSI Project activities. Appendices B through G provide supplementary technical data, with Appendix E containing a tabular summary of the environmental monitoring program. Appendix H describes other plans which provide data to this program. Appendix I contains a listing of acronyms and abbreviations. Appendix J contains a glossary for the text, and Appendix K lists any changes made in the field monitoring activities.

Science Applications International Corporation

L89-ADM-NEC-009
WBS # 1.2.5.4.5
QA

March 1, 1989

Carl P. Gertz, Project Manager
Yucca Mountain Project Office
U.S. Department of Energy
Nevada Operations Office
P.O. Box 98518
Las Vegas, NV 89193-8518

Subject: Contract #DE-AC08-87NV10576
Environmental Monitoring Program Summary for 1987

Dear Mr. Gertz:

Enclosed is the subject document, which has been previously approved for distribution by the Project Office. If you have any questions regarding this document or need further information, please contact Steve Woolfolk of my staff at extension 7804.

Sincerely,

SCIENCE APPLICATIONS
INTERNATIONAL CORPORATION

for Neal E. Carter
Acting Project Manager

NEC:DAF:mlh

Enclosure:
As stated

NNA 3140756 4pp.

101 Convention Center Dr., Ste. 407, Las Vegas, NV 89109 (702) 295-1204

cc w/encl:
E. Baynard, HQ (EH-1) FORS (3 copies)
R. Stein, HQ (RW-30) FORS
G. Parker, HQ (RW-333) FORS
S. Franks, EH, NV
B. Church, ESH, NV
D. Vieth, EPD, NV
P. Fitzsimmons, HPDWD, NV
C. Gertz, YMP, NV
E. Wilmot, YMP, NV
W. Dixon, YMP, NV
M. Blanchard, YMP, NV
J. Blaylock, YMP, NV
L. Skousen, YMP, NV
R. Kaiser, YMP, NV
M. Powell, YMP, NV (10 copies)
D. Livingston, YMP, NV
L. O'Neal, HPDWD,NV
F. Bingham, EPD, NV
C. West, OEA, NV (10 copies)
V. Witherill, NTSO, NV
R. Friedrichs, EPD, NV
M. Marelli, HPDWD, NV
J. Linehan, NRC, Washington, D.C. (3 copies)
P. Prestholt, NRC, Las Vegas, NV
N. Carter, SAIC, Las Vegas, NV
W. Macnabb, SAIC, Las Vegas, NV
M. Foley, SAIC, Las Vegas, NV
M. Voegele, SAIC, Las Vegas, NV
J. Shaler, SAIC, Las Vegas, NV
S. Klein, SAIC, Las Vegas, NV
J. Younker, SAIC, Las Vegas, NV
P. Mudra, SAIC, Las Vegas, NV
M. Glora, SAIC, Las Vegas, NV
S. Volek, SAIC, Las Vegas, NV (20 copies)
D. Dawson, SAIC, Las Vegas, NV
C. Pflum, SAIC, Las Vegas, NV
M. Brown, SAIC, Las Vegas, NV
S. Woolfolk, SAIC, Las Vegas, NV (10 copies)
J. Prince, SAIC, Las Vegas, NV (2 copies)
A. Colarusso, SAIC, Las Vegas, NV
G. Daer, SAIC, Las Vegas, NV
A. Kirk, SAIC, Las Vegas, NV
S. Lee, SAIC, Las Vegas, NV

cc w/encl (cont'd):
C. Tung, SAIC, Las Vegas, NV
W. Collucci, SAIC, Las Vegas, NV
D. Witham, SAIC, Las Vegas, NV
M. Jablonski, SAIC, Las Vegas, NV
M. Dussman, SAIC, Las Vegas, NV
M. Harris, SAIC, Las Vegas, NV
W. Jacobs, SAIC, Las Vegas, NV
S. Phillips, SAIC, Las Vegas, NV
E. Ripley, SAIC, Las Vegas, NV
J. Therien, SAIC, Las Vegas, NV
R. Kettel, SAIC, Las Vegas, NV
E. McCann, SAIC, Las Vegas, NV
J. Newby, SAIC, Las Vegas, NV
J. Tappen, Westinghouse, Las Vegas, NV
C. Costa, EPA/NRAD, Las Vegas, NV
S. Black, EPA/NRAD, Las Vegas, NV
K. Del Giorgio, EPA/NRAD, Las Vegas, NV
C. Lui, EPA/NRAD, Las Vegas, NV
D. Thome', EPA/NRAD, Las Vegas, NV
N. Sunderland, EPA/NRAD, Las Vegas, NV
L. Smith, EPA/NRAD, Las Vegas, NV
F. Grossman, EPA/NRAD, Las Vegas, NV
A. Jarvis, EPA/NRAD, Las Vegas, NV
J. Akridge, EPA/NRAD, Las Vegas, NV
R. Holloway, EPA/NRAD, Las Vegas, NV
S. Faller, EPA/NRAD, Las Vegas, NV
J. Moore, EPA/NRAD, Las Vegas, NV
W. Bliss, EPA/ORP, Las Vegas, NV
R. Hopper, EPA/ORP, Las Vegas, NV
C. Wills, EG&G/EM, Las Vegas, NV
L. Pippin, DRI, Reno, NV
T. Hunter, SNL, 6310, Albuquerque, NM
R. Sandoval, SNL, 6316, Albuquerque, NM
A. Stevens, SNL, 6311, Albuquerque, NM
L. Ballou, LLNL, Livermore, CA
D. Oakley, LANL, Los Alamos, NM
L. Hayes, USGS, Denver, CO
B. Smith, REECo, Las Vegas, NV
C. Rosenberry, REECo, Las Vegas, NV
I. Wells, REECo, Las Vegas, NV
D. Brown, U.S. Fish and Wildlife Service, Las Vegas, NV
C. Meyer, USAF, DOE, NV
R. Wycoff, BLM, Las Vegas, NV
K. Rinaldi, USDA/Forest Service, Las Vegas, NV
R. Loux, NWPO, Carson City, NV (5 copies)

cc w/encl (cont'd):
S. Marshall, NSDH, Carson City, NV
Comm. J. Garcia Jr., Nye County, NV
Comm. P. Christensen, Clark County, NV
Comm. K. Whipple, Lincoln County, NV
Comm. H. Dahlstrom, Esmeralda County, NV
G. Sawyer, Nevada Commission on Nuclear Projects, Carson City, NV
T. Hickey, Nevada Committee on High Level Waste, Carson City, NV
R. Lurie, Mayor, Las Vegas, NV
J. Seastrand, Mayor, North Las Vegas, NV
L. Kesterson, Mayor, Henderson, NV
S. Bradhurst, Local Government Advisory Group, Tonopah, NV
M. Baughman, Local Government Advisory Group, Carson City, NV
D. Bayer, Local Government Advisory Group, Carson City, NV
D. Bechtel, Local Government Advisory Group, Las Vegas, NV
P. Cummings, Local Government Advisory Group, Las Vegas, NV
J. Finney, Local Government Advisory Group, Henderson, NV
J. Kinnee, Local Government Advisory Group, North Las Vegas, NV
O. Ravenholt, Clark County Health Department, Las Vegas, NV
R. Christensen, Nye County Health Department, Tonopah, NV
J. Wilkin, Lincoln County Health Department, Pioche, NV
E. Reed, Esmeralda County Health Department, Goldfield, NV
R. McNellis, Environmental Research Council, UNLV, Las Vegas, NV
(2 copies)
K. Bright, Chairman, Inyo County Supervisors, Independence, CA
J. Eton, Inyo County Health Department, Independence, CA

NNWSI/88-12
SAIC-88/8010

Nevada Nuclear Waste Storage Investigations Project
Environmental Monitoring Program Summary For 1987

May 1988

This report addresses the information requirements
specified in Department of Energy Order 5484.1,
"Environment Protection, Safety, and Health Protection Information Reporting"
(February 24, 1981)

This document was prepared by:

The Radiological Field Programs Branch of the Technical and Management Support Services (T&MSS) Contractor (SAIC) to the DOE NNWSI Project with support from:

S. Woolfolk	SAIC/T&MSS
J. Prince	SAIC/T&MSS
G. Daer	SAIC/T&MSS
A. Colarusso	SAIC/T&MSS
C. Costa	U.S. EPA/NRAD
S. Black	U.S. EPA/NRAD
C. Liu	U.S. EPA/NRAD
D. Thome	U.S. EPA/NRAD
N. Sunderland	U.S. EPA/NRAD
L. Smith	U.S. EPA/NRAD
F. Grossman	U.S. EPA/NRAD
A. Jarvis	U.S. EPA/NRAD
and technical editing by	
C. Weiss	SAIC/T&MSS

as part of DOE Contract Number DE-AC08-87NV10576.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

NNWSI PROJECT ENVIRONMENTAL MONITORING PROGRAM SUMMARY FOR 1987

1.0 Introduction

This document provides a summary of the calendar year 1987 radiological environmental monitoring activities conducted by the Nevada Nuclear Waste Storage Investigations (NNWSI) Project in the Yucca Mountain area. Current NNWSI Project activities include meteorological and radiological monitoring activities. Other monitoring activities and expansion of existing monitoring activities are scheduled to begin in FY 88 or FY 89.

1.1 Location

The NNWSI Project site is located in southwestern Nevada on land in the Yucca Mountain area. While the size of the site is still under evaluation, the area of intensive study is shown in Figure 1-1. The site is located about 26 km north of the town of Amargosa Valley (formerly Lathrop Wells).

1.2 Work Performed

The U.S. Department of Energy (DOE) is responsible for developing the Nation's first geologic repository for permanent disposal of high-level radioactive waste and spent nuclear fuel. The Nuclear Waste Policy Act (NWPA) of 1982 specifies the process for selecting a repository site and assigns primary responsibility for site selection and repository design, construction, and operation to the DOE. Following the step-by-step process set forth in the original NWPA, the Secretary of Energy recommended three sites for extensive study ("site characterization"). On May 28, 1986, the President approved the Secretary's recommendations, establishing Yucca Mountain, Nevada, as one of three sites to be characterized. In December 1987, Congress amended the NWPA to specify that Yucca Mountain would be studied to determine whether it meets stringent standards for isolating radionuclides. All site-specific activities at the other two sites were discontinued at that time.

The NNWSI Project is guided by the DOE's Office of Civilian Radioactive Waste Management (OCRWM) and is managed locally by DOE's Nevada Operations Office (DOE/NV). The Project Office and support contractors are conducting earth science and environmental studies of Yucca Mountain during site characterization (DOE, 1988) as well as studying potential effects of the Project on the region near the site. This site characterization phase is scheduled to continue through the early 1990's. When testing is complete and if the site is found suitable, the Secretary will seek Presidential approval to submit an application to construct a repository to the Nuclear Regulatory Commission (NRC). The NRC then will decide whether the proposed site meets strict Federal regulations that prohibit a repository from posing a threat to the environment. If the NRC approves, repository construction can begin.

A very limited number of activities associated with the site characterization program are being performed at this time. The current NNWSI Project environmental monitoring activities are described in the Meteorological Monitoring Plan (SAIC, 1985) and the Preliminary Site Characterization Radiological Monitoring Plan (PSCRMP) (SAIC, 1987), and include, since late

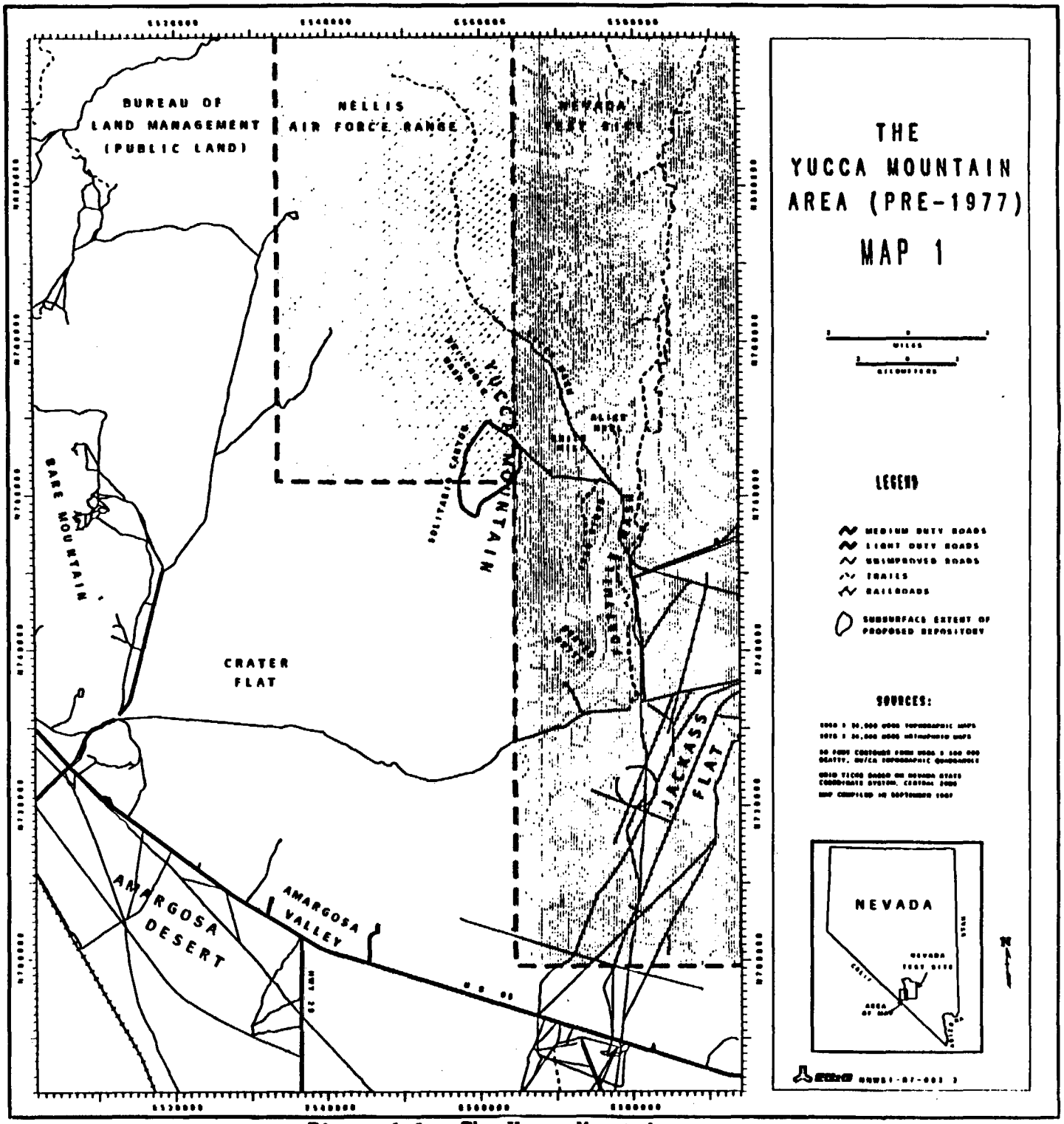


Figure 1-1. The Yucca Mountain area

March 1988, screening of water pumped from the site for tritium before disposal. The continuous radon monitoring activities discussed in the PSCRMP are still in the implementation phase. It should be noted that the PSCRMP will be replaced by the Radiological Monitoring Plan (RMP) (SAIC, 1988), which specifies the full scope of monitoring activities for the NNWSI Project (Appendix A). The RMP is planned for release in late April or early May of 1988. The NNWSI Project publishes meteorological monitoring data in quarterly and annual reports; consequently, meteorological data are not included in this report.

