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OPERATIONAL AIR SAMPLING REPORT
January 1 Through June 30, 1993

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Abstract

Nevada Test Site vertical shaft and tunnel events generate beta/gamma fission products. The REECo air sampling program is designed to measure these radionuclides at various facilities supporting these events. The current testing moratorium and closure of the Decontamination Facility has decreased the scope of the program significantly. Of the 243 air samples collected in the only active tunnel complex, none showed any airborne fission products. Tritiated water vapor concentrations were very similar to previously reported levels. The 246 air samples collected at the Area-6 decontamination bays and laundry were again well below any Derived Air Concentration calculation standard. Laboratory analyses of these samples were negative for any airborne fission products.

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Abbreviations

ALARA:	as low as reasonably achievable
ASD:	Analytical Services Department
cfm:	cubic feet per minute
DNA:	Defense Nuclear Agency
DCG:	Derived Concentration Guide
DAC:	Derived Air Concentrations
GZ:	ground zero
HPD:	Health Protection Department
LPG:	liquid petroleum gas
Lpm:	liters per minute
μCi/mL:	microcuries per milliliter
NTS:	Nevada Test Site
RPT:	Radiation Protection Technicians
RFOS:	Radiological Field Operations Section

1. INTRODUCTION

This report summarizes air sampling programs for the Defense Nuclear Agency (DNA) tunnel complexes and the Area-6 Decontamination Pad and Laundry. Evaluations are based on the analyses of the Analytical Services Department (ASD) Counting Laboratory and the calculations of Health Protection Department (HPD), Radiological Field Operations Section (RFOS) Radiation Protection Technician's (RPT) or Health Physicists. This report addresses air samples collected January 1 through June 30, 1993.

Air sampling is one of the more useful ways of assessing the effectiveness of operational radiation safety programs at the Nevada Test Site (NTS). Air sampling programs document NTS airborne radionuclide concentrations in various work locations and environments. These concentrations generally remain well below the Derived Air Concentration (DAC) values prescribed by the Department of Energy (DOE) in DOE Order 5480.11, Attachment 1 and also well below the Derived Concentration Guide (DCG) values dictated by DOE Order 5400.5, Chapter III.

Of the NTS operational air sampling programs in the tunnel complexes, the initial mining and event reentry and recovery operations represent the only real airborne radioactive inhalation potentials to personnel. Weekly Drierite samples for tritium analysis were taken in the active tunnel complex to document any changes in normal background levels or reentry drifts as they are advanced toward ground zero (GZ) areas. Underground water sources are considered primary transporters of tritium from old event areas.

Although the majority of field operational air sampling programs are conducted primarily for documentation, continuous review of the data and sampling techniques is used to incorporate new programs to generate environmentally representative data for the various facilities. Such a philosophy is in the best interest of ALARA (as low as reasonably achievable) programs.

2. SAMPLING PROGRAMS AND POLICIES

Fission product beta/gamma emitters are the radionuclides of greatest interest for NTS operations. An air sample is collected in any work area where the potential for airborne contamination may exist. These areas are identified using past air sample results from similar operations or from the type of work performed in the facility. Most air samples collected on a routine basis are analyzed by the ASD Laboratory using gamma spectra analysis to determine beta/gamma radionuclide concentrations. The Drierite samples taken in the tunnel complexes are also analyzed by the ASD Laboratory. Gross alpha and beta/gamma concentrations are calculated at facilities where routine detailed radionuclide analysis is not required.

It is the policy of the HPD to perform air sampling in active work areas containing contaminated debris or in areas where mining and drilling operations have the potential to encounter radioactive materials in fissures, cavities, or water. The sampling program continues for documentation purposes until the operation is completed. Once activities in a work area have been suspended and personnel are no longer present, air sampling in that area is discontinued unless requested for special operations.

The gamma spectra results for routine air samples are reviewed by REEC Co HPD/FOS Health Physicists. Any results indicating the presence of fission products are investigated to relate specific operations to the generation of airborne radionuclides. Engineering or administrative controls are evaluated for prevention of routine airborne generation for subsequent operations.

3. SAMPLING TECHNIQUES

Routine air samples consist of a Whatman 41 cellulose fiber prefilter and an MSA activated charcoal cartridge housed in a four-inch diameter sample head. Several types of calibrated pumps with air flow calibrated liquid petroleum gas (LPG) meters are used to determine total air volume sampled. Air sample data are reported in microcuries per milliliter ($\mu\text{Ci/mL}$).