The radiological monitoring activities currently consist of one continuous air sampler located near the 60-meter meteorological tower (Figure 1-2), seven passive integrating radon samplers located in the Facility Area (Figure 1-2), and one passive integrating radon sampler attached to the 10-meter meteorological tower in Coyote Wash.

1.3 Environmental Setting

The NNWSI Project site at Yucca Mountain is located in southwestern Nevada, approximately 26 km north of the town of Amargosa Valley (formerly Lathrop Wells). The site, part of which includes the southeastern corner of the Nevada Test Site (NTS), is located exclusively within lands controlled by the Federal Government. Yucca Mountain lies within the Basin and Range physiographic province, a broad area of generally linear mountain ranges and intervening valleys. Figure 1-3 depicts the topography of the area in the immediate vicinity of Yucca Mountain. The climate of the area is identified with strong solar insolation, limited precipitation, low relative humidity, and large diurnal temperature ranges. Temperatures vary from highs of approximately 36°C during the summer to lows of approximately 2°C during the winter. Annual precipitation is typically 145 mm in the area. Winds from the south account for a high percentage of the summer seasonal flow. On a diurnal basis, flow from the south predominates in the summer daytime hours, while northwest and northwesterly winds dominate nighttime hours. Winter wind distributions are dominated by the northwest and north-northwesterly flows. Southerly winds during the winter are greatly reduced from those that are observed during the summer.

Land use in the region includes agriculture, mining, recreation, and private and commercial development, all on a very limited basis. The Amargosa Valley and Pahrump Valley are the primary areas of agricultural significance. All agricultural production presently is beyond 24 km of the Yucca Mountain site. Land use information is summarized in the Yucca Mountain Environmental Assessment (EA) (DOE, 1986).

1.4 Related Reports

The NTS environmental monitoring reports published by Reynolds Electrical and Engineering Co. (REECo) and by the Nuclear Radiation Assessment Division (NRAD) of the U.S. Environmental Protection Agency (EPA) also contain data relating to the NNWSI Project area.

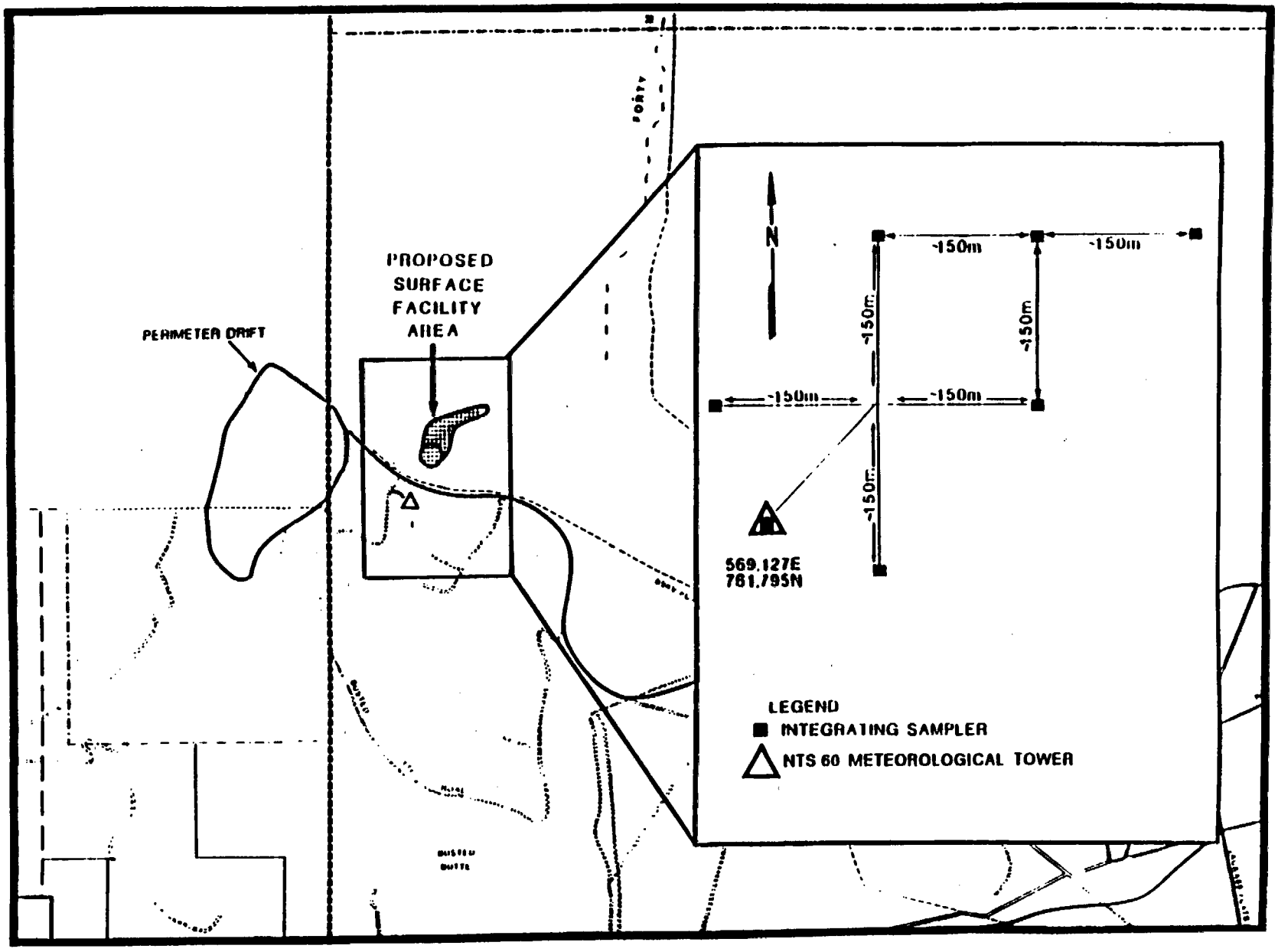


Figure 1-2. PSCRMP sampling locations

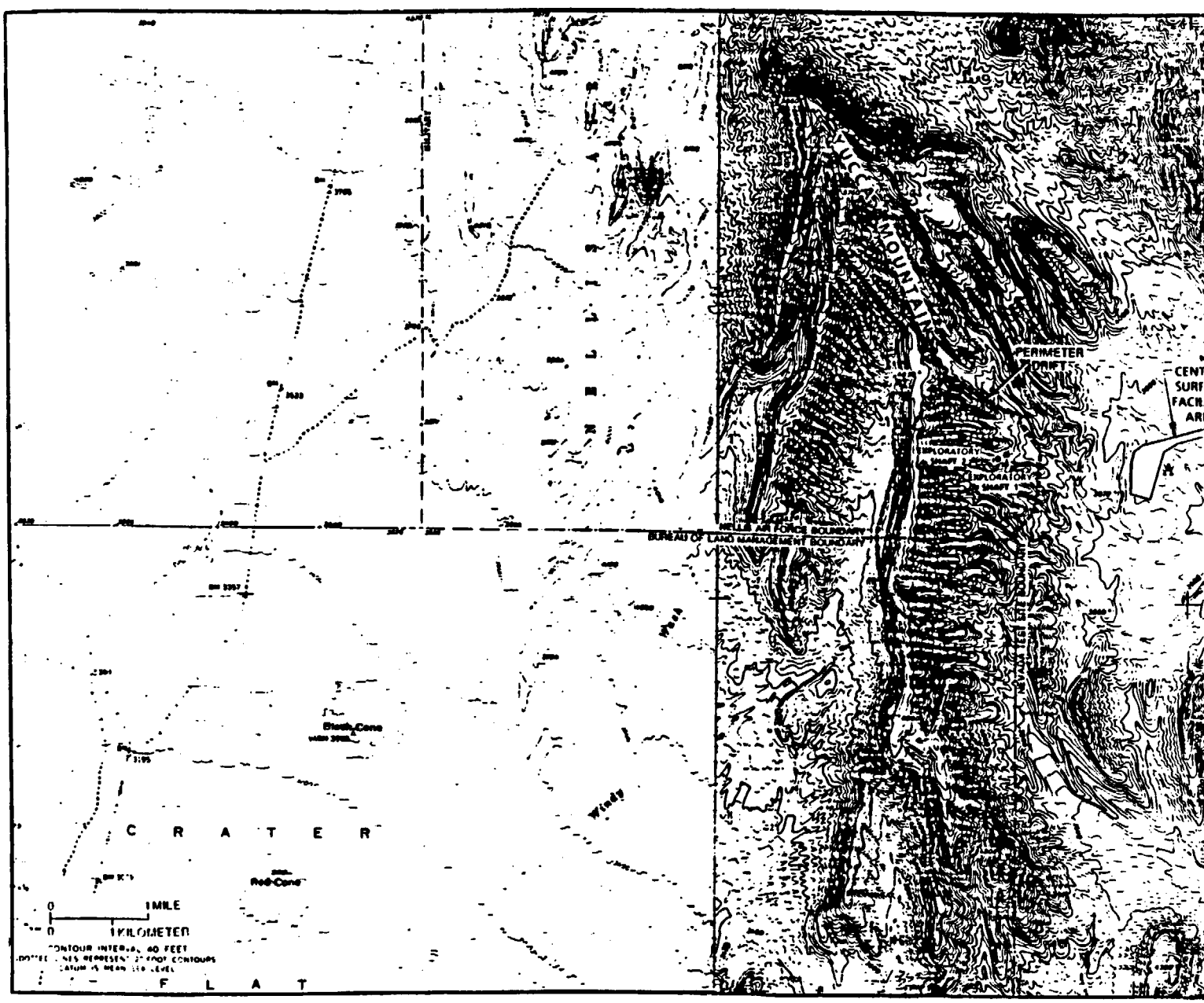


Figure 1-3. Yucca Mountain near-field topography

2.0 Pollutants Released in Effluents

There is currently little or no activity on the NNWSI Project site. Ambient emissions are presently zero with the exception of the resuspension of existing material by casual traffic. The data collected as part of the PSCRMP program address ambient airborne activity prior to initiation of significant site characterization activity. In addition, the data on the release of liquids pumped from wells in the area are also addressed.

2.1 Air

The air monitoring consists of two major activities: particulate and iodine monitoring using a continuous air monitor, and radon monitoring using passive integrating radon samplers (Track Etch™ detectors).

2.1.1 Continuous air monitor results

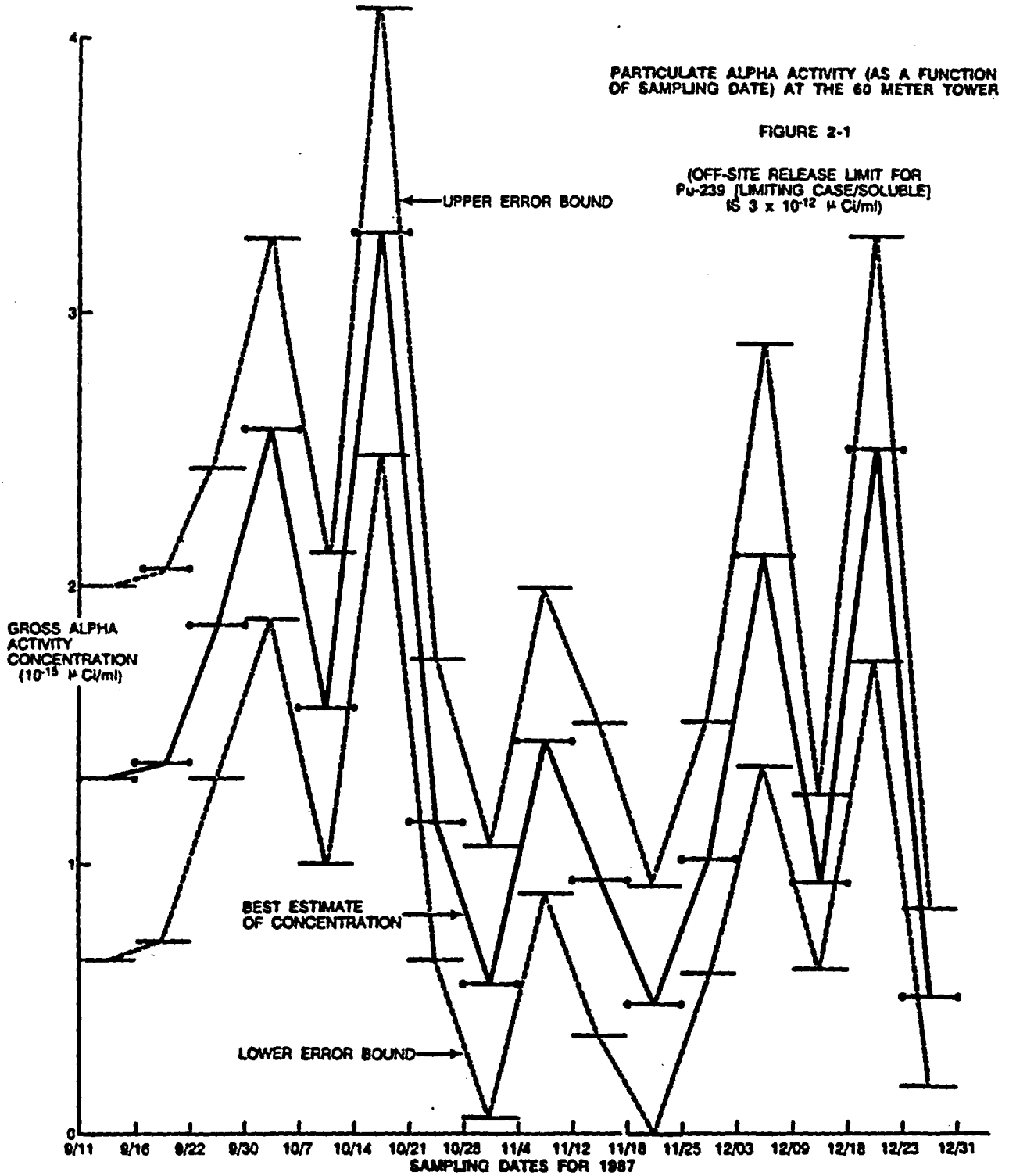
Upon receipt, the weekly particulate samples were analyzed for alpha, beta, and gamma activity and the charcoal cartridges for gamma activity. The gross alpha count results and the gross beta count results are shown in Figure 2-1 and Figure 2-2, respectively. The results of the gamma spectrum analyses for the particulate filter and charcoal cartridges are summarized in Table 2-1. Finally, the isotopic/radionuclide analyses of the composite of all particulate filters from September 11, 1987, to December 31, 1987, are summarized in Table 2-2.

2.1.2 Integrating sampler (IS) results

The results of the IS analyses for the period from September 9, 1987, to October 4, 1987, are summarized in Table 2-3. Based on these results, it was determined that the sampling period would be increased from monthly to quarterly to provide more accurate data. The QC data indicated that accurate measurement at ambient levels requires a larger integrated exposure, so the period was extended. The results from October 4, 1987, to January 5, 1988, are shown in Table 2-4. Based on the data in Table 2-4, radon concentration in the areas monitored ranged from about 0.4 to 0.7 picocuries per liter. Since only one quarter of data is available, no significant conclusions can be reached at this time.

2.2 Liquid

The projected liquid releases from NNWSI Project activities are from groundwater pumped to the surface as a result of groundwater monitoring activities. Since screening of the activity was not initiated until March 1988, no specific data are available for the 1987 calendar year. However, the tritium level in the water from two wells sampled since the screening was initiated in calendar year 1988 has been less than 8×10^{-7} microcuries per milliliter (80 picocuries per liter).


PARTICULATE ALPHA ACTIVITY (AS A FUNCTION OF SAMPLING DATE) AT THE 60 METER TOWER
FIGURE 2-1
(OFF-SITE RELEASE LIMIT FOR Pu-239 [LIMITING CASE/SOLUBLE] IS 3 x 10-12 μ Ci/ml)
UPPER ERROR BOUND
BEST ESTIMATE OF CONCENTRATION
LOWER ERROR BOUND
GROSS ALPHA ACTIVITY CONCENTRATION (10-15 μ Ci/ml)
0
1
2
3
4
9/11
9/16
9/22
9/30
10/7
10/14
10/21
10/28
11/4
11/12
11/18
11/25
12/03
12/09
12/18
12/23
12/31
SAMPLING DATES FOR 1987

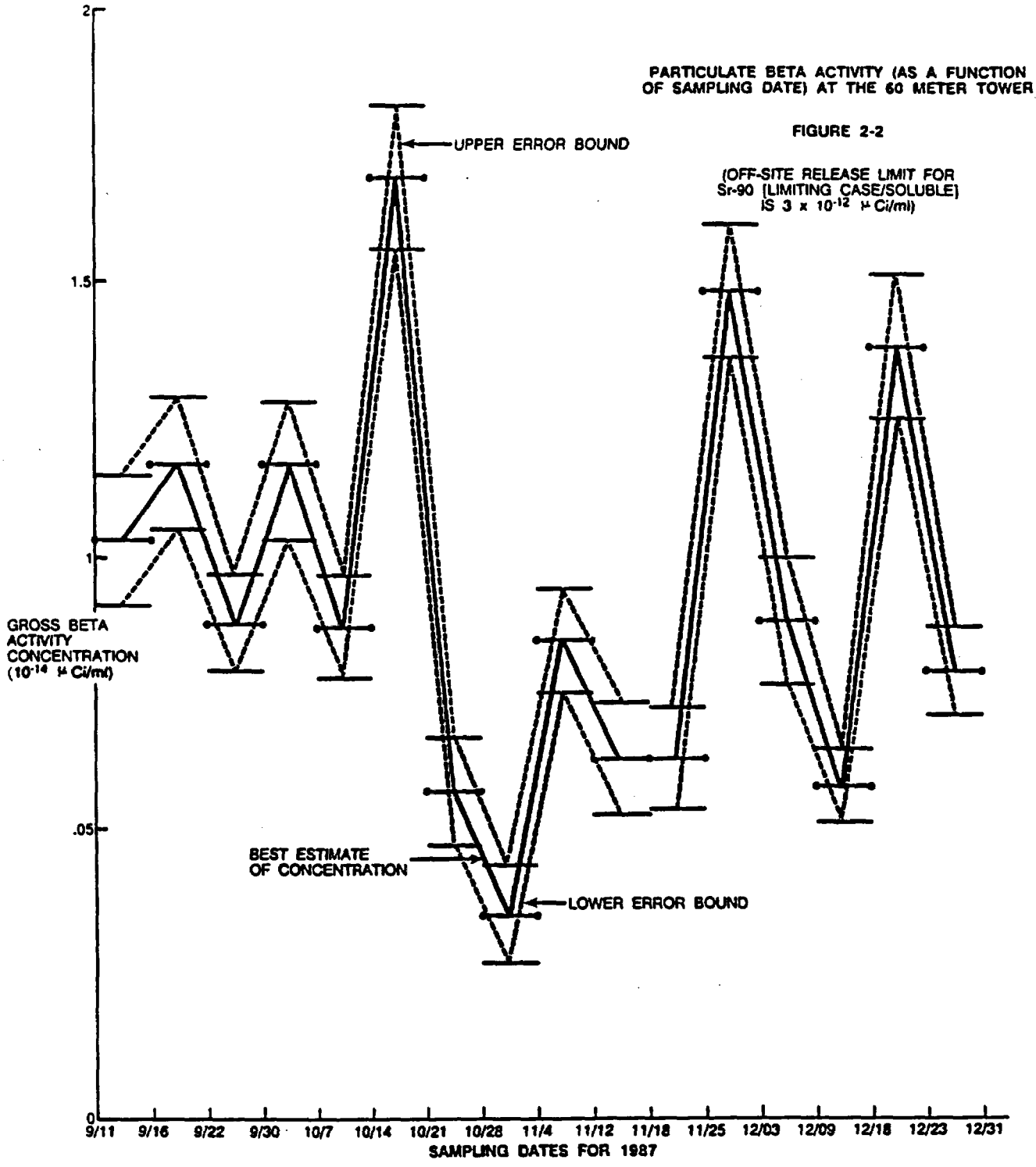

PARTICULATE BETA ACTIVITY (AS A FUNCTION OF SAMPLING DATE) AT THE 60 METER TOWER
FIGURE 2-2
(OFF-SITE RELEASE LIMIT FOR Sr-90 (LIMITING CASE/SOLUBLE) IS 3 x 10-12 μ Ci/ml)
UPPER ERROR BOUND
BEST ESTIMATE OF CONCENTRATION
LOWER ERROR BOUND
GROSS BETA ACTIVITY CONCENTRATION (10-14 μ Ci/ml)
2
1.5
1
.05
0
9/11
9/16
9/22
9/30
10/7
10/14
10/21
10/28
11/4
11/12
11/18
11/25
12/03
12/09
12/18
12/23
12/31
SAMPLING DATES FOR 1987

Table 2-1. Particulate and iodine gamma activity from continuous air monitor

Date (1987)	Activity (μCi/ml)[a,b]	
	Particulate	Iodine
9/11 to 9/16	MDA	MDA
9/16 to 9/22	$2.53 \pm 1.31 \times 10^{-13}$ Be-7[c]	MDA
9/22 to 12/31	MDA	MDA

[a]MDA means activity concentration is less than the minimum detectable activity.

[b]The statistical confidence level used to evaluate the uncertainty bounds is 95%.

[c]Naturally occurring radionuclide.

Table 2-2. Isotopic/radionuclide specific analyses of composite particulate filters (last quarter of 1987, September 11 to December 31)

Radionuclide	Analysis[a]	Concentration average over one quarter in $\mu Ci/ml^{b,c}$
Be-7	Gamma spectral analysis	$7.25 \pm .58 \times 10^{-14}$
Ra-226	Gamma spectral analysis	$4.7 \pm 2.4 \times 10^{-16}$
Other gamma emitters	Gamma spectral analysis	<MDA
Sr-90 and Sr-89	Wet chemistry	TBD
Th-230, Pu-238, Pu-239, Pu-240, Th-232	Wet chemistry/Alpha spectral analysis	TBD
Pu-241	Wet chemistry - beta counting	TBD
Uranium	Wet chemistry - counting	TBD
Tc-99	APD	
Po-210, Np-237, Am-241, Am-243, Cm-243, Cm-244	APD	TBD

[a]TBD means "to be determined" and indicates the analyses are ongoing. APD means the analysis process is in development.
[b]The statistical confidence level used to evaluate the uncertainty bound is 95%. MDA means minimum detectable activity.
[c]Naturally occurring radionuclide.

Table 2-3. Monthly integrating sampler results (September to October 1987)

Location		Radon concentration[a,b] (average) pCi/l
Number	Description	
1x	Coyote Wash - 10-meter tower (Exploratory Shaft Area)	0.8 ± 0.3
6x	60-meter tower	0.7 ± 0.2
7ax	Facility Area - North	0.4 ± 0.2
7bx	Facility Area - East	0.6 ± 0.2
7cx	Facility Area - South	1.2 ± 0.3
7dx	Facility Area - West	1.1 ± 0.3
QC spikes	Approximately 0.6 ± 0.2 pCi/l	1.1 ± 0.3, 1.8 ± 0.4, 2.3 ± 0.4, 1.5 ± 0.3, 1.7 ± 0.4, 2.6 ± 0.5
QC blanks	Approximately 0.0 pCi/l	1.1 ± 0.3, 1.7 ± 0.4

[a]The statistical confidence level used to evaluate the uncertainty bound is 95%.

[b]Uncertainties reflect counting statistics only and are not indicative of the uncertainty in the measurement. These uncertainty values are those provided by the vendor. Future reports will contain an evaluation of analytical uncertainty.

Table 2-4. Quarterly integrating sampler results (October to December 1987)

Location		Radon concentration[a,b] (average) pCi/l
Number	Description	
1x	Coyote Wash - 10-meter tower (Exploratory Shaft Area)	0.4 ± 0.1
6x	60-meter tower	0.5 ± 0.1
7ax	Facility Area - North	0.4 ± 0.1
7bx	Facility Area - East	0.4 ± 0.1
7cx	Facility Area - South	0.7 ± 0.2
7dx	Facility Area - West	0.4 ± 0.1
QC spikes	Approximately 27.3 ± 2.8 pCi/l	25.6 ± 2.2, 26.7 ± 2.3, 22.7 ± 2.1, 22.2 ± 2.1, 23.8 ± 2.1, 25.4 ± 2.2
QC blanks	Approximately zero	0.2 ± 0.1, 0.0, 0.0, 0.1 ± 0.1, 0.4 ± 0.1, 0.1 ± 0.1

[a]The statistical confidence level used to evaluate the uncertainty bound is 95%.

[b]Uncertainties reflect counting statistics only and are not indicative of the uncertainty in the measurement. These uncertainty values are those provided by the vendor. Future reports will contain an evaluation of analytical uncertainity.

3.0 Comparison of Effluents with Respect to Applicable Standards

Based on the data in Section 2.1.1, it is clear that the airborne radioactive material from the site is below the NRC, DOE, and EPA offsite standards. It is projected that the offsite dose from all NNWSI Project activities will be well below 1 mrem/year to the maximally-exposed member of the public and, in fact, the activity concentration in the area is essentially independent of NNWSI Project activity, which is minimal.