Tritium water vapor samples are drawn from ambient air in areas where elevated tritium levels are suspected or to collect background information for future reference. A 10/20 mesh indicating Drierite housed in a 10.75-inch (27.3-cm) long $\times$ 1.75-inch (4.45-cm) diameter Lucite column is used as the collection system. Samples are drawn through a 0.188-inch (0.476-cm) aperture at flow rates of 3 to 4 liters per minute (lpm) as measured with a calibrated rotameter. Collection times range from 3 to 6 hours to attain an 80 percent saturation level. This data is also reported in $\mu\text{Ci/mL}$.

4. G TUNNEL COMPLEX

This tunnel complex remained inactive through this reporting period. No low-volume air samples or Drierite samples were taken at any location.

5. N TUNNEL COMPLEX

Because of the testing moratorium and budgetary constraints, this tunnel complex was inactive through this reporting period. No low-volume air samples or Drierite samples were taken at any location.

6. P TUNNEL COMPLEX

Air sampling stations were continued in support of the 06 Bypass and Line-Of-Sight (LOS) drifts as preevent mining and construction proceeded. The portal ventline exhaust air sampling station was discontinued in January 1993 after all reentry operations had been concluded for the 05 Cavity event.

A total of 239 work area and 4 ventline exhaust air samples were taken during the 06 Bypass and LOS preevent mining operations. There were no fission products detected on any sample.

One tritiated water vapor sampling station was used in this period. It was moved to various locations within the 06 Bypass and 06 LOS drifts as mining operations advanced toward the GZ area. A total of 14 samples were collected with an average concentration of $6.9\text{E-}11$ $\mu\text{Ci/mL}$ and a maximum of $2.3\text{E-}10$ $\mu\text{Ci/mL}$. The results are summarized in Figure 1. The P-tunnel complex is shown in Figure 2.

Figure 1. P-Tunnel Tritium Concentrations

Figure 2. P-Tunnel Complex Air Sampling Locations January 1, Through June 30, 1993

7. T TUNNEL COMPLEX

This tunnel complex remained shut down through this reporting period. A weekly inspection program checked ventilation, water drainage, and electrical maintenance. An RPT was assigned to provide an escort for the weekly underground checks of this complex. No underground air samples were taken.

8. TEST SUPPORT COMPOUND

No activities were conducted at this facility.

9. DECONTAMINATION FACILITY

The air sampling program was affected by the closure of the Decontamination Facility Lagoon in November 1992. The water supply was shut down at this time which effectively closed the facility. A weekly exchange air sampling schedule was maintained for the bays.

There are seven operative fixed air sampling locations at the Decontamination Pad. Four sampling stations are located in the large bay and three sampling stations are located in the small bay. Five additional exhaust fan sample locations in the roof are available but are not used routinely. These locations are indicated in Figure 3. The sampling network utilizes Whatman 41 cellulose fiber sampling media and operates within the range of two to four cubic feet per minute (cfm). LPG meters record the integrated sample volume. Each sample is collected over a minimum 24-hour period up to weekly intervals during low activity. Each sample is then allowed to decay for a 24-hour period before counting to increase the probability of detection of alpha or beta/gamma emitters other than the radon/thoron daughters collected.

A representative 1.5-inch (3.81-cm) diameter portion of each 4-inch (10.16-cm) diameter air filter is counted for alpha and beta/gamma activity in the Tennelec Model LB-5100 proportional counter located at the Decontamination Pad. The counting results are then entered on the Air Sample Data form 2409, and the DAC fractions for beta-gamma and alpha emitters are calculated. The alpha reference nuclide used for routine operations is Pb-210 (DAC = $1\text{E-}10 \mu\text{Ci/mL}$). This is a beta emitter, but it also has the most restrictive DAC of the radon (^{220}Rn) and thoron (^{222}Rn) daughters which are the alpha emitters routinely detected during counting of the air sample filters. Use of this nuclide for calculating DAC fractions introduces a conservative bias for triggering investigations for possible airborne alpha emitters. The beta reference nuclide for routine operations is Sr-90

Figure 3. Decontamination Pad (Building 6-605) Air Sampling Locations

(DAC = $8\text{E-}09 \mu\text{Ci/mL}$). The DACs for specific radionuclides will be used for DAC fraction calculations when identified by process knowledge or analysis results. Selected samples from the bays, laundry facility and Dyna Drill shop are sent quarterly to the ASD Laboratory for analysis to assure quality control. Gamma spectra analysis and gross beta and alpha counts are performed on each set of samples.