The radon data indicate that the ambient radon concentration is very low. There are no applicable standards for emanation of radon to the atmosphere from geological formations.

There are currently no liquid effluent release data. However, all water returned to the environment after being pumped from the groundwater system will be screened for tritium activity in excess of applicable release limits. Tritium is the best indicator of any contamination intrusion into the groundwater system at the NTS. The concentration of tritium in the groundwater screening performed on a limited number of NNWSI Project water samples is below drinking water limits established by the EPA and probably below the detection capability of the method used in the screening analysis (Section 2.2).

4.0 References

DOE (U.S. Department of Energy), 1986. "Environmental Assessment for Yucca Mountain Site, Nevada Research and Development Area, Nevada," DOE/RW-0073, three volumes, Washington, D.C.

DOE (U.S. Department of Energy), 1988. "Consultation Draft Site Characterization Plan for Yucca Mountain Site, Nevada Research and Development Area, Nevada," DOE/RW-0160, six volumes, OCRWM, Washington, D.C.

NWPA (Nuclear Waste Policy Act), 1983. "Nuclear Waste Policy Act of 1982," Public Law 97-425, 42 USC 10101-10226, Washington, D.C.

SAIC (Science Applications International Corporation), 1985. "Meteorological Monitoring Plan for Site Characterization," DOE/NV-10270-5, SAIC-84/7600.

SAIC (Science Applications International Corporation), 1987. "Preliminary Site Characterization Radiological Monitoring Plan for the NNWSI Project Yucca Mountain Site," DOE/NV/10270-14, SAIC-86/8007.

SAIC (Science Applications International Corporation), 1988. "Radiological Monitoring Plan for the NNWSI Project," DOE/NV-10576-6, SAIC-87/8000 (controlled document).

APPENDIX A

EXECUTIVE SUMMARY FOR THE RADIOLOGICAL MONITORING PLAN

The Radiological Monitoring Plan (RMP) provides a detailed description of the radiological monitoring activities to be performed during site characterization of the Yucca Mountain site in southern Nevada. Radiological monitoring activities for all Nevada Nuclear Waste Storage Investigations (NNWSI) Project phases through site closure will be detailed in subsequent revisions of the document (six revisions are currently planned).

The RMP is the controlling document for the implementation of the Technical and Management Support Services (T&MSS) Contractor's radiological monitoring activities in support of the NNWSI Project. The document replaces the Preliminary Site Characterization Radiological Monitoring Plan (PSCRMP), which addressed a few aspects of those radiological monitoring activities requiring early implementation. The RMP describes the collection of required radiological data identified in the Radiological Compliance Guide (RCG), Site Characterization Plan (SCP), (DOE, 1986b), Environmental Program Plan (EPP), and other Project documents. Procedures are issued as part of a controlled procedure manual, which is maintained in an updated, audited form by each user. The RMP complies with the requirements of the Waste Management Project Office (WMPO) Quality Assurance Program Plan (QAPP) and supporting documents, including NNWSI Project and T&MSS administrative procedures.

THE RADIOLOGICAL MONITORING PROGRAM

The RMP (Rev. 0) represents a blueprint for the radiological monitoring program during the site characterization phase. The proposed monitoring program (as detailed in Section 4 of the RMP) will collect environmental radiological information to establish existing radiological conditions and satisfy eight basic objectives:

Characterization of the worksite environment. This element will involve determining the existing radioactivity concentrations in the background environment at the site and the potential radon emission from the site. These activities are underway as described in the PSCRMP.

Characterization of the radiological impact of Nevada Test Site (NTS) activities on the repository site. This element will involve determination of ambient airborne radionuclide concentrations in the Yucca Mountain area, evaluation of radioactivity concentrations in the groundwater, performance of soil and driftwall sampling in surface and underground work areas, biota sampling, and surface and sedimentation analyses of the Fortymile Canyon/Wash ephemeral stream.

Facility design and preparation of the Safety Analysis Report. This element will require ambient radiation data, radon exposure data, and soil and driftwall sampling data. Results from evaluation of these data will be used in the design of the facility's ventilation system, airborne radioactivity monitoring systems, and safety analysis activities.

Monitoring of site characterization impacts. This element will include soil sampling, water sampling, and radon monitoring.

Verification of the feasibility of monitoring the environment for appropriate radionuclides. This element will involve quantification of existing conditions at the site using various environmental samples and an indicator species. An indicator species is an animal which can be used to indicate the presence or absence of unsuspected sources of radioactivity (release pathways).

Planning of facility decontamination and decommissioning. This element will involve soil, biota, and water sampling. Archiving of these samples in the Sample Management Facility will be required.

Verification of compliance with DOE Orders and NTS requirements during site characterization. The program will monitor water samples for tritium. Soil columns will not be used to remove radioactive material from liquids. Groundwater characteristics will be verified as safe before release of any such water to the surface-water system.

Preparation of the Environmental Impact Statement (EIS). Specific data and collection activities for the EIS will be identified during the EIS scoping process. Data collected for site characterization activities will also be used to supplement the data collected specifically for the EIS radiological baseline.

The radiological monitoring program will evaluate various ways in which an individual can be exposed to radioactivity (exposure pathways to man): direct exposure to radiation, inhalation of resuspended (or airborne) radioactive particulates, worker and equipment contamination, and indirect pathways (such as ingestion of contaminated foodstuffs or fauna). The program will gather environmental radiological data to satisfy these evaluation needs as well as many others. Approximately six years are needed to establish an environmental data base (barring unplanned releases at the NTS). Characterization of the radon baseline requires much less time: two years of data collection are desirable, but only one year of data may be collected because of Project schedule constraints.

The radiological monitoring program's sampling activities are directed toward monitoring release pathways and the exposure pathways to man in two areas: a circular area measuring 168-kilometers across and centered on Yucca Mountain (the program sampling area), and the City of Las Vegas. This arrangement meets all regulations and requirements for model pathways. There are five basic types of sampling described in the RMP: airborne monitoring, water sampling, soil and drift surface sampling, biota sampling, and ambient radiation monitoring.

Airborne monitoring. Airborne monitoring is the foundation of the radiological monitoring program activities and involves the monitoring of radioactive particulates, radioiodine, tritium, and inert gases. These four categories account for most of the radioactive materials released from any site. C-14 (CO_2) will also be monitored. Air sampling will be conducted to evaluate potential doses to offsite inhabitants from inhaled radionuclides, direct radiation, or ingestion of contaminants. Both far-field (beyond a

15-kilometer radius of the site) and near-field (within a 15-kilometer radius of the site) air samplers will be used. Radon/radon daughter product sampling activities will be restricted to the near-field area. Only seven new far-field stations are being added to the current NTS network; data from existing U.S. Environmental Protection Agency (EPA) stations will be used, and NNWSI Project stations will be installed at some existing Reynolds Electrical and Engineering Co. (REECo) air sampler locations. Data from the REECo air monitoring program will also be available.

Particulate sample analyses will be performed by the EPA Nuclear Radiation Assessment Division (NRAD) Laboratory. For tritium and inert-gas (non-radon) sampling, equipment both currently in use and being evaluated by the NRAD will be used by the radiological monitoring program. The tritium and inert-gas samples will also be analyzed by the NRAD Laboratory. Radon monitoring will involve the use of time-integrating samplers supplemented by continuous radon monitors. The radon monitoring network is intended to establish a baseline and measure the future changes in the radon levels near the exploratory shaft. Underground air in the main drifts and near the working face will be sampled for radon and its daughter products. The monitoring of C-14 will be based on the C-14 content in flora.

Water sampling. In general, the principal exposure pathways from waterborne radionuclides to individuals are ingestion of drinking water and consumption of aquatic species or irrigated crops. Potential water pathways at Yucca Mountain include ephemeral streams, catch basins, groundwater, airborne deposition to the Amargosa River or streams, and reservoirs or ponds supplied from groundwater sources.

Surface-water samples will be collected routinely at a representative unaffected control location to provide background data for comparison with data from affected locations. Ephemeral stream samples will be collected at four stations located in Fortymile Wash just east of Yucca Mountain. Water sampling will rely to a large extent on existing EPA water samplers and locations. A representative sampling of water from catch basins within the near-field will be made, and sediment samples will be taken at all surface-water and ephemeral stream locations.

Grab samples of drinking water will be collected from nearby communities. Lake Mead water will be included in this activity and is currently being sampled by the NRAD. EPA water sampling data available for several sampling locations will be also be used.

Monitoring of groundwater will be conducted near the proposed repository facility and in areas downgradient from other facilities or activities. To facilitate the assessment of potential sources of radionuclides, at least two wells will be selected for evaluation. Where available, existing NNWSI Project and NTS wells and planned NNWSI Project wells will be used. Water samples will be obtained (if possible) from U.S. Geological Survey (USGS) or other test wells in the near-field area as they become available. Most of the near-field samples will be archived.

Surface-water samples will be taken from beneath the water surface to avoid floating debris, while ephemeral streams will be sampled by installing a large-volume passive container in the stream bed. Sediment samples from

surface-water sampling locations will be usually be collected using hand-held equipment or a core sampler.

Water typically will be sampled annually. Sediment samples also will be taken annually, following the first significant waterflow in the spring. Ephemeral stream sampling will be conducted each time a significant waterflow occurs in the stream being evaluated.

Soil and drift surface sampling. Soil sampling will be used to assess deposition of radionuclides from site activities, evaluate the long-term accumulation trends of radionuclides, and estimate environmental radionuclide inventories. Soil samples will be collected at air sampling locations, and a set of representative samples will be taken throughout the indicator species sampling area. The latter will allow characterization of the conditions to which the indicator species is exposed. Representative soil samples will be taken from all environmental sampling locations and areas where major activities are planned. These samples will be archived for possible use in future evaluations or activities. An annual sampling frequency is planned to assess long-term trends.

Driftwall samples are directed towards characterizing natural radon emissions. During underground mining and operation, driftwall sampling will be used to characterize the uranium and thorium sources which produce the radon/radon daughter products emanating from the mine.

Biota sampling. Biota sampling involves sampling of milk, crops, game, and animal produce from livestock. These samples provide the most direct means for assessing the radiation dose to man from ingestion of contaminants (the food pathways to man). Many details of the biota sampling activities cannot be presented until a detailed survey is conducted of the agricultural and cultural activities within the program sampling area. This information will be collected over the next two years. For now, the biota samples collected in the program will include the indicator species and items representing both direct and indirect pathways to man.

Direct pathways to man are represented by food items. Sampling may include milk, crops intended for human consumption, beef, poultry, and eggs. Milk sampling of all dairy cattle herds in the sampling area is already performed by the NRAD for the NTS. Data from the NRAD program should be sufficient for the radiological monitoring program. To monitor iodine-129, cattle thyroids will be collected each fall when grazing activities end. Crop samples will include those produced for human consumption as well as for livestock feed. Meat, poultry, and egg samples may be obtained from commercial producers and local family farms. Domestic animal produce will be sampled annually at the time of the slaughter or harvest. Poultry and eggs may be sampled quarterly. Field surveys of game bird species will be conducted quarterly.

Indirect pathways to man include cattle and deer forage. Native cattle forage samples will be taken from eight locations established on lands where cattle are grazed within the program sampling area. Three forage species will be chosen for monitoring. Three samples from each species will be collected at each location. A total of 72 samples will be collected over a two-year period. Cattle forage sampling will not be initiated before 1989.

The food habits of mule deer will be studied by analyzing scat samples collected from Yucca Mountain. Results will determine which deer forage species should be collected for analysis. Three forage species will be chosen for monitoring. Three samples from each species will be collected at twenty designated sampling locations. All twenty locations will be sampled at least twice during the site characterization phase.

Indicator species assist in detecting inadvertent releases of radioactivity and in monitoring any long-term radionuclide accumulation in the local environment. Small mammals (mice and rats) will be used by the radiological monitoring program as indicators of radionuclide concentrations in the biosphere. Merriam's kangaroo rat and the long-tailed pocket mouse are the designated indicator species for the program because they are typically the two most abundant and ubiquitous small mammal species on Yucca Mountain. Eight small mammal monitoring locations will be established in the vicinity of Yucca Mountain. At each location, trap lines will be arranged. The trap lines will be operated four times a year. Samples for radioanalysis will be collected two of the four times. The other two times, animals will only be marked. Lagomorphs (rabbits) were not included as an integral part of the radiological monitoring program because of their relative rarity on Yucca Mountain; however, systematic transect surveys will be conducted semiannually to collect data which will enable the program to determine when population densities are sufficient to permit sampling. To evaluate the feasibility of incorporating predators (coyotes, bobcats, etc.) into the program, scent-station surveys assessing the presence, relative abundance, and general distribution of predators will be performed four times a year.

Ambient radiation monitoring. Ambient radiation monitoring involves the monitoring of external radiation exposures. The radiological monitoring program will use integrating dosimeters, specifically thermoluminescent dosimeters (TLDs), to monitor any incremental changes in external radiation doses to key population groups in the program sampling area. The dosimeters will be placed at all environmental sampling stations. In addition to these locations, other TLD locations have been added to provide an accurate representation of current site conditions. Where TLDs are used, at least three will be provided for each location to permit averaging of the data and detection of faulty dosimeters. Quarterly exchange periods are planned. Various exposure rate instruments will also be used for continuous monitoring of the exposure rate as a function of time. An Aerial Measurements System (AMS) aerial survey is also being arranged for the Yucca Mountain area. An AMS survey provides detailed data analysis of gamma radiation levels in and around nuclear facilities. The AMS is operated for the DOE by EG&G, Inc. In situ gamma spectral analyses at most sampling locations will also be included as part of the ambient radiation monitoring of the radiological monitoring program. Current data from the NTS public monitoring program will also be available for the ambient radiation monitoring activity.

Other aspects of the radiological monitoring program's monitoring and data-gathering activities--the rules and regulations involved in their development; the assessment methodologies used to understand and categorize their data; the quality assurance procedures followed to ensure their accuracy and validity--are detailed in other sections of the RMP.

The primary participants in the radiological monitoring program will be the DOE Nevada Operations Office (DOE/NV) Waste Management Project Office (WMPO), the EPA NRAD, and the T&MSS Contractor (Science Applications International Corporation). Other involved groups will include the DOE/NV Health Physics and Environmental Division, EG&G/Energy Measurements (Santa Barbara Operations), the EPA Office of Radiation Programs, REECo, DOE/NV, and the State of Nevada. All activities in the program will have the approval of the WMPO and the concurrence of the DOE/NV.

ORGANIZATION OF THE RADIOLOGICAL MONITORING PLAN

The RMP has eight major parts and eleven appendices. Section 1 provides introductory remarks and establishes the framework of the document. Section 2 provides a general discussion of the regulatory and control framework for the document. Section 3 provides a detailed discussion of the technical requirements and guidance mandating completion of the radiological monitoring activities discussed in the document. The manner in which the document implements data collection in support of issue resolution for the issues hierarchy as discussed in the SCP and the EPP is also addressed in Section 3. Section 4 provides details of the radiological monitoring activities and the activities related to the requirements in Section 3. Section 5 sets forth the radiological analytical techniques used in collection of data for resolution of the issues in the issues hierarchy. Section 5 also addresses how these techniques fit within the regulatory framework described in Sections 2 and 3. Section 6 identifies non-monitoring data required to support resolution of the issues and discusses how these data will be collected. Section 7 addresses quality assurance, and Sections 8 and 9 address administrative concerns and their resolution within the program. Appendix A provides a description of NNWSI Project activities. Appendices B through G provide supplementary technical data, with Appendix E containing a tabular summary of the environmental monitoring program. Appendix H describes other plans which provide data to this program. Appendix I contains a listing of acronyms and abbreviations. Appendix J contains a glossary for the text, and Appendix K lists any changes made in the field monitoring activities.

SAIC
Science Applications International Corporation

L89-ADM-NEC-009
WBS # 1.2.5.4.5
QA

March 1, 1989

Carl P. Gertz, Project Manager
Yucca Mountain Project Office
U.S. Department of Energy
Nevada Operations Office
P.O. Box 98518
Las Vegas, NV 89193-8518

Subject: Contract #DE-AC08-87NV10576
Environmental Monitoring Program Summary for 1987

Dear Mr. Gertz:

Enclosed is the subject document, which has been previously approved for distribution by the Project Office. If you have any questions regarding this document or need further information, please contact Steve Woolfolk of my staff at extension 7804.

Sincerely,

SCIENCE APPLICATIONS
INTERNATIONAL CORPORATION

for Neal E. Carter
Acting Project Manager

NEC:DAF:mlh

Enclosure:
As stated

X 9021407 56 4pp

101 Convention Center Dr., Ste. 407, Las Vegas, NV 89109 (702) 295-1204
Other SAIC Offices Albuquerque, Ann Arbor, Arlington, Atlanta, Boston, Chicago, Huntsville, La Jolla, Los Angeles, McLean, Orlando, Santa Barbara, Sunnyvale, and Tucson

cc w/encl:
E. Baynard, HQ (EH-1) FORS (3 copies)
R. Stein, HQ (RW-30) FORS
G. Parker, HQ (RW-333) FORS
S. Franks, EH, NV
B. Church, ESH, NV
D. Vieth, EPD, NV
P. Fitzsimmons, HPDWD, NV
C. Gertz, YMP, NV
E. Wilmot, YMP, NV
W. Dixon, YMP, NV
M. Blanchard, YMP, NV
J. Blaylock, YMP, NV
L. Skousen, YMP, NV
R. Kaiser, YMP, NV
M. Powell, YMP, NV (10 copies)
D. Livingston, YMP, NV
L. O'Neal, HPDWD,NV
F. Bingham, EPD, NV
C. West, OEA, NV (10 copies)
V. Witherill, NTSO, NV
R. Friedrichs, EPD, NV
M. Marelli, HPDWD, NV
J. Linehan, NRC, Washington, D.C. (3 copies)
P. Prestholt, NRC, Las Vegas, NV
N. Carter, SAIC, Las Vegas, NV
W. Macnabb, SAIC, Las Vegas, NV
M. Foley, SAIC, Las Vegas, NV
M. Voegele, SAIC, Las Vegas, NV
J. Shaler, SAIC, Las Vegas, NV
S. Klein, SAIC, Las Vegas, NV
J. Younker, SAIC, Las Vegas, NV
P. Mudra, SAIC, Las Vegas, NV
M. Glora, SAIC, Las Vegas, NV
S. Volek, SAIC, Las Vegas, NV (20 copies)
D. Dawson, SAIC, Las Vegas, NV
C. Pflum, SAIC, Las Vegas, NV
M. Brown, SAIC, Las Vegas, NV
S. Woolfolk, SAIC, Las Vegas, NV (10 copies)
J. Prince, SAIC, Las Vegas, NV (2 copies)
A. Colarusso, SAIC, Las Vegas, NV
G. Daer, SAIC, Las Vegas, NV
A. Kirk, SAIC, Las Vegas, NV
S. Lee, SAIC, Las Vegas, NV

cc w/encl (cont'd):
C. Tung, SAIC, Las Vegas, NV
W. Collucci, SAIC, Las Vegas, NV
D. Witham, SAIC, Las Vegas, NV
M. Jablonski, SAIC, Las Vegas, NV
M. Dussman, SAIC, Las Vegas, NV
M. Harris, SAIC, Las Vegas, NV
W. Jacobs, SAIC, Las Vegas, NV
S. Phillips, SAIC, Las Vegas, NV
E. Ripley, SAIC, Las Vegas, NV
J. Therien, SAIC, Las Vegas, NV
R. Kettel, SAIC, Las Vegas, NV
E. McCann, SAIC, Las Vegas, NV
J. Newby, SAIC, Las Vegas, NV
J. Tappen, Westinghouse, Las Vegas, NV
C. Costa, EPA/NRAD, Las Vegas, NV
S. Black, EPA/NRAD, Las Vegas, NV
K. Del Giorgio, EPA/NRAD, Las Vegas, NV
C. Lui, EPA/NRAD, Las Vegas, NV
D. Thome', EPA/NRAD, Las Vegas, NV
N. Sunderland, EPA/NRAD, Las Vegas, NV
L. Smith, EPA/NRAD, Las Vegas, NV
F. Grossman, EPA/NRAD, Las Vegas, NV
A. Jarvis, EPA/NRAD, Las Vegas, NV
J. Akridge, EPA/NRAD, Las Vegas, NV
R. Holloway, EPA/NRAD, Las Vegas, NV
S. Faller, EPA/NRAD, Las Vegas, NV
J. Moore, EPA/NRAD, Las Vegas, NV
W. Bliss, EPA/ORP, Las Vegas, NV
R. Hopper, EPA/ORP, Las Vegas, NV
C. Wills, EG&G/EM, Las Vegas, NV
L. Pippin, DRI, Reno, NV
T. Hunter, SNL, 6310, Albuquerque, NM
R. Sandoval, SNL, 6316, Albuquerque, NM
A. Stevens, SNL, 6311, Albuquerque, NM
L. Ballou, LLNL, Livermore, CA
D. Oakley, LANL, Los Alamos, NM
L. Hayes, USGS, Denver, CO
B. Smith, REECo, Las Vegas, NV
C. Rosenberry, REECo, Las Vegas, NV
I. Wells, REECo, Las Vegas, NV
D. Brown, U.S. Fish and Wildlife Service, Las Vegas, NV
C. Meyer, USAF, DOE, NV
R. Wycoff, BLM, Las Vegas, NV
K. Rinaldi, USDA/Forest Service, Las Vegas, NV
R. Loux, NWPO, Carson City, NV (5 copies)

cc w/encl (cont'd):
S. Marshall, NSDH, Carson City, NV
Comm. J. Garcia Jr., Nye County, NV
Comm. P. Christensen, Clark County, NV
Comm. K. Whipple, Lincoln County, NV
Comm. H. Dahlstrom, Esmeralda County, NV
G. Sawyer, Nevada Commission on Nuclear Projects, Carson City, NV
T. Hickey, Nevada Committee on High Level Waste, Carson City, NV
R. Lurie, Mayor, Las Vegas, NV
J. Seastrand, Mayor, North Las Vegas, NV
L. Kesterson, Mayor, Henderson, NV
S. Bradhurst, Local Government Advisory Group, Tonopah, NV
M. Baughman, Local Government Advisory Group, Carson City, NV
D. Bayer, Local Government Advisory Group, Carson City, NV
D. Bechtel, Local Government Advisory Group, Las Vegas, NV
P. Cummings, Local Government Advisory Group, Las Vegas, NV
J. Finney, Local Government Advisory Group, Henderson, NV
J. Kinnee, Local Government Advisory Group, North Las Vegas, NV
O. Ravenholt, Clark County Health Department, Las Vegas, NV
R. Christensen, Nye County Health Department, Tonopah, NV
J. Wilkin, Lincoln County Health Department, Pioche, NV
E. Reed, Esmeralda County Health Department, Goldfield, NV
R. McNellis, Environmental Research Council, UNLV, Las Vegas, NV
(2 copies)
K. Bright, Chairman, Inyo County Supervisors, Independence, CA
J. Eton, Inyo County Health Department, Independence, CA

NNWSI/88-12
SAIC-88/8010

Nevada Nuclear Waste Storage Investigations Project
Environmental Monitoring Program Summary For 1987

May 1988

This report addresses the information requirements
specified in Department of Energy Order 5484.1,
"Environment Protection, Safety, and Health Protection Information Reporting"
(February 24, 1981)

This document was prepared by:

The Radiological Field Programs Branch of the Technical and Management Support Services (T&MSS) Contractor (SAIC) to the DOE NNWSI Project with support from:

S. Woolfolk	SAIC/T&MSS
J. Prince	SAIC/T&MSS
G. Daer	SAIC/T&MSS
A. Colarusso	SAIC/T&MSS
C. Costa	U.S. EPA/NRAD
S. Black	U.S. EPA/NRAD
C. Liu	U.S. EPA/NRAD
D. Thome	U.S. EPA/NRAD
N. Sunderland	U.S. EPA/NRAD
L. Smith	U.S. EPA/NRAD
F. Grossman	U.S. EPA/NRAD
A. Jarvis	U.S. EPA/NRAD
and technical editing by	
C. Weiss	SAIC/T&MSS

as part of DOE Contract Number DE-AC08-87NV10576.

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

NNWSI PROJECT ENVIRONMENTAL MONITORING PROGRAM SUMMARY FOR 1987

1.0 Introduction

This document provides a summary of the calendar year 1987 radiological environmental monitoring activities conducted by the Nevada Nuclear Waste Storage Investigations (NNWSI) Project in the Yucca Mountain area. Current NNWSI Project activities include meteorological and radiological monitoring activities. Other monitoring activities and expansion of existing monitoring activities are scheduled to begin in FY 88 or FY 89.

1.1 Location

The NNWSI Project site is located in southwestern Nevada on land in the Yucca Mountain area. While the size of the site is still under evaluation, the area of intensive study is shown in Figure 1-1. The site is located about 26 km north of the town of Amargosa Valley (formerly Lathrop Wells).

1.2 Work Performed

The U.S. Department of Energy (DOE) is responsible for developing the Nation's first geologic repository for permanent disposal of high-level radioactive waste and spent nuclear fuel. The Nuclear Waste Policy Act (NWPA) of 1982 specifies the process for selecting a repository site and assigns primary responsibility for site selection and repository design, construction, and operation to the DOE. Following the step-by-step process set forth in the original NWPA, the Secretary of Energy recommended three sites for extensive study ("site characterization"). On May 28, 1986, the President approved the Secretary's recommendations, establishing Yucca Mountain, Nevada, as one of three sites to be characterized. In December 1987, Congress amended the NWPA to specify that Yucca Mountain would be studied to determine whether it meets stringent standards for isolating radionuclides. All site-specific activities at the other two sites were discontinued at that time.

The NNWSI Project is guided by the DOE's Office of Civilian Radioactive Waste Management (OCRWM) and is managed locally by DOE's Nevada Operations Office (DOE/NV). The Project Office and support contractors are conducting earth science and environmental studies of Yucca Mountain during site characterization (DOE, 1988) as well as studying potential effects of the Project on the region near the site. This site characterization phase is scheduled to continue through the early 1990's. When testing is complete and if the site is found suitable, the Secretary will seek Presidential approval to submit an application to construct a repository to the Nuclear Regulatory Commission (NRC). The NRC then will decide whether the proposed site meets strict Federal regulations that prohibit a repository from posing a threat to the environment. If the NRC approves, repository construction can begin.