For the two sets of samples submitted this time period, all gamma spectra analysis results were non-detectable for fission products. All gross alpha and beta count results were at or below the ASD laboratory's detection limit. A total of 189 air samples, 27 per station, were collected and analyzed for gross alpha and beta/gamma activity this reporting period for the large and small bays. No exhaust fan samples were collected. The maximum results for any station were $2\text{E-}05$ and $5\text{E-}04$ DAC fractions for gross beta/gamma and alpha respectively. The analysis result summaries for each station are listed in Table 1.

10. DECONTAMINATION LAUNDRY

One air sampling head is suspended above and slightly forward of each of the washing machines in the laundry. This represents the personnel breathing zone. Samples are drawn through Whatman 41 cellulose fiber sampling media. LPG meters record the integrated sample volumes. This type of sample is collected once a week during non-operational periods and daily during operational periods. The air filters are analyzed using the Decontamination Pad Tennelec as previously described, except that the entire Whatman 41 filter is counted, since it does not exceed 1.5 inches in diameter.

A total of 21 samples, 7 per station, were taken during this period. The maximum gross beta/gamma results for any station was $1\text{E-}05$ and for alpha was $6\text{E-}04$ of their respective DAC fractions. The results are summarized in Table 2.

An air sampling system is used to monitor the dryer exhaust effluent. One air sampling head is suspended at the outside exhaust of each dryer compartment. Samples are collected only during dryer operational periods. The Decontamination Laundry air sampling locations are shown in Figure 4.

A total of 36 samples, 6 per station, were taken from the dryer exhausts during this period. The maximum gross beta/gamma results for any station was $5\text{E-}04$ and for alpha was $1\text{E-}02$ of their respective DAC fractions. The summarized data is contained in Table 2.

TABLE 1. Decontamination Pad Air Sample Results

Station	Radionuclide	No. Samples Detectable	% of Total	Avg. DAC Fraction	Max. DAC Fraction
LARGE BAY:					
1	Gross β/γ	24	89	3E-6	1E-5
	Gross α	21	78	1E-4	4E-4
2	Gross β/γ	26	96	5E-6	2E-5
	Gross α	23	85	1E-4	5E-4
3	Gross β/γ	25	92	4E-6	2E-5
	Gross α	23	85	1E-4	5E-4
4	Gross β/γ	25	92	4E-6	2E-5
	Gross α	18	67	9E-5	4E-4
SMALL BAY:					
5	Gross β/γ	24	89	4E-6	1E-5
	Gross α	18	67	9E-5	3E-4
6	Gross β/γ	23	85	3E-6	9E-6
	Gross α	20	74	8E-5	2E-4
7	Gross β/γ	23	85	4E-6	2E-5
	Gross α	19	70	2E-4	5E-4

Total Samples Per Station = 27

TABLE 2. Decontamination Pad Laundry Air Sample Results

Station	Radionuclide Detectable	No. Samples Total	% of Fraction	Avg. DAC Fraction	Max. DAC
WASHERS:					
1	Gross β/γ	5	71	3E-6	1E-5
	Gross α	2	29	1E-4	6E-4
2	Gross β/γ	5	71	3E-6	1E-5
	Gross α	3	43	1E-4	4E-3
3	Gross β/γ	5	71	2E-6	1E-5
	Gross α	3	43	1E-4	4E-4

Total Samples Per Station = 7

DRYERS:

1	Gross β/γ	4	67	7E-5	2E-4
	Gross α	1	17	N/A	2E-3
2	Gross β/γ	2	33	5E-5	2E-4
	Gross α	1	17	N/A	3E-3
3	Gross β/γ	3	50	4E-5	9E-5
	Gross α	1	17	N/A	2E-3
4	Gross β/γ	5	83	1E-4	5E-4
	Gross α	3	50	5E-3	1E-2
5	Gross β/γ	4	67	2E-4	5E-4
	Gross α	1	17	N/A	1E-2
6	Gross β/γ	4	67	1E-4	5E-4
	Gross α	1	17	N/A	2E-2

Total Samples Per Station = 6

Figure 4. Decontamination Pad Laundry (Building 6 607) Air Sampling Locations

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