A very limited number of activities associated with the site characterization program are being performed at this time. The current NNWSI Project environmental monitoring activities are described in the Meteorological Monitoring Plan (SAIC, 1985) and the Preliminary Site Characterization Radiological Monitoring Plan (PSCRMP) (SAIC, 1987), and include, since late

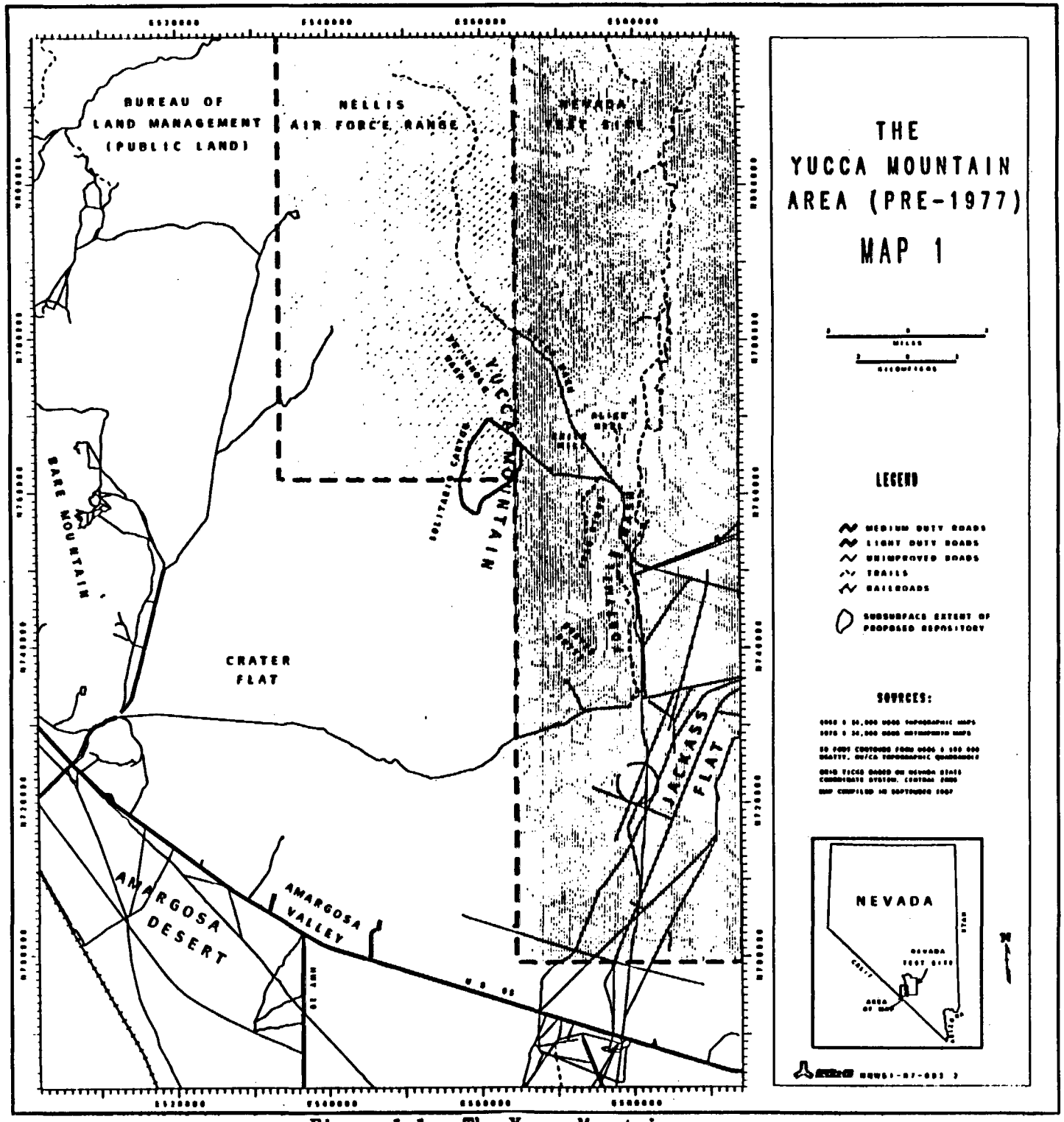


Figure 1-1. The Yucca Mountain area

March 1988, screening of water pumped from the site for tritium before disposal. The continuous radon monitoring activities discussed in the PSCRMP are still in the implementation phase. It should be noted that the PSCRMP will be replaced by the Radiological Monitoring Plan (RMP) (SAIC, 1988), which specifies the full scope of monitoring activities for the NNWSI Project (Appendix A). The RMP is planned for release in late April or early May of 1988. The NNWSI Project publishes meteorological monitoring data in quarterly and annual reports; consequently, meteorological data are not included in this report.

The radiological monitoring activities currently consist of one continuous air sampler located near the 60-meter meteorological tower (Figure 1-2), seven passive integrating radon samplers located in the Facility Area (Figure 1-2), and one passive integrating radon sampler attached to the 10-meter meteorological tower in Coyote Wash.

1.3 Environmental Setting

The NNWSI Project site at Yucca Mountain is located in southwestern Nevada, approximately 26 km north of the town of Amargosa Valley (formerly Lathrop Wells). The site, part of which includes the southeastern corner of the Nevada Test Site (NTS), is located exclusively within lands controlled by the Federal Government. Yucca Mountain lies within the Basin and Range physiographic province, a broad area of generally linear mountain ranges and intervening valleys. Figure 1-3 depicts the topography of the area in the immediate vicinity of Yucca Mountain. The climate of the area is identified with strong solar insolation, limited precipitation, low relative humidity, and large diurnal temperature ranges. Temperatures vary from highs of approximately 36°C during the summer to lows of approximately 2°C during the winter. Annual precipitation is typically 145 mm in the area. Winds from the south account for a high percentage of the summer seasonal flow. On a diurnal basis, flow from the south predominates in the summer daytime hours, while northwest and northwesterly winds dominate nighttime hours. Winter wind distributions are dominated by the northwest and north-northwesterly flows. Southerly winds during the winter are greatly reduced from those that are observed during the summer.

Land use in the region includes agriculture, mining, recreation, and private and commercial development, all on a very limited basis. The Amargosa Valley and Pahrump Valley are the primary areas of agricultural significance. All agricultural production presently is beyond 24 km of the Yucca Mountain site. Land use information is summarized in the Yucca Mountain Environmental Assessment (EA) (DOE, 1986).

1.4 Related Reports

The NTS environmental monitoring reports published by Reynolds Electrical and Engineering Co. (REECo) and by the Nuclear Radiation Assessment Division (NRAD) of the U.S. Environmental Protection Agency (EPA) also contain data relating to the NNWSI Project area.

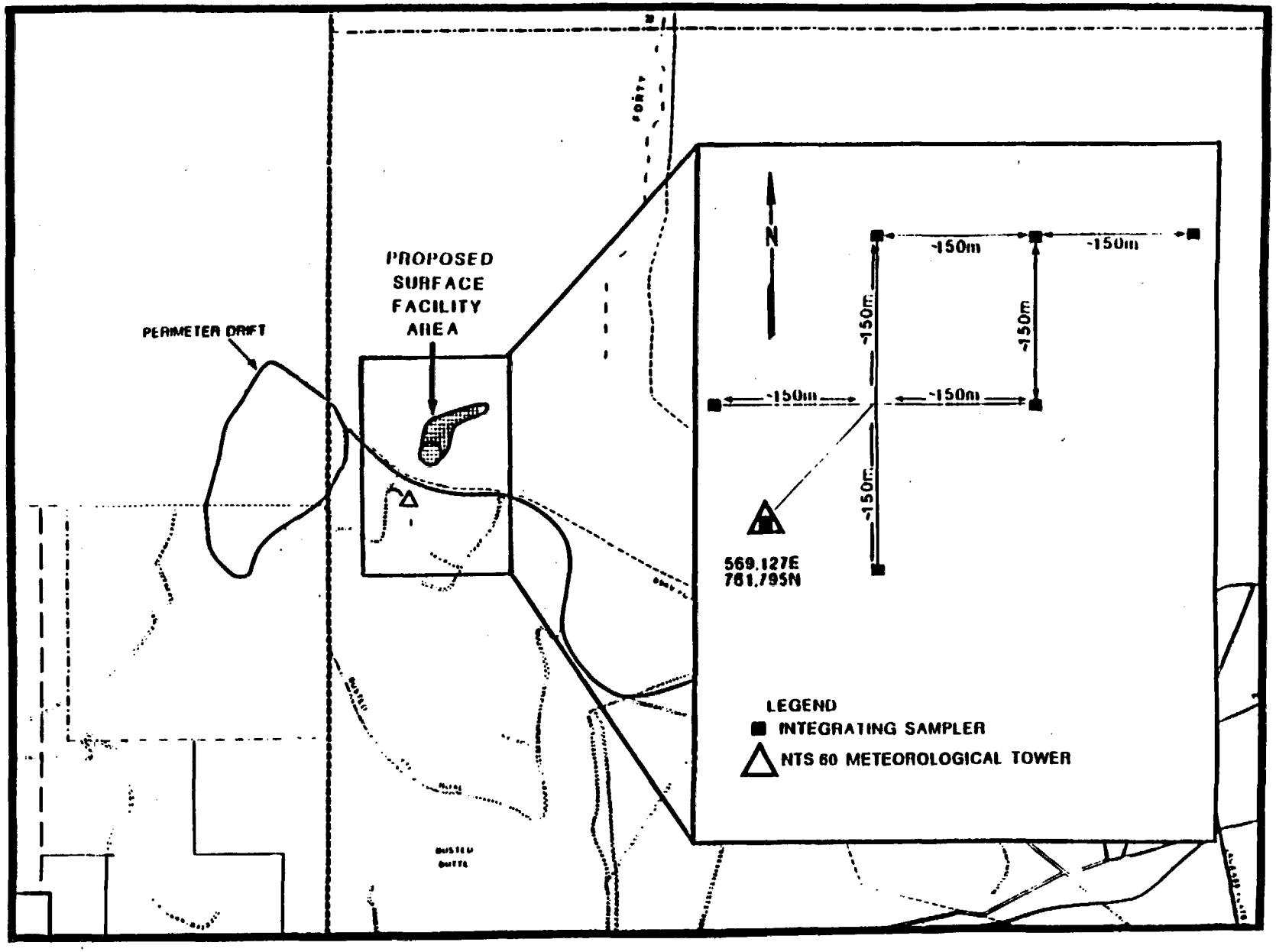


Figure 1-2. PSCRMP sampling locations

Figure 1-3. Yucca Mountain near-field topography

2.0 Pollutants Released in Effluents

There is currently little or no activity on the NNWSI Project site. Ambient emissions are presently zero with the exception of the resuspension of existing material by casual traffic. The data collected as part of the PSCRMP program address ambient airborne activity prior to initiation of significant site characterization activity. In addition, the data on the release of liquids pumped from wells in the area are also addressed.

2.1 Air

The air monitoring consists of two major activities: particulate and iodine monitoring using a continuous air monitor, and radon monitoring using passive integrating radon samplers (Track Etch™ detectors).

2.1.1 Continuous air monitor results

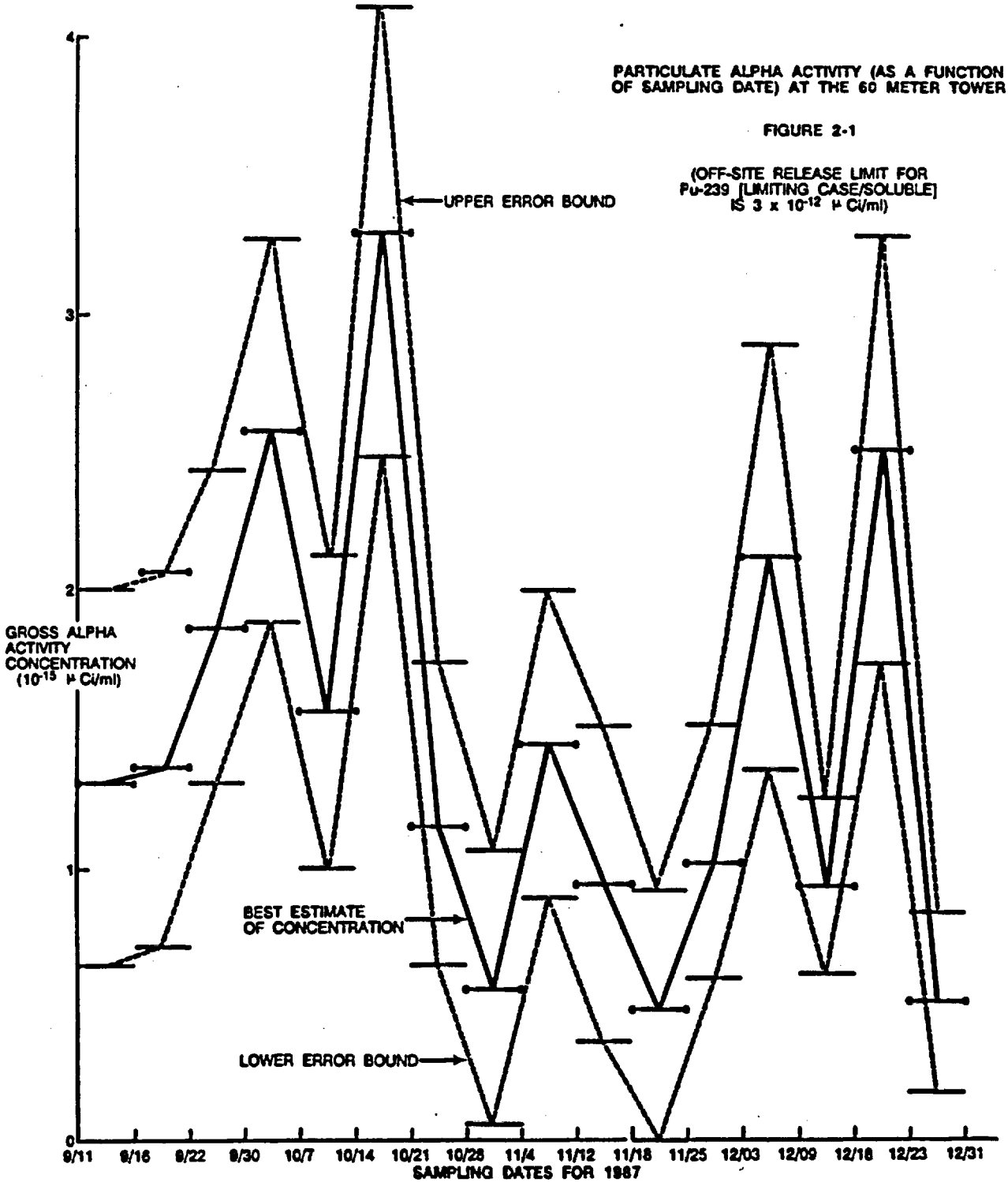
Upon receipt, the weekly particulate samples were analyzed for alpha, beta, and gamma activity and the charcoal cartridges for gamma activity. The gross alpha count results and the gross beta count results are shown in Figure 2-1 and Figure 2-2, respectively. The results of the gamma spectrum analyses for the particulate filter and charcoal cartridges are summarized in Table 2-1. Finally, the isotopic/radionuclide analyses of the composite of all particulate filters from September 11, 1987, to December 31, 1987, are summarized in Table 2-2.

2.1.2 Integrating sampler (IS) results

The results of the IS analyses for the period from September 9, 1987, to October 4, 1987, are summarized in Table 2-3. Based on these results, it was determined that the sampling period would be increased from monthly to quarterly to provide more accurate data. The QC data indicated that accurate measurement at ambient levels requires a larger integrated exposure, so the period was extended. The results from October 4, 1987, to January 5, 1988, are shown in Table 2-4. Based on the data in Table 2-4, radon concentration in the areas monitored ranged from about 0.4 to 0.7 picocuries per liter. Since only one quarter of data is available, no significant conclusions can be reached at this time.

2.2 Liquid

The projected liquid releases from NNWSI Project activities are from groundwater pumped to the surface as a result of groundwater monitoring activities. Since screening of the activity was not initiated until March 1988, no specific data are available for the 1987 calendar year. However, the tritium level in the water from two wells sampled since the screening was initiated in calendar year 1988 has been less than 8×10^{-7} microcuries per milliliter (80 picocuries per liter).


PARTICULATE ALPHA ACTIVITY (AS A FUNCTION OF SAMPLING DATE) AT THE 60 METER TOWER
FIGURE 2-1
(OFF-SITE RELEASE LIMIT FOR Pu-239 [LIMITING CASE/SOLUBLE] IS 3 x 10⁻¹² μ Ci/ml)
UPPER ERROR BOUND
GROSS ALPHA ACTIVITY CONCENTRATION (10⁻¹⁵ μ Ci/ml)
BEST ESTIMATE OF CONCENTRATION
LOWER ERROR BOUND
0
1
2
3
4
9/11
9/16
9/22
9/30
10/7
10/14
10/21
10/28
11/4
11/12
11/18
11/25
12/03
12/09
12/18
12/23
12/31
SAMPLING DATES FOR 1987

PARTICULATE BETA ACTIVITY (AS A FUNCTION OF SAMPLING DATE) AT THE 60 METER TOWER

FIGURE 2-2

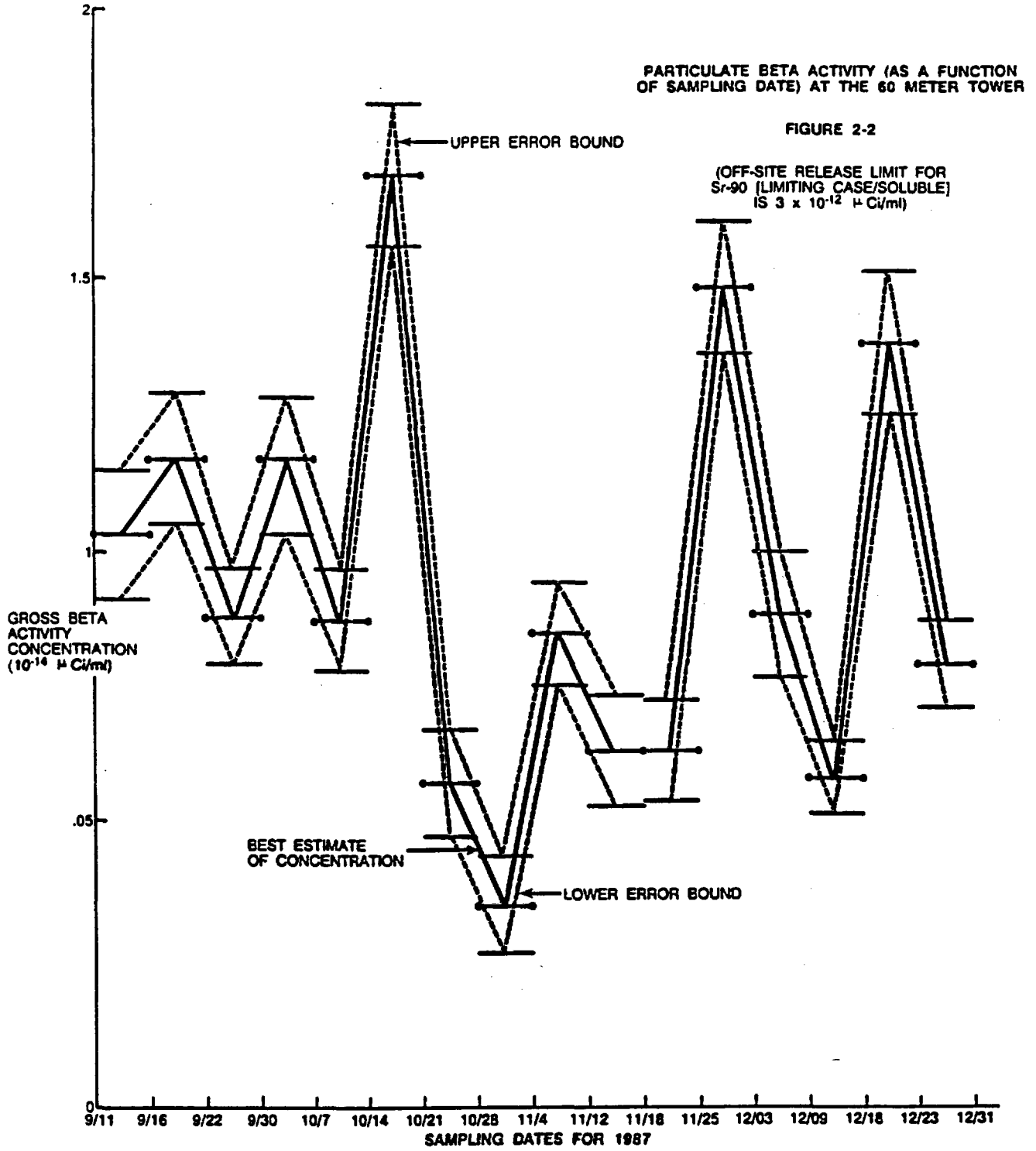


Table 2-1. Particulate and iodine gamma activity from continuous air monitor

Date (1987)	Activity (μCi/ml)[a,b]	
	Particulate	Iodine
9/11 to 9/16	MDA	MDA
9/16 to 9/22	$2.53 \pm 1.31 \times 10^{-13}$ Be-7[c]	MDA
9/22 to 12/31	MDA	MDA

[a]MDA means activity concentration is less than the minimum detectable activity.

[b]The statistical confidence level used to evaluate the uncertainty bounds is 95%.

[c]Naturally occurring radionuclide.

Table 2-2. Isotopic/radionuclide specific analyses of composite particulate filters (last quarter of 1987, September 11 to December 31)

Radionuclide	Analysis[a]	Concentration average over one quarter in $\mu Ci/ml$[b,c]
Be-7	Gamma spectral analysis	$7.25 \pm .58 \times 10^{-14}$
Ra-226	Gamma spectral analysis	$4.7 \pm 2.4 \times 10^{-16}$
Other gamma emitters	Gamma spectral analysis	<MDA
Sr-90 and Sr-89	Wet chemistry	TBD
Th-230, Pu-238, Pu-239, Pu-240, Th-232	Wet chemistry/Alpha spectral analysis	TBD
Pu-241	Wet chemistry - beta counting	TBD
Uranium	Wet chemistry - counting	TBD
Tc-99	APD	
Po-210, Np-237, Am-241, Am-243, Cm-243, Cm-244	APD	TBD

[a]TBD means "to be determined" and indicates the analyses are ongoing. APD means the analysis process is in development.

[b]The statistical confidence level used to evaluate the uncertainty bound is 95%. MDA means minimum detectable activity.

[c]Naturally occurring radionuclide.

Table 2-3. Monthly integrating sampler results (September to October 1987)

Location		Radon concentration[a,b] (average) pCi/l
Number	Description	
1x	Coyote Wash - 10-meter tower (Exploratory Shaft Area)	0.8 ± 0.3
6x	60-meter tower	0.7 ± 0.2
7ax	Facility Area - North	0.4 ± 0.2
7bx	Facility Area - East	0.6 ± 0.2
7cx	Facility Area - South	1.2 ± 0.3
7dx	Facility Area - West	1.1 ± 0.3
QC spikes	Approximately 0.6 ± 0.2 pCi/l	1.1 ± 0.3, 1.8 ± 0.4, 2.3 ± 0.4, 1.5 ± 0.3, 1.7 ± 0.4, 2.6 ± 0.5
QC blanks	Approximately 0.0 pCi/l	1.1 ± 0.3, 1.7 ± 0.4

[a]The statistical confidence level used to evaluate the uncertainty bound is 95%.

[b]Uncertainties reflect counting statistics only and are not indicative of the uncertainty in the measurement. These uncertainty values are those provided by the vendor. Future reports will contain an evaluation of analytical uncertainty.

Table 2-4. Quarterly integrating sampler results (October to December 1987)

Location		Radon concentration[a,b] (average) pCi/l
Number	Description	
1x	Coyote Wash - 10-meter tower (Exploratory Shaft Area)	0.4 ± 0.1
6x	60-meter tower	0.5 ± 0.1
7ax	Facility Area - North	0.4 ± 0.1
7bx	Facility Area - East	0.4 ± 0.1
7cx	Facility Area - South	0.7 ± 0.2
7dx	Facility Area - West	0.4 ± 0.1
QC spikes	Approximately 27.3 ± 2.8 pCi/l	25.6 ± 2.2, 26.7 ± 2.3, 22.7 ± 2.1, 22.2 ± 2.1, 23.8 ± 2.1, 25.4 ± 2.2
QC blanks	Approximately zero	0.2 ± 0.1, 0.0, 0.0, 0.1 ± 0.1, 0.4 ± 0.1, 0.1 ± 0.1

[a]The statistical confidence level used to evaluate the uncertainty bound is 95%.

[b]Uncertainties reflect counting statistics only and are not indicative of the uncertainty in the measurement. These uncertainty values are those provided by the vendor. Future reports will contain an evaluation of analytical uncertainity.

3.0 Comparison of Effluents with Respect to Applicable Standards

Based on the data in Section 2.1.1, it is clear that the airborne radioactive material from the site is below the NRC, DOE, and EPA offsite standards. It is projected that the offsite dose from all NNWSI Project activities will be well below 1 mrem/year to the maximally-exposed member of the public and, in fact, the activity concentration in the area is essentially independent of NNWSI Project activity, which is minimal.

The radon data indicate that the ambient radon concentration is very low. There are no applicable standards for emanation of radon to the atmosphere from geological formations.

There are currently no liquid effluent release data. However, all water returned to the environment after being pumped from the groundwater system will be screened for tritium activity in excess of applicable release limits. Tritium is the best indicator of any contamination intrusion into the groundwater system at the NTS. The concentration of tritium in the groundwater screening performed on a limited number of NNWSI Project water samples is below drinking water limits established by the EPA and probably below the detection capability of the method used in the screening analysis (Section 2.2).

4.0 References

DOE (U.S. Department of Energy), 1986. "Environmental Assessment for Yucca Mountain Site, Nevada Research and Development Area, Nevada," DOE/RW-0073, three volumes, Washington, D.C.

DOE (U.S. Department of Energy), 1988. "Consultation Draft Site Characterization Plan for Yucca Mountain Site, Nevada Research and Development Area, Nevada," DOE/RW-0160, six volumes, OCRWM, Washington, D.C.

NWPA (Nuclear Waste Policy Act), 1983. "Nuclear Waste Policy Act of 1982," Public Law 97-425, 42 USC 10101-10226, Washington, D.C.

SAIC (Science Applications International Corporation), 1985. "Meteorological Monitoring Plan for Site Characterization," DOE/NV-10270-5, SAIC-84/7600.

SAIC (Science Applications International Corporation), 1987. "Preliminary Site Characterization Radiological Monitoring Plan for the NNWSI Project Yucca Mountain Site," DOE/NV/10270-14, SAIC-86/8007.

SAIC (Science Applications International Corporation), 1988. "Radiological Monitoring Plan for the NNWSI Project," DOE/NV-10576-6, SAIC-87/8000 (controlled document).

APPENDIX A

EXECUTIVE SUMMARY FOR THE RADIOLOGICAL MONITORING PLAN

The Radiological Monitoring Plan (RMP) provides a detailed description of the radiological monitoring activities to be performed during site characterization of the Yucca Mountain site in southern Nevada. Radiological monitoring activities for all Nevada Nuclear Waste Storage Investigations (NNWSI) Project phases through site closure will be detailed in subsequent revisions of the document (six revisions are currently planned).

The RMP is the controlling document for the implementation of the Technical and Management Support Services (T&MSS) Contractor's radiological monitoring activities in support of the NNWSI Project. The document replaces the Preliminary Site Characterization Radiological Monitoring Plan (PSCRMP), which addressed a few aspects of those radiological monitoring activities requiring early implementation. The RMP describes the collection of required radiological data identified in the Radiological Compliance Guide (RCG), Site Characterization Plan (SCP), (DOE, 1986b), Environmental Program Plan (EPP), and other Project documents. Procedures are issued as part of a controlled procedure manual, which is maintained in an updated, audited form by each user. The RMP complies with the requirements of the Waste Management Project Office (WMPO) Quality Assurance Program Plan (QAPP) and supporting documents, including NNWSI Project and T&MSS administrative procedures.

THE RADIOLOGICAL MONITORING PROGRAM

The RMP (Rev. 0) represents a blueprint for the radiological monitoring program during the site characterization phase. The proposed monitoring program (as detailed in Section 4 of the RMP) will collect environmental radiological information to establish existing radiological conditions and satisfy eight basic objectives:

Characterization of the worksite environment. This element will involve determining the existing radioactivity concentrations in the background environment at the site and the potential radon emission from the site. These activities are underway as described in the PSCRMP.

Characterization of the radiological impact of Nevada Test Site (NTS) activities on the repository site. This element will involve determination of ambient airborne radionuclide concentrations in the Yucca Mountain area, evaluation of radioactivity concentrations in the groundwater, performance of soil and driftwall sampling in surface and underground work areas, biota sampling, and surface and sedimentation analyses of the Fortymile Canyon/Wash ephemeral stream.

Facility design and preparation of the Safety Analysis Report. This element will require ambient radiation data, radon exposure data, and soil and driftwall sampling data. Results from evaluation of these data will be used in the design of the facility's ventilation system, airborne radioactivity monitoring systems, and safety analysis activities.

Monitoring of site characterization impacts. This element will include soil sampling, water sampling, and radon monitoring.

Verification of the feasibility of monitoring the environment for appropriate radionuclides. This element will involve quantification of existing conditions at the site using various environmental samples and an indicator species. An indicator species is an animal which can be used to indicate the presence or absence of unsuspected sources of radioactivity (release pathways).

Planning of facility decontamination and decommissioning. This element will involve soil, biota, and water sampling. Archiving of these samples in the Sample Management Facility will be required.

Verification of compliance with DOE Orders and NTS requirements during site characterization. The program will monitor water samples for tritium. Soil columns will not be used to remove radioactive material from liquids. Groundwater characteristics will be verified as safe before release of any such water to the surface-water system.

Preparation of the Environmental Impact Statement (EIS). Specific data and collection activities for the EIS will be identified during the EIS scoping process. Data collected for site characterization activities will also be used to supplement the data collected specifically for the EIS radiological baseline.

The radiological monitoring program will evaluate various ways in which an individual can be exposed to radioactivity (exposure pathways to man): direct exposure to radiation, inhalation of resuspended (or airborne) radioactive particulates, worker and equipment contamination, and indirect pathways (such as ingestion of contaminated foodstuffs or fauna). The program will gather environmental radiological data to satisfy these evaluation needs as well as many others. Approximately six years are needed to establish an environmental data base (barring unplanned releases at the NTS). Characterization of the radon baseline requires much less time: two years of data collection are desirable, but only one year of data may be collected because of Project schedule constraints.

The radiological monitoring program's sampling activities are directed toward monitoring release pathways and the exposure pathways to man in two areas: a circular area measuring 168-kilometers across and centered on Yucca Mountain (the program sampling area), and the City of Las Vegas. This arrangement meets all regulations and requirements for model pathways. There are five basic types of sampling described in the RMP: airborne monitoring, water sampling, soil and drift surface sampling, biota sampling, and ambient radiation monitoring.

Airborne monitoring. Airborne monitoring is the foundation of the radiological monitoring program activities and involves the monitoring of radioactive particulates, radioiodine, tritium, and inert gases. These four categories account for most of the radioactive materials released from any site. C-14 (CO_2) will also be monitored. Air sampling will be conducted to evaluate potential doses to offsite inhabitants from inhaled radionuclides, direct radiation, or ingestion of contaminants. Both far-field (beyond a

15-kilometer radius of the site) and near-field (within a 15-kilometer radius of the site) air samplers will be used. Radon/radon daughter product sampling activities will be restricted to the near-field area. Only seven new far-field stations are being added to the current NTS network; data from existing U.S. Environmental Protection Agency (EPA) stations will be used, and NNWSI Project stations will be installed at some existing Reynolds Electrical and Engineering Co. (REECo) air sampler locations. Data from the REECo air monitoring program will also be available.

Particulate sample analyses will be performed by the EPA Nuclear Radiation Assessment Division (NRAD) Laboratory. For tritium and inert-gas (non-radon) sampling, equipment both currently in use and being evaluated by the NRAD will be used by the radiological monitoring program. The tritium and inert-gas samples will also be analyzed by the NRAD Laboratory. Radon monitoring will involve the use of time-integrating samplers supplemented by continuous radon monitors. The radon monitoring network is intended to establish a baseline and measure the future changes in the radon levels near the exploratory shaft. Underground air in the main drifts and near the working face will be sampled for radon and its daughter products. The monitoring of C-14 will be based on the C-14 content in flora.

Water sampling. In general, the principal exposure pathways from waterborne radionuclides to individuals are ingestion of drinking water and consumption of aquatic species or irrigated crops. Potential water pathways at Yucca Mountain include ephemeral streams, catch basins, groundwater, airborne deposition to the Amargosa River or streams, and reservoirs or ponds supplied from groundwater sources.

Surface-water samples will be collected routinely at a representative unaffected control location to provide background data for comparison with data from affected locations. Ephemeral stream samples will be collected at four stations located in Fortymile Wash just east of Yucca Mountain. Water sampling will rely to a large extent on existing EPA water samplers and locations. A representative sampling of water from catch basins within the near-field will be made, and sediment samples will be taken at all surface-water and ephemeral stream locations.

Grab samples of drinking water will be collected from nearby communities. Lake Mead water will be included in this activity and is currently being sampled by the NRAD. EPA water sampling data available for several sampling locations will be also be used.

Monitoring of groundwater will be conducted near the proposed repository facility and in areas downgradient from other facilities or activities. To facilitate the assessment of potential sources of radionuclides, at least two wells will be selected for evaluation. Where available, existing NNWSI Project and NTS wells and planned NNWSI Project wells will be used. Water samples will be obtained (if possible) from U.S. Geological Survey (USGS) or other test wells in the near-field area as they become available. Most of the near-field samples will be archived.

Surface-water samples will be taken from beneath the water surface to avoid floating debris, while ephemeral streams will be sampled by installing a large-volume passive container in the stream bed. Sediment samples from

surface-water sampling locations will be usually be collected using hand-held equipment or a core sampler.

Water typically will be sampled annually. Sediment samples also will be taken annually, following the first significant waterflow in the spring. Ephemeral stream sampling will be conducted each time a significant waterflow occurs in the stream being evaluated.

Soil and drift surface sampling. Soil sampling will be used to assess deposition of radionuclides from site activities, evaluate the long-term accumulation trends of radionuclides, and estimate environmental radionuclide inventories. Soil samples will be collected at air sampling locations, and a set of representative samples will be taken throughout the indicator species sampling area. The latter will allow characterization of the conditions to which the indicator species is exposed. Representative soil samples will be taken from all environmental sampling locations and areas where major activities are planned. These samples will be archived for possible use in future evaluations or activities. An annual sampling frequency is planned to assess long-term trends.

Driftwall samples are directed towards characterizing natural radon emissions. During underground mining and operation, driftwall sampling will be used to characterize the uranium and thorium sources which produce the radon/radon daughter products emanating from the mine.

Biota sampling. Biota sampling involves sampling of milk, crops, game, and animal produce from livestock. These samples provide the most direct means for assessing the radiation dose to man from ingestion of contaminants (the food pathways to man). Many details of the biota sampling activities cannot be presented until a detailed survey is conducted of the agricultural and cultural activities within the program sampling area. This information will be collected over the next two years. For now, the biota samples collected in the program will include the indicator species and items representing both direct and indirect pathways to man.

Direct pathways to man are represented by food items. Sampling may include milk, crops intended for human consumption, beef, poultry, and eggs. Milk sampling of all dairy cattle herds in the sampling area is already performed by the NRAD for the NTS. Data from the NRAD program should be sufficient for the radiological monitoring program. To monitor iodine-129, cattle thyroids will be collected each fall when grazing activities end. Crop samples will include those produced for human consumption as well as for livestock feed. Meat, poultry, and egg samples may be obtained from commercial producers and local family farms. Domestic animal produce will be sampled annually at the time of the slaughter or harvest. Poultry and eggs may be sampled quarterly. Field surveys of game bird species will be conducted quarterly.

Indirect pathways to man include cattle and deer forage. Native cattle forage samples will be taken from eight locations established on lands where cattle are grazed within the program sampling area. Three forage species will be chosen for monitoring. Three samples from each species will be collected at each location. A total of 72 samples will be collected over a two-year period. Cattle forage sampling will not be initiated before 1989.

The food habits of mule deer will be studied by analyzing scat samples collected from Yucca Mountain. Results will determine which deer forage species should be collected for analysis. Three forage species will be chosen for monitoring. Three samples from each species will be collected at twenty designated sampling locations. All twenty locations will be sampled at least twice during the site characterization phase.

Indicator species assist in detecting inadvertent releases of radioactivity and in monitoring any long-term radionuclide accumulation in the local environment. Small mammals (mice and rats) will be used by the radiological monitoring program as indicators of radionuclide concentrations in the biosphere. Merriam's kangaroo rat and the long-tailed pocket mouse are the designated indicator species for the program because they are typically the two most abundant and ubiquitous small mammal species on Yucca Mountain. Eight small mammal monitoring locations will be established in the vicinity of Yucca Mountain. At each location, trap lines will be arranged. The trap lines will be operated four times a year. Samples for radioanalysis will be collected two of the four times. The other two times, animals will only be marked. Lagomorphs (rabbits) were not included as an integral part of the radiological monitoring program because of their relative rarity on Yucca Mountain; however, systematic transect surveys will be conducted semiannually to collect data which will enable the program to determine when population densities are sufficient to permit sampling. To evaluate the feasibility of incorporating predators (coyotes, bobcats, etc.) into the program, scent-station surveys assessing the presence, relative abundance, and general distribution of predators will be performed four times a year.

Ambient radiation monitoring. Ambient radiation monitoring involves the monitoring of external radiation exposures. The radiological monitoring program will use integrating dosimeters, specifically thermoluminescent dosimeters (TLDs), to monitor any incremental changes in external radiation doses to key population groups in the program sampling area. The dosimeters will be placed at all environmental sampling stations. In addition to these locations, other TLD locations have been added to provide an accurate representation of current site conditions. Where TLDs are used, at least three will be provided for each location to permit averaging of the data and detection of faulty dosimeters. Quarterly exchange periods are planned. Various exposure rate instruments will also be used for continuous monitoring of the exposure rate as a function of time. An Aerial Measurements System (AMS) aerial survey is also being arranged for the Yucca Mountain area. An AMS survey provides detailed data analysis of gamma radiation levels in and around nuclear facilities. The AMS is operated for the DOE by EG&G, Inc. In situ gamma spectral analyses at most sampling locations will also be included as part of the ambient radiation monitoring of the radiological monitoring program. Current data from the NTS public monitoring program will also be available for the ambient radiation monitoring activity.

Other aspects of the radiological monitoring program's monitoring and data-gathering activities--the rules and regulations involved in their development; the assessment methodologies used to understand and categorize their data; the quality assurance procedures followed to ensure their accuracy and validity--are detailed in other sections of the RMP.

The primary participants in the radiological monitoring program will be the DOE Nevada Operations Office (DOE/NV) Waste Management Project Office (WMPO), the EPA NRAD, and the T&MSS Contractor (Science Applications International Corporation). Other involved groups will include the DOE/NV Health Physics and Environmental Division, EG&G/Energy Measurements (Santa Barbara Operations), the EPA Office of Radiation Programs, REECo, DOE/NV, and the State of Nevada. All activities in the program will have the approval of the WMPO and the concurrence of the DOE/NV.

ORGANIZATION OF THE RADIOLOGICAL MONITORING PLAN

The RMP has eight major parts and eleven appendices. Section 1 provides introductory remarks and establishes the framework of the document. Section 2 provides a general discussion of the regulatory and control framework for the document. Section 3 provides a detailed discussion of the technical requirements and guidance mandating completion of the radiological monitoring activities discussed in the document. The manner in which the document implements data collection in support of issue resolution for the issues hierarchy as discussed in the SCP and the EPP is also addressed in Section 3. Section 4 provides details of the radiological monitoring activities and the activities related to the requirements in Section 3. Section 5 sets forth the radiological analytical techniques used in collection of data for resolution of the issues in the issues hierarchy. Section 5 also addresses how these techniques fit within the regulatory framework described in Sections 2 and 3. Section 6 identifies non-monitoring data required to support resolution of the issues and discusses how these data will be collected. Section 7 addresses quality assurance, and Sections 8 and 9 address administrative concerns and their resolution within the program. Appendix A provides a description of NNWSI Project activities. Appendices B through G provide supplementary technical data, with Appendix E containing a tabular summary of the environmental monitoring program. Appendix H describes other plans which provide data to this program. Appendix I contains a listing of acronyms and abbreviations. Appendix J contains a glossary for the text, and Appendix K lists any changes made in the field monitoring activities